TRENDS IN
LANGUAGE ACQUISITION RESEARCH 22

Sources of Variation in First Language Acquisition

Languages, contexts, and learners

Edited by Maya Hickmann, Edy Veneziano and Harriet Jisa

JOHN BENJAMINS PUBLISHING COMPANY

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Trends in Language Acquisition Research

ISSN 1569-0644

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John Benjamins Publishing Company
Amsterdam / Philadelphia

The paper used in this publication meets the minimum requirements of the American National Standard for Information Sciences – Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

DOI 10.1075/tilar.22

Cataloging-in-Publication Data available from Library of Congress:
LCCN 2017020007 (PRINT) / 2017039738 (E-BOOK)

ISBN 978 90 272 4412 3 (HB)
ISBN 978 90 272 6532 6 (E-BOOK)

John Benjamins Publishing Company · https://benjamins.com

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INTRODUCTION

What can variation tell us about first language acquisition?

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After years of research focusing on universal regularities in child language, the study of variation has enriched our understanding of language development. Variation stems from exogenous and endogenous factors that can all influence the development of communicative capacities. This volume focuses on three main sources of variation considered from a large multimodal perspective that includes speech, gesture, and signs. First, research suggests that development partly varies with linguistic and/or cultural environments. A second source of variation stems from the input to which children are exposed across contexts. Finally, learners themselves differ along many dimensions, such as cognitive maturity, exposure to language(s), relative reliance on the visuo-gestural modality, and language impairments. The discussion highlights the need for more research on inter- and intra-individual variation within comparative perspectives allying complementary methodologies.

Keywords: exogenous/endogenous factors, input, discourse type, gesture, language impairment, linguistic and cultural environment, inter/intraindividual variation, morphosyntax, semantics

1. Why variation in language acquisition?

The study of child language has undergone a number of theoretical and methodological changes since it began around the middle of the twentieth century. The pioneering work of Roger Brown and collaborators in the late fifties and early sixties paved the way for rigorous empirically based research on child language (see for example Brown 1973 for a compendium of this early work). The novelty was to study child language on the basis of spontaneous *corpora* with a child-centered approach

DOI 10.1075/tilar.22.01hic

aiming at uncovering the rules behind children's productions, without taking the structure of the adult language as a referent. During this period, descriptions were phrased in terms of *pivot grammars* (Braine 1963, 1976; Miller & Ervin 1964) or in terms of semantico-grammatical functions such as Agent, Beneficiary, Object, Locative, or Possessor (e.g., Bloom 1971, 1973; Brown 1973).

But how can children learn these rules and, more importantly, how can they fill the gap from child grammars to adult categories and structures? On the one hand, most approaches were based on the search for universal generalizations within different frameworks. Some of these generalizations (e.g., within a generativist approach) were aimed at uncovering innate species- and domain-specific capacities that are presumed to be biologically programmed and to underlie the human 'language faculty'. Other views (e.g., within cognitivist perspectives) have been more concerned with regularities in the development of general cognitive capacities that allow all children to gradually construct representations along several successive steps unfolding during development. Irrespective of their theoretical framework, most researchers aimed at drawing general conclusions about language acquisition, typically ignoring the variability that can be observed in development. This variability was at first considered irrelevant and viewed as an obstacle to be overcome in order to uncover the more general and universal developmental trends. With time, many authors have come to realize that variation is essential for a fuller and more subtle understanding of development as it enables us to take into account the many different factors that may impinge upon it.

The theoretical and methodological benefits derived from a focus on different types of variation during development, rather than only on common patterns, have begun to enrich our understanding of language acquisition. Variation is now frequently reported and recurrently discussed. Although it is by now recognized as an important phenomenon, it is, however, not yet sufficiently studied nor well understood. One major difficulty in studying this topic stems from its inherently heterogeneous and multidimensional nature, requiring a multidisciplinary approach allying complementary domains of research (e.g., linguistics, cognitive, social and developmental psychology, neuroscience), each of which contributes its own methodologies to the research.

Until the nineties, the general methodology primarily consisted of longitudinal studies of the language production from early on of a few children speaking essentially one particular language. Over the years, and with the growing importance of the *Child Language Data Exchange System* – CHILDES (MacWhinney 1991/2000),[1] these databases were gradually expanded to include representative samples of

1. Also available at <http://childes.talkbank.org/>

different types of learners (e.g., children/adults, monolinguals/bilinguals) at different ages and in different language groups. They were also more often complemented by experimental methods testing language production and comprehension with both off-line and on-line measures (eye-tracking paradigm, e.g., Papafragou, Hulbert & Trueswell 2008), with neurophysiological measures of brain functioning (ERP, EEG, fMRI, e.g., Brusini et al. 2016; Friederici & Thierry 2008, for infant research) and with various modeling techniques specifically devoted to different aspects of language development (e.g., Edelman & Waterfall 2007; Freudenthal, Pine, Aguado-Orea & Gobet 2007; Pearl 2010).

Contrary to earlier periods, accounts of development now aim at incorporating variation into developmental models rather than simply treating it as a kind of "noise" in the data. As a result, models built around the abstract notion of an "ideal native speaker" have been substantially revised. Such models assumed that adult native speakers were typically monolinguals, displayed similar behaviors guided by the same norms across all contexts. Such an ideal speaker has become rare in the context of fluctuating populations in which many, if not most, speakers are nowadays bilingual or multilingual to different extents.

In addition, classical models view learners (adults or children) as following a linear progression along successive or recurrent steps (e.g., phases, stages, competence levels) leading them toward the full knowledge of competent native speakers. Previous studies (Brown 1973; Slobin 1985; also see more recent discussions in Carlucci & Case 2013; Plunkett & Markman 1991; Marcus, Pinker, Ullman, Hollander, Rosen & Fei Xu 1992; Siegler 2004) have shown the existence of U-shaped curves during development, reflecting children's transition from rote learning to rule-based overgeneralizations. For example, during the development of morphology in English, children follow a three-step process whereby they first use correct forms, then incorrect but plausible ones, and finally, correct forms again but now rule-based and taking exceptions into account (e.g., *drank, drinked, drank*; *feet, foots, feet*). Although the idea that learners "progress" overall throughout development is still valid, new approaches also admit variable or "fuzzy" learning processes that also take into account other types of non-linear developmental patterns at some moments during language learning (e.g., van Geert 1991, 2010).

In light of increasing data indicating the importance of variation in language acquisition, new theoretical questions have emerged, some of which with important implications for applications in fields such as language teaching or clinical intervention for language-impaired speakers. What are the factors creating variation? How do these factors operate, and are they interrelated? If so much variability exists, can we still draw conclusions about general developmental patterns that could apply to all children in all learning contexts at the risk of ignoring a great number of important factors that influence development? Is it still possible to find strong regularities behind highly variable developmental patterns? More generally, can this variability contribute to a better understanding of language acquisition, and if so, how?

The present volume presents a large number of papers that address some of these questions. The next section (Section 2) provides a brief overview of some of the factors that contribute to different types of variation in language acquisition. We then turn to the specific content of the chapters themselves (Section 3). These contributions are organized into three parts according to their contribution to the different factors that partially constrain development: universal vs. language-specific aspects of language development, properties of the input to which children are exposed, and characteristics of the learners themselves.

2. Factors and types of variation

Variation can stem from two types of factors: exogenous and endogenous factors. After a brief description of these two types of factors (2.1), we illustrate variation that may result from either or both of these sets of factors, such as the ones briefly summarized below: variation between and within individuals (2.2), variation related to developmental periods (2.3), and variation due to the specific modalities (speech, gesture, signs) which contribute to the development of communication (2.4).

2.1 Exogenous and endogenous factors

Exogenous factors that might affect language acquisition involve the different environments in which learning takes place, while endogenous factors involve dimensions of the learners themselves. Each of these sets of factors may impact the rate and course of development and they may in part interact with each other.

Exogenous factors include a myriad of variables, such as socio-economic status, cultural environment, exposure to different kinds of language use or discourse types, linguistic features that are variable across languages (or language types), speakers' sociolinguistic history such as degrees and types of bilingualism (simultaneous vs. delayed bilingualism) and/or exposure to more than one language (typologically close or distant from each other), quantity and quality of social interaction with siblings, peers, and/or adults.

Endogenous factors include many dimensions characterizing learners such as: gender, age, level of verbal and non-verbal cognitive and socio-cognitive abilities in different domains of mental functioning (e.g., reasoning capacities, conceptual development, increasing memory capacities, executive functions, "Theory of Mind"), language learning "styles" or "strategies", as well as other inter-individual differences that have been as yet insufficiently studied (e.g., personality traits such as motivation, extroverted or introverted learners, talkative vs. silent learners).

These are only a few among the many exogenous and endogenous variables that are relevant to understand variability in language acquisition. They should all be taken into account in two ways: as factors to be studied in their own right because they contribute to our understanding of language acquisition, or as variables that must be controlled in order to avoid confounding results.

2.2 Inter- and intra-individual variation

Developmental research has studied two types of variation: inter-individual and intra-individual. With respect to the first type of variation, early studies of child language showed the existence of different learning "strategies". For example, Nelson (1973, 1981) proposed that children relied on different styles in building up their early lexicon (first fifty words), which contained variable proportions of different parts of speech: some followed a "referential" strategy (producing a majority of object words), others had an "expressive" strategy (producing a large number of social terms and formulas, pronouns and function words in addition to object words). Such variation has been later related to rate of lexical development, but it is not clear whether children's preferences result from endogenous factors (child characteristics) or from exogenous ones (due to different inputs or interactional styles experienced by children), or from both. This type of research aims at capturing differences among individual children who are similar with respect to a number of exogenous and endogenous variables in a given study (e.g., age, gender, school class, cognitive level, exposure to language, socio-cultural practices).

The study of intra-individual variation was promoted especially through the advent of techniques designed to model development. It concerns differences in the behavior of a given individual child across contexts and/or at different moments of development, as well as non-linear developmental changes that may be characterized by some regressions or fluctuations observable at different moments during the development of a given child. The understanding of this type of variation constitutes an important contribution of the modeling research carried out within the framework of the theory of *Dynamic systems* (van Geert 1991, 2010). This approach has shown, for example, that non-linear patterns may indicate new developments that are about to emerge in the child (e.g., Bassano et al. 2011).

2.3 Developmental periods

Research on child language has widened the time span studied during development. In recent years, studies have included very young infants in the pre-linguistic period (from shortly after birth onwards) as well as pre-schoolers, school-age children, and adolescents. Depending on the period selected, results may lead to very different conclusions. For example, in the literature on the acquisition of reference (cf. Serratrice & Allen 2015), some studies claim early mastery of the referential system (before age three), while others show much later developments (until at least age ten). Such discrepancies are partly due to considerable heterogeneity across studies in their theoretical frameworks and research foci (e.g., morphosyntax vs. pragmatics) and/or the use of different methodologies (e.g., corpora of spontaneous speech in natural environments vs. experimentally controlled data and specific discourse types such as narratives or descriptions), all of which can lead to different views of children's linguistic knowledge.

Relying on various experimental techniques (preferential looking, habituation and reaction to novelty, electrophysiological measures of brain activity), studies focusing on very early developmental periods have uncovered unexpectedly early capacities in infants of only a few months of age (see among others Baillargeon 1987; Golinkoff et al. 2013; Mandler 1998; Spelk, Breinlinger, Macomber & Jacobson 1992; Friederici, Friedrich & Christophe 2007). These capacities include some early capacities in various conceptual domains (object permanence, time, causality, agentivity, numerosity). They also include early discrimination and categorization capacities for language material reflecting sensitivities to grammatical and semantic features of the language (e.g., category-specific grammatical functors) as well as to the specific stress pattern of their language (e.g., Shi 2014; Werker & Gervain 2013; Friederici, Friedrich & Christophe 2007).

Although inter-individual variation in infant capacities exists (e.g., Christia et al. 2008), considerably more variation can be observed at later developmental periods, with the gradual enrichment of syntactic, semantic and pragmatic components of linguistic knowledge. Some aspects of this enrichment can be observed relatively early and in all children, but others appear later and in more varied ways, as they depend on more complex discourse skills required by different types of speech situations (e.g., narratives, descriptions, argumentation, cf. Berman 2015; Berman & Slobin 1994; Hickmann 2003; Jisa 2005; Mazur-Palandre, Fayol & Jisa 2012; Snow, Lawrence & White 2009: Strömqvist & Verhoeven 2004; Veneziano & Hudelot 2009; Veneziano 2016).

2.4 Multimodality

During communication, speech or signs are typically accompanied by gestures which also display variation. A growing number of researchers have become interested in promoting more general multimodal approaches to communication encompassing both vocal and visuo-gestural modalities in children from very early on (e.g., gaze, pointing, co-verbal representational gestures, discourse cohesive gestures) within and/or across languages. Some studies show that gesture and speech develop in parallel in first and second language acquisition (e.g., Bates et al. 1979; Capirci et al. 1996; Nicoladis et al. 1999) and that gestures may be good predictors of language development, from the emergence of first words up to complex types of language use later in acquisition (Özçalışkan & Goldin-Meadow 2005). Some authors further propose that gestures combine with speech by expressing information that is complementary to speech, particularly during early developmental periods. Cohen's early study (1952) already considered gesture-word combinations as transitional between one- and two-word utterances. In this view, complementary and supplementary gestures help children when they encounter difficulties in solving a problem or when attempting to communicate something for which they have not yet acquired the appropriate linguistic means of expression because of insufficient lexical or grammatical knowledge (Alibali & Goldin-Meadow 1993; Capirci et al. 1996; Goldin-Meadow 2003a, b; Pine, Bird & Kirk 2007).

Other studies (e.g., Gullberg & de Bot 2010; Kita & Özyürek 2003; Özyürek et al. 2005, 2008) show that, somewhat later in development, representational gestures take on yet additional functions in that they are also partially co-expressive with speech and present increasing differences across languages. In addition to notorious inter-individual variation in the use of co-speech gestures, it can be argued that the input to children varies across language groups not only in verbal but also in gestural expression, and that these differences influence both speech and gesture development in systematic ways. Within this approach, authors propose that speech and co-speech gestures are part of the same expressive program used by speakers when they communicate. This coupling of speech and gesture modalities in human communication has given rise to theories aiming at understanding the emergence of the language-gesture coupling from both ontogenetic and phylogenetic perspectives (McNeill 1992, 2005, 2014).

Studies focusing on deaf children acquiring sign language as their first language constitute a distinct but related line of research, also concerned with the visual-gestural modality. Compared to co-speech gestures, communication in sign languages relies even more on this modality. Since early work (e.g., Klima & Bellugi 1979), sign languages have raised interesting questions for linguistic and cognitive developmental theory. For example, cross-linguistic research comparing different sign languages has begun to shed light on the nature and role of iconicity across these languages (e.g., Antinoro Pizzuto, Rossini, Sallandre & Wilkinson 2008). However, it is still unclear what their status is within a typological perspective (e.g., Cuxac 2000; Goldin-Meadow 2003a, b; Perniss & Özyürek 2008; Slobin et al. 2003; Talmy 2003).

From a developmental point of view, sign languages also highlight the role of iconicity in the visual-gestural modality in children's developing communicative competence. Some studies have addressed the question of how *home signs* emerge among deaf children never previously exposed to any ambient language (Goldin-Meadow 2003c). These fundamental questions are much debated and far from being solved, requiring further comparisons of language development in different signed and spoken languages.

3. The organization of this volume

The present volume brings together a large number of contributions which examine several types of variation, stemming from distinct but partially related sources of variation in language acquisition. The list of these sources is clearly not exhaustive but it is representative of the developmental literature as it captures many types of variation that are most commonly cited, including those mentioned in Section 2 above. The volume is organized into three parts.

Part I is concerned with universal vs. variable aspects of language development from infancy to later childhood, taking into account general vs. language-specific properties of the target language (or languages) to be acquired. Part II examines properties of the input addressed to children, as well as different types of contexts in which they evolve and the various discourse types with which they are confronted, discussing the effect of this variation on language development. Part III includes a number of learner characteristics: monolingual first language learners, simultaneous bilinguals, second language learners, deaf children acquiring a sign language, children and adolescents with language impairments.

As a whole, the volume adopts a comparative perspective in order to examine multiple dimensions that characterize these three sources of variation. It also covers a large range of languages and of language domains over a long developmental span, from the earliest (pre-linguistic) to later periods (adolescence and adulthood) of language acquisition.

3.1 Universals and cross-linguistic variation in acquisition

Languages have particular properties that may influence the rhythm and course of children's language development. In the last twenty years, an increasing number of studies have documented the wide diversity that exists across linguistic systems in different domains (Evans & Levinson 2009). In the face of this diversity, many questions have arisen and are still debated (among others, see Gentner & Goldin-Meadow 2003; Slobin 1996, 2004). In particular, it has revived the old Whorfian question concerning the relation between language and cognition, and has given rise to new versions of this approach. According to these views, languages act as filters that influence what speakers pay attention to, what they choose to express explicitly or to leave implicit, and how they organize this information in discourse. In these approaches, space has been the center of much debate. It is a fundamental domain of cognition, assumed to be biologically based and independent of language (e.g., Landau & Jackendoff 1993; Munnich & Landau 2003; Landau & Lakusta 2006) but, at the same time, it shows striking typological variation across linguistic systems that has led some authors to postulate that spatial language may impact spatial cognition (e.g., among others, Allen et al. 2007; Bowerman & Choi 2001; Bowerman & Levinson 2001; Gumperz & Levinson 1996; Levinson 2003; Slobin 1996, 2004; Talmy 2000).

The chapters in Part I of the volume address some of these questions by considering general and variable aspects of language development in several domains: phonology (Rose; Vihman & Wauquier), the role of prosody, morphosyntax, and semantics in children's learning of nouns vs. verbs (Brusini, de Carvalho, Dautriche, Gutman, Cauvet, Millotte, Amsili & Christophe; Veneziano & Parisse), the syntax and semantics of motion expression (Choi), and the development of discourse organization (Colletta, Kunene & Guidetti). We briefly present below the main issues addressed and the conclusions drawn by the specific chapters, taking each of these domains in turn.

Phonology

Two chapters consider these questions in the domain of phonology. On the basis of data from spontaneous corpora during the first-word period in 15 languages, **Vihman and Wauquier** provide evidence for the existence of cross-linguistic similarities reflecting universal learning processes during phonological development. In particular, in all languages they observe similar processes giving rise to child-specific phonological patterns (or *templates*) that index phonological and lexical development. Some variation can also be observed in the specific forms of children's templates, reflecting the properties of the ambient language. Nonetheless, beyond this cross-linguistic variation, the recurrent processes underlying children's construction of idiosyncratic patterns result from a number of general constraints, such as articulatory and speech planning limitations, which can be observed in all languages.

While acknowledging the relevance of templates, **Rose** highlights the importance of including abstract categories such as segmental features and syllable structure constituents in order to account for subsequent full-fledged phonological development. He proposes an *emergentist* view according to which abstract categories emerge gradually within the child's lexicon through learning. In this view, different models are necessary to explain different periods that characterize phonological development. Holistic models based on templates are especially relevant for early phonological productions, while formal models of phonological representation account for later developmental periods.

Nouns and verbs: Prosody, morphosyntax, and semantics

Brusini et al. discuss several studies that used various methodologies (preferential looking, active behavioral choices, evoked potentials and computational modeling). They show how phrasal prosody and function words interact to bootstrap lexical and syntactic acquisition. Eighteen-month-old children can use the prosodic unity of Phonological Phrases to constrain the syntactic analysis of utterances. At the same time, they can use function words to infer the syntactic category (nouns vs. verbs) of unknown content words, and guess their plausible meaning accordingly (nouns for objects and verbs for actions). Computer-based simulations suggest moreover that a small number of known words might suffice to get the process going.

In a related chapter, **Veneziano and Parisse** present the results of a comprehension task designed to evaluate whether French-speaking children between 2 and 4 years of age could retrieve the meaning of homophonous or nonce words on the sole basis of the category-specific grammatical contexts in which they were embedded. Although items, overall, were correctly responded to beyond chance at all ages, only some of the children, particularly at two and three years, succeeded in passing the whole set of items beyond chance level. These results suggest substantial inter-individual variation and gradual mastery of the category-specific noun and verb grammatical contexts. A case study assessing production and comprehension longitudinally shows that production precedes comprehension, the latter requiring greater morphosyntactic knowledge than early signs of grammaticalization in production.

Syntax and semantics of motion expression

Based on early data from spontaneous production, **Choi** compares the expression of motion by young Korean children (1;11–4;2) to previous English and French data (Hickmann, Hendriks & Champaud 2009). Results show that language specificities have an impact on what information children choose to express, resulting in variation across and within language types. With respect to inter-type variation, children focus on Path in Korean and French (*verb-framed* languages) but often add Manner to Path in English (*satellite-framed*). Intra-type variation between Korean and French also shows that children express more information in Korean at all ages. Both types of variation are due to the fact that Korean provides serial verb constructions (allowing Path and Manner verbs to co-occur within the clause) and Manner adverbs (including mimetics).

Speech and co-verbal gesture

Some chapters examine the relation between speech and gesture during development across child languages. **Özyürek** reviews a large sample of studies on co-speech gestures across languages and cultures. She shows the complex interplay between speech and gesture as well as developmental changes in the relationship between these two modalities from early supplementary gestures to later language-specific co-expressive gestures. The data suggest that the specificities of each language (or language type) result in variation not only in speech but also in co-verbal gestures. From a developmental point of view, however, it takes children some time to gradually learn the full-fledged adult pattern of speech-gesture coordination, which is mastered only during later development.

Colletta et al. present a study that highlights cultural effects on the use of co-speech gestures. They compare speech and gestures produced in narratives by children acquiring two contrasting languages: Zulu (a pro-drop Bantu language) and French (a non-pro-drop Romance language). Differences across these two groups show that narratives contain more details about the story in speech and more representational gestures in Zulu, but more verbal comments and more pragmatic gestures in French. In the absence of expected language effects, the authors conclude that these results do not show linguistic differences, but rather reflect differences between two very different cultures, one relying on oral tradition (Zulu) and the other on literate tradition (French).

3.2 Variation in input and in contexts during acquisition

Variation in language use depends on a great variety of contexts, registers, and discourse types. This type of variation is multidimensional involving for example different language modalities (oral vs. written), dialogic vs. more monologic discourse (conversation vs. third person narratives), planned vs. unplanned and/or formal, informal, telegraphic discourse with known or previously unknown interlocutors. These factors constitute the second source of variation in language acquisition that partially contributes to the acquisition process by providing children with various types of input and/or interactive contexts in which they experience their first language (or languages in the case of bilingual or multilingual speakers). Among other factors within this source of variation is the relationship between caretakers' and children's speech. Child language studies have long recognized the important role of input and interaction in the development of language. For example, early studies have concerned caretakers' use of "baby talk" when addressing children (see a summary in Gallaway & Richards 1994 and a recent review in Veneziano, in press). More systematic studies are necessary to resolve debates about how they might impact the development of language and communication more generally.

The following types of variation are dealt with in the chapters of Part II: variable language contexts implying different degrees of shared knowledge among the interlocutors (Clark); the changing relationships between children's and adults' speech addressed to them in interpersonal interaction over development (Bassano & van Geert); the variable role of input features such as frequency and neighborhood density in the emergence of children's early lexicon (Kern, dos Santos & Stokes); and the nature of different types of activities accompanying speech as well as the use of different registers or discourse types (Salazar Orvig, Marcos, Heurdier & da Silva; Bernicot, Goumi, Bert-Erboul & Volckaert-Legrier; Watorek).

Common ground

Taking the notion of *common ground* (Clark 2015) as a starting point, **Clark** discusses variation in children's experiences with language in variable contexts and how this variation affects children's readiness to establish and then enrich shared backgrounds when conversing with different interlocutors, particularly unfamiliar ones. Exposure to a range of conversational partners requires adjusting to different kinds of *common grounds*, given that what interlocutors know about the child's past experiences and daily routines may differ. For these reasons, exposure to different conversational partners allows children to expand their communicative skills during language learning and it plays an important role in how language develops from early on.

Input properties

Word frequency has been discussed in the literature among other input features that impact early lexical development and requires careful analysis, given its interaction with other factors and the need to find an appropriate level of granularity (e.g., Lieven 2010). On the basis of a large sample of data collected with the French version of the MacArthur Development Inventory Questioonnaire (462 children of 16 to 30 months having acquired at least five words), **Kern et al.** quantify the role of word frequency and of neighborhood density (number of phonological neighbours for each word) in the development of vocabulary size. Although low vocabulary size is related to high word frequency and to high neighborhood density, a closer look at the data reveals variation in this respect as a function of grammatical categories: both factors partially account for the acquisition of nouns, but neither played any role in the acquisition of predicates.

Discourse types and registers

Register differences are at the center of **Bernicot et al.**'s study of *texting* in young adolescents. This type of communication is a recent and frequent phenomenon linked to the advent of cell phones. Compared to some other registers, texting emerges spontaneously without any teaching and evolves at an extremely rapid rate. Findings show that a number of indices vary between texting and other registers of written language, such as orthographic (spelling) and dialogic indices (openings and closings in the interaction). Given that most adolescents heavily rely on texting for communication, more systematic studies of this kind are necessary to determine the effect of heavy use of texting on oral/written language development.

Watorek compares children's (4–10 years) uses of referring expressions in two different text types: spatial descriptions focusing on spatial relations among entities depicted in a static picture and narratives based on a silent animated cartoon. Results show that children have more difficulties organizing the referential cohesion of discourse with spatial description than with film retelling because these two discourse types imply a different cognitive load. More specifically, she argues that spatial description is more difficult because it requires linearizing a multidimensional configuration to a greater extent than narratves, while the construction of a narrative is based on a linear chronological event structure, which is easier to manage.

Focusing on much earlier periods, **Salazar-Orvig et al.** show variation in children's choices of referring expressions as a function of activity types (everyday activities, games with toys, the use of iconic material) and speech genres (negotiation, description, narrative, evaluation, labeling, explanation, metalinguistic uses). For example, clitic demonstrative pronouns were associated with activities involving pictures and labeling, and strong demonstrative pronouns with games involving toys. Emerging third person pronouns were frequent in narratives and especially in descriptions, where they were mostly used in utterances that followed the first mention of the denoted referent.

Input-output relationships

Since early pioneering work on mothers' speech addressed to children (Snow 1972), more recent research has revived interest in this topic examining in some detail the relationships between child-directed speech and language development (e.g., Behrens 2006; van Dijk & van Geert 2013; also see Veneziano in press). Within a dynamic approach of input-output relationships, **Bassano and van Geert** examine the acquisition of nominal determiners in three young children followed longitudinally from one to three years, each learning a different first language (French, Austrian German, Dutch). Children varied with respect to the timing and magnitude of the explosion in the production of determiners. Dynamic modeling reveals corresponding changes over time in child and in child-directed speech, suggesting mutual influences between input and output. In this approach, child-directed speech is viewed as the result of dynamic, transactional, adaptation processes between the child and the adult.

3.3 Variation in types of acquisition and types of learners

Learners themselves differ along a number of dimensions that constitute yet another source of variation. Comparing different types of learners can shed light on various aspects of development. For example, they can provide a rich source of information to disentangle factors that are normally confounded during first language acquisition, e.g., the role of cognitive maturity (developing at the same time as language in children vs. already developed in adult learners), the impact of spoken vs. visuo-spatial communicative modalities (e.g., in the use of co-verbal gestures and sign languages), or dissociations between language functions (e.g., in some language impairments).

Comparisons include a number of populations comprising different types of language learners and learning situations: L1 development in monolinguals, 2L1 in bilingual children acquiring two or more languages simultaneously, and L2 in adults acquiring a foreign language (MacWhinney; Kail, Kihlstedt & Bonnet), deaf children acquiring sign language (Sallandre, Schoder & Hickmann), or several of these learner types (Morgenstern, Blondel, Beaupoil, Benazzo, Boutet, Kochan & Limousin). Also included are children and adolescents with various language disorders, sometimes accompanied by other deficits (e.g., patients with Autism Spectrum Disorder, Specific Language Impairment, brain lesions), for whom research can help formulate appropriate means of prevention, diagnosis or remediation, and whose acquisition paths shed light on the development of more typically-developing learners (Tager-Flusberg; Reilly, Bernicot, Goumi, Bert-Erboul & Volckaert-Legrier; Dardier & Champagne-Lavau).

L1, 2L1 and L2 acquisition

MacWhinney proposes an expansion of the *Competition Model* (MacWhinney & Bates 1989) resulting in a new version, the *Unified Competition Model*, whose aim is to encompass processes underlying both child L1 and adult L2 language learning. According to this model, and in contrast to other frameworks (for example, those based on the central role of critical periods in language acquisition), these two types of learning share the same underlying socio-cognitive processes and only differ with respect to the degree to which a number of risk factors – entrenchment, transfer, overanalysis, isolation – as well as support processes countering them – resonance, decoupling, chunking, participation – affect language learning in child vs. adult learners.

Within the *Competition Model*, **Kail et al.** examine language processing by simultaneous French/Swedish bilingual children as compared to previously published data on monolinguals (Kail 2004, 2012; Kail et al. 2012). They focus on different constraints determining *cue cost* in a given language: contextual and structural information, word order and morphology. Lower response speed and accuracy in the bilingual group suggest that bilingualism leads to some difficulty in attentional control during language processing, which implies a greater cognitive cost due to the need to inhibit the non-relevant language. However, despite this and other differences across the two groups, the weight of each component was roughly the same for both groups, suggesting that similar cognitive operations underlie language processing in the two groups.

Speech, gesture and sign

Two papers highlight the role of the expressive modality (spoken modality for speech, visuo-spatial for co-speech gestures and sign languages) and of iconicity (especially in the case of sign language) during the development of children's communicative skills.

Sallandre et al. study the role of iconicity in the expression of motion by deaf children aged 5 to 10 years acquiring French Sign Language (LSF) as their first language, compared to previously published data on French- and English-speaking children (Hickmann, Taranne & Bonnet 2009). From five years on, deaf children frequently use different types of iconic structures and produce semantically dense utterances that encode both Path and Manner (rather than only one of these components). However, clear variation in density was also observed as a function of event type (UP>DOWN>ACROSS) independently of language. In addition, with some event types, the data showed an increase in semantic density, in the use of serial constructions expressing different perspectives (narrator and character), and in the encoding of relevant locative information in discourse.

Morgenstern et al. analyze the expression of negation during early phases of communicative development in five children who varied in the degree to which they relied on gestural and/or oral modalities, including three monolinguals (French, English, LSF) and two bilinguals (French/LSF, French/Italian). Some variation occurred across the five children as a function of communicative modalities and of their monolingual or bilingual learning environment. Nonetheless, common features emerged across all children during development such as the early use of non-conventional body movements followed by the gradual addition of conventional gestures, signs, and/or spoken productions in multimodal communication.

Language impairments

Research on language impairments addresses important societal challenges with implications for prevention, diagnosis, and rehabilitation. Three papers directly consider variation due to different types of language impairment.

Tager-Flusberg reviews available research on behavioral and neural predictors of language development in children diagnosed as having – or as presenting a risk of developing – autism spectrum disorder (ASD), a complex heterogeneous disorder in which communication is impaired and visuo-gestural skills vary widely. Results show that the foundations of this variation in language outcomes are already apparent in neural responses to speech in the first year and in atypical vocal productions. In toddlers, non-verbal cognitive abilities are an important concurrent and longitudinal predictor of language outcomes, with gesture being a second strong independent predictor. Early language is itself an important predictor of language development at 3 years. The clinical implications of these findings and the gaps in current research are discussed.

Reilly et al. compare spoken and written narratives produced by French- and English-speaking children and adolescents with language impairments (LI), and those produced by typically developing (TD) controls. As expected, LI children in both language groups exhibited difficulties with morphology, but this problem was greater in the written narratives of French-speaking children who did not improve much from early to later ages. However, from school age on, LI and TD children in both language groups were able to use the pragmatic and rhetorical conventions of their respective language, employing complex syntax in both modalities to establish coherence in their stories. The theoretically important question of the gap between morphology and syntax in LI children is extensively addressed in the discussion.

Dardier and Champagne-Lavau review the literature on the pragmatic ability to retrieve non-literal meanings in different kinds of populations (adults, adolescents, and children) with acquired frontal brain lesions. They show that brain-injured populations have more difficulties understanding non-literal language, such as indirect requests (e.g., "It's cold in here" meaning "Close the window") than do control populations, as they seem to suffer from "failure of inferential reasoning" probably due to difficulties in making use of available textual and contextual cues. In addition, a dissociation between pragmatic and metapragmatic skills is observed in some brain-injured subjects who can specify whether or not an utterance is pragmatically appropriate in a given context, but cannot formulate explicitly the reasons for their judgments.

4. Concluding remarks and future perspectives

This volume discusses variation due to three major sources: (1) universal aspects of language development vs. cross-linguistic (and/or cross-cultural) differences, (2) features of the input and of the contexts of learning; and (3) properties of the learners themselves. By considering these different types of variation within a broad multimodal perspective, it addresses a number of theoretical questions debated in cognitive science. These questions include the relative weight of constraints stemming from developing knowledge of the lingujistic system, as well as the role of a number of endogenous and exogenous factors contributing to children's development. The chapters in this volume highlight implications of these issues for our understanding of language acquisition, as well as for planning intervention in educational and clinical contexts. They also point to several directions that should be pursued in future research.

First and foremost, comparative perspectives must be pursued and should include more languages (vocal and sign) in order to avoid hasty or limited generalizations that are susceptible to being misleading. We know that the rhythm and course of language learning partly depend on features that are specific to each language (or language type) and thus these facts must be further enriched before general conclusions can be reached. Thus, in order to support or reject generalizations about universal aspects of language processing and acquisition, it is necessary to systematically compare specific aspects of learners' grammatical and lexical knowledge in different domains (entities, space, time) across spoken and signed languages within and across language types. More cross-linguistic research is also necessary to study the relation of speech and co-speech gestures in natural contexts and in more controlled (experimental) situations. Last but not least, comparative research is clearly essential to understand the impact of socio-cultural factors on communicative (linguistic and gestural) development. Thus, new research must test specific hypotheses about the relative weight of language and/or culture and their interactions, controlling for both types of factors as much as possible.

In addition, this comparative perspective must be combined with complementary methodologies (e.g., see Choi & Hattrup 2012; Engemann et al. 2015; Gennari et al. 2002; Papafragou, Massey & Gleitman 2002; Papafragou, Hulber & Trueswell 2008). Thus, combining verbal and non-verbal measures (e.g., production, comprehension, grammaticality judgments, similarity judgments and categorization, memory and recognition) with on-line measures (e.g., eye-tracking, reaction times, neurophysiological measures) can provide crucial timing information that may show variation in the temporal unfolding of language processing depending on the language. Furthermore, although no one can dispute the existence of linguistic diversity and its impact on children's verbalizations, there is still no consensus about its potentially deeper implications for non-verbal cognition. For example, do cross-linguistic differences influence how speakers construe events during communication? The use of concurrent tasks (*dual-task paradigm*) has begun to address this question, for example by preventing participants from internally verbalizing information to be expressed, thereby presumably ensuring that performance is entirely non-verbal. However, it is likely that the high cognitive load involved in this paradigm (even more so in children) artificially eliminates interesting variation that could be observed otherwise.

Finally, both inter-individual and intra-individual variation are in great need of future research. Despite available studies and despite a renewed interest in the study of variation, still too much research on children's language and co-speech gestures reports only group data aiming at identifying commonalities while ignoring variation. A number of factors should be considered, all of which may contribute to understanding developmental change and variation therein. Characteristics of the social environments (e.g., exposure to multiple languages, interlocutors, and contexts of language use, registers and discourse types, literacy or oral tradition) and characteristic of children's individual profiles (e.g., personality traits, habitual social practices, levels of cognitive and linguistic development) are promising candidates that should help explain inter- and intra-individual variation in language and gesture development.

In conclusion, studying the numerous factors that determine variation in child language throughout development implies a vast program that requires comparing languages, socio-cultural environments, contexts, and learner types within a large multimodal approach that integrates speech and gesture. Such a program also crucially calls for the use of complementary methodological paradigms which are in great need of being renewed. Fostering such comparative and methodologically rich research will contribute significantly to expanding and renewing our models of development.

Acknowledgements

This volume emerged from a research group entitled *Langues, langage oral et cognition: acquisition et dysfonctionnements* ('Languages, oral language and cognition: acquisition and impairments', GDR 3195 "Adyloc", 2008–2016) financed by the CNRS (INSHS & INSB). Our thanks go to Dana Cohen for her help in copy-editing, as well as to the co-editors of the TiLAR series, Shanley Allen and Caroline Rowland, for their careful reading of the volume. We also thank the many experts who took time to contribute substantially to the reviewing process.

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PART I

Universals and cross-linguistic variation in acquisition

CHAPTER 1

Templates in child language

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To what extent do developmental templates, or idiosyncratic child word patterns, reflect (i) universal tendencies of neurophysiologically grounded production, (ii) perceptually-based guidance due to the frequency of occurrence in input speech or to the rhythmic patterning of the adult language, or (iii) formal principles of phonological structure? We will argue here that all of these elements play a role in the emergence of these child structures, which constitute the first evidence of phonology in the child. We focus on the first-word period and provide evidence of both cross-linguistic commonalities and typological differences, which reflect the structure of the ambient language as perceived and filtered by the child. We then focus in on the role of template formation in individual children.

Keywords: acquisition of L1, development, phonology, templates, speech rhythm, infant perception

Introduction

To what extent do developmental templates, or idiosyncratic child word patterns, reflect (i) universal tendencies of neurophysiologically grounded production, (ii) perceptually-based guidance due to the frequency of occurrence in input speech or to the rhythmic patterning of the adult language, or (iii) formal principles of phonological structure? We will argue here that all of these elements play a role in the emergence of these child structures, which constitute the first evidence of phonology in the child. In addressing these issues we focus on the first-word period, when phonological templates are most often observed. We begin by defining the phenomenon. We then review the available evidence as to its universality and the extent to which templates reflect properties of the input or commonalities of phonological development in the early stages. Finally, we discuss the role of templates in responding to various challenges posed by the ambient language (articulatory,

DOI 10.1075/tilar.22.02vih

speech planning, perceptual and mnemonic) and in scaffolding the emergence of the more adult-like phonological representations observed at later stages, which we do not address here (for later phonological development see, among others, Rose 2000; Goad & Rose 2003; Fikkert & Levelt 2008).

1. Templates

1.1 Definition

By phonological templates we mean to refer to child-specific phonological patterns or emergent neuromotor routines that lead to increasing *similarity among the child's early word forms* – often at the *expense of accuracy*. A child's first word forms generally constitute a fairly accurate match to the target words (Ferguson & Farwell 1975); these words are 'selected'. From among those early word forms, the child then begins to rely on certain accessible patterns or motoric routines as he attempts more complex target structures. When the child's patterns are extended to target words less close to the pattern, these words are said to be 'adapted' to the pattern (Vihman & Velleman 2000).

For operational purposes we identify as templates only child patterns that are used to assimilate more complex or difficult ('adapted') words as well as accommodating the kinds of ('selected') target forms that initially inspired child use of the pattern. Note, however, that some children rarely show 'adaptation', but instead manifest their reliance on a template through the systematic accumulation of words of a particular type (e.g., monosyllabic words with coda, an approach seen often enough in children acquiring English). There could be various reasons for a child following this alternative path, such as having sufficiently flexible articulatory skills to allow a concentration on accurate production of one dominant pattern, for example, or simply due to a temperamental preference for 'safe options'.

In the next section, in which we report the available evidence, we respond to two sets of questions about the 'universality' or 'generality' of child phonological templates:

1. Do all children create them? And do they correspond to particular moments in phonological development?
2. How universal are the structures observed? Are they the same, regardless of target language? To what extent can they be seen as reflecting neurophysiological constraints on articulation and speech planning?

2. Evidence

Templatic analyses of early words are only available for a small number of children so far, with very small samples for most languages (five to ten children, typically). But individual differences within language groups are at their strongest in early phonology, so we can already begin to see what is common and what is rare, despite sparse sampling. The first issue we address here is the question of the universality of templatic patterns across both children and languages.

2.1 Universality of templates

Templatic patterns have so far been identified in at least 15 languages (counting UK and US English as one), for a total of 114 children (Table 1). These analyses are sufficient to show that templates can be observed in the majority of children, regardless of target language. The phenomenon of template use thus appears to reflect a response deployed at one time or another by most children as part of their acquisition of phonology. But more detailed consideration of the data makes it possible to refine the analysis in several respects.

First, we observe that templates appear and then fade in any given child, sometimes (but not necessarily) with subsequent replacement by another template. For example, a child might create a template of the form <CVɪ/CVjV> at 12–14 months, make use of it for two – three months, and then, at 19 months, deploy a consonant harmony template in producing her first words of three or more syllables, although only for a period of days or weeks (Vihman & Vihman 2011).

Secondly, templates are generally more commonly seen as more systematic but also simpler (CV, CVC, VCV) at earlier stages of acquisition, when the phonological inventory is still quite rudimentary; they disappear altogether with phonological advance (Macken 1979). Finally, the complexity of the templatic patterns used (CV or CVC *vs*. CVCVC or CCVCC) appears to be related not only to target language and the size of the child's expressive lexicon but also to the child's age, receptive lexicon and possibly level of cognitive advance as well (Vihman et al. 2013).

The picture sketched above presents templates as a set of universal 'schemas' for phonological scaffolding that are available to all children, regardless of target language. These schemas make it possible to create systematic structures within the limits of input constraints in order to produce more or less effective output forms for the purpose of communication. In the case of typically developing children who are making rapid progress in phonological development templates appear early and fade rapidly, since the scaffolding that they afford is quickly superseded. In contrast, children with slower development or with difficulties of some kind, whose inventory of phonological elements advances more slowly, show a greater dependence on scaffolding by templates and can be expected to make use of them over a longer period (Velleman & Vihman 2002; Vihman et al. 2013).

Table 1. Languages for which phonological template analyses have been carried out on developmental data

Languages	N children included	References
Arabic	5	Khattab & Al Jamimi 2013
Brazilian Portuguese	5	Oliveira-Guimarães 2013; Baia 2013
Dutch	5	Fikkert & Levelt 2008
English (US)	10	Jaeger 1997; Menn 1971; Stoel-Gammon & Cooper 1984; Vihman 2014; Vihman & Kunnari 2006; Vihman & Velleman 1989; Vihman, Velleman & McCune 1994
English (UK)	35	Priestly 1977; Szreder 2013a; Vihman et al. 2013; Waterson 1971
Estonian	6	Vihman 1976, 2014; Vihman & Croft 2007; Vihman & Vihman 2011; Vihman 2016
Finnish	7	Savinainen-Makkonen 2001, 2007; Vihman 2010; Vihman & Kunnari 2006
French	12	Vihman 1993, 2010, 2014; Brulard & Carr 2003; Vihman & Kunnari 2006; Wauquier & Yamaguchi 2013
German	2	Elsen 1996; Vihman 2016
Hebrew	2	Berman 1977; Keren-Portnoy & Segal 2016
Hindi	1	Vihman & Croft 2007
Italian	19	Keren-Portnoy et al. 2008; Vihman 2010, 2014; Vihman & Majorano 2017
Polish	1	Szreder 2013b
Spanish	2	Macken 1978, 1979
Welsh	3	Vihman 2010; Vihman & Kunnari 2006
N = 15	114	

2.2 Common characteristics

We begin by describing characteristics observed across a variety of languages. In the following section we will provide some illustration of templates that more directly reflect the influence of the ambient language.

2.2.1 *Maximum length*

The *maximum length* of early words, for most children, is two syllables (within the single-word period); longer patterns do occur, in children acquiring languages with longer basic word forms in the input, such as Spanish (Vihman 1980), Japanese (Vihman 1991) or Italian (D'Odorico, Carubbi, Salerni & Calvo 2001). The disyllabic prosodic structure has been taken by some investigators to result from universal principles specifying the foot as a requisite constraint on production (Goad & Rose 2003, but see Wauquier & Yamaguchi 2013; Bills & Golston 2002; Marshall & Chiat 2003; Inkelas & Rose 2007). Yet, developmental speech planning and memory constraints can just as readily be invoked to account for these limitations on template size and structure in early word forms.

2.2.2 *Harmony*

Consonant variation across the word is a major challenge for the child, as is apparent from the widespread occurrence of harmony and onset-consonant omission in child forms. Consonant harmony (or assimilation of consonants at a distance) is the most common response to this challenge. In fact, this has been proposed as a 'universal' of child phonology (Smith 1973: 162, 206), although the evidence now clearly shows that its occurrence varies widely by child (Vihman 1978) and by language (e.g., Finnish, 4 out of 7 children observed [57%], (UK) English, 5 out of 16 children observed [31%] in two studies (Keren-Portnoy et al. 2010; Vihman et al. 2012), but French, 1 out of 12 children observed [9%]). In some studies it has been suggested that consonant harmony is conditioned by the dominant prosodic pattern of the input language (i.e., trochaic/iambic foot: Rose 2000) or by articulatory maturation (Dos Santos 2007).

Although full harmony is a common output solution for consonants, it is rarely observed for vowels. The paucity of vowel-harmony templates may be related to the difficulty of transcribing vowels accurately, to the high variability in child vowel production or, more likely, to both.

2.2.3 *Melody*

Melodies (or fixed patterns across a word form) have been reported far more rarely than harmony, making quantification impractical. Melodies can affect consonants (e.g., labial – coronal: see Macken 1979; Jaeger 1997) or vowels (e.g., Vihman, Velleman & McCune 1994: CVCI pattern; also the diary reports in Vihman 1976: <[low]…[high]> and Vihman & Vihman 2011: CVI and CVCI). Where consonantal melodies have been observed, they affect place, not manner (for labial – coronal, Macken 1979; Studdert-Kennedy & Goodell 1995; for labial – coronal/dorsal, Jaeger 1997; for dorsal – labial/coronal, Berman 1977).

Where a single fixed consonantal segment is involved, it occurs on C2 of cvcv, not C1. Fixed medial segments observed in individual child templates include glide [j], Priestly (1977); liquid [l], Vihman (1993); glottal [h], Stemberger (1993); and the feature [labial], Vihman et al. (1994). For cvc, similarly, it is the C2 slot that is specified: e.g., for fricative, Velten (1943); Vihman & Croft (2007); for dorsal, Menn (1971); for [t], Brulard & Carr (2003); for [l], Elsen (1996).

The vocalic melodies so far observed affect height and backness, not rounding (a – i: Vihman 1976; Vihman et al. 1994; a – u: Kunnari 2000; a – e/o: Salo 1993). They observe the sequence <low-high>, not the reverse. Where a fixed vocalic segment is involved, either front or back diphthongs may be specified (e.g., <vi>: Vihman et al. 1994; Elsen 1996; Vihman & Vihman 2011).

2.2.4 *Clusters*

Clusters are rare in child word forms, even word-internally (i.e., internal codas are rare), but in Slavic languages, where clusters are of frequent occurrence in the input, they may occur as part of child templates (Szreder 2013b; see also the early occurrence of clusters in the extensive word list provided in Pačesova 1968).

2.3 Ambient language effects

To some extent the same templatic patterns occur in different languages, but the templates nevertheless reflect typological differences resulting from the differing structures of the input languages. Thus, certain patterns are common in some languages but not observed at all in others, at least within the single-word period. For example, words with coda seldom occur early in French, and certainly not disyllabic words with coda (cvcvc), despite the existence of such words in the adult lexicon and even in the language spoken to children (e.g., *capuche* 'hood', *facil* 'easy', *regarde* 'look'); similarly, child words of the shape vcv seldom occur in English. At the same time, the children in a given language group are never found to all follow a single pattern; there are at most tendencies, with individual differences in children's word forms reflecting, in part, variable effects of input frequency of adult structures and perhaps also variable sensitivity to accentual or rhythmic patterning.

In order to compare across children and languages, we restrict ourselves here to templatic patterns that account for at least *20% of a child's lexicon*, whether in a given session or, for diary studies, over a designated period. We illustrate the typological specificity of templates here by drawing on the children who make the heaviest use of any given pattern (in language groups for which we have data for at least 4 children) and by indicating, where possible, the number of children who show the same pattern. (Since consonant harmony is by far the most frequently discussed and illustrated of the child templatic patterns we do not illustrate it here.)

2.3.1 *VC(:)V (no specified melody or harmony)*

This formula refers to words that lack an initial consonant. We find the pattern both in languages with medial geminates and in languages with final-syllable accent; we discuss these separately.

In many languages with geminates, the VCV pattern occurs frequently, with both singleton and geminate medial consonants. Finnish provides the best illustration (Vihman & Velleman 2000; Savinainen-Makkonen 2007). Five of the seven children observed (71%) make over 20% use of this pattern at the end of the single-word period; Atte, 1;8 (Appendix 1b) makes the highest use of the pattern (62%). Note that the child omits even early-learned word-initial consonants to achieve the pattern (*pallo, nalle*). Similarly, three out of six Estonian children observed (50%: Vihman & Croft 2007; Vihman & Vihman 2011; Vihman 2016) used the pattern, as did the one Hindi-learning child whose data have been analyzed (Vihman & Croft 2007). All of these are languages with geminates.

Vihman and Majorano (2017) undertook an experimental study to determine whether it is the presence of medial geminates that underlies the common use of <vc(:)v> described above. Fourteen Italian children out of 30 observed in a cross-sectional study at 21 months (47%) used the pattern. Three experiments with 11-month-olds (using the Headturn Preference Procedure: Kemler Nelson et al. 1995), showed (a) that, as in previous studies of English and French (Hallé & Boysson-Bardies 1994, 1996; Vihman et al. 2004), word forms familiar from everyday life could be distinguished from unfamiliar words without situational context or special training in the lab. However, in trochaic disyllables, which constitute a large majority of Italian early words, change to the initial consonant blocks word-form recognition only when (b) the medial consonant is a singleton, not when (c) it is a geminate. This suggests that the salient medial geminate reduces infant attention to the onset consonant, resulting in the common <vc(:)v> template described above.

A tendency to omit the initial consonant, like that noted above for languages with geminates, is also seen in children learning French (see 2.2.2), with its phrase-final lengthening, or Hebrew, with its predominantly iambic accentual pattern (Keren-Portnoy & Segal 2016).

2.3.2 *VCV, with vowel melody or harmony*

Beryl, at 1;7.26 (Appendix 1a), shows a strong <aCv> pattern (32/56, or 57% of the words in the session). Even the more restricted harmony pattern <aCa/ɔ/o> meets the criterion for her (25/56 [45%]). The <aCv> pattern is relatively common in French, occurring at the criterial level in 3 out of 12 children. Note that the target word forms that Beryl produces in accord with this template are quite diverse, including not only vowel-onset words (e.g., *agneau, encore, étoile*), but also consonant-onset words from which she omits the initial consonant, even when it is an early-learned stop or nasal (e.g., *baleine, bateau, dauphin, micro, nuage*).

2.3.3 *CVCVC*

This pattern is characteristic of English, which has a far higher occurrence of codas in the input than French or Finnish, for example. One of the first clear templatic accounts in the literature of a <cvcvc> pattern was that of Priestly (1977), whose son Christopher, consistently imposed the pattern <cvjvc> on disyllabic words that he attempted to produce from 1;10 to 2;2; by the end of this period 'ordinary replacement forms' – featuring common processes such as cluster simplification – were used in place of the idiosyncratic template.

One study recorded three groups of children toward the end of the single-word period. At age two, 11 of the children were identified as typically developing children, 21 as late talkers; however, by 2;6 10 of the late talkers had 'caught up' with expected levels of expressive language use and were re-classified as 'transitional' late talkers (Vihman et al. 2013). One or two children in each of the three groups had 20% or more disyllabic words with codas, often with either a final fricative or harmony on one or the other of two pairs of C…C sequences in the word, or both.

To summarize, ambient language influence is apparent in the shaping of templates, but high individual variation is the rule and much of the patterning observed remains common cross-linguistically. We now turn to a description of those commonalities.

3. The template as a response to challenges

Here we take up the question of the mechanisms or functions that underlie templates. We see templates as responding to different kinds of challenges posed by the target language through the complexities of the input speech signal.

3.1 Mechanisms or functions

Templates reflect the use of existing resources to deal with what is novel and therefore challenging. The limitations on child production are of several different types – *articulatory* or *speech-planning limitations* constitute an obvious challenge, but the concurrent demands of *rapid lexical learning* also pose a major mnemonic challenge. In addition, the *linearity* of speech (along with its high variability and transitory nature) poses an important phonological challenge at a time when neither the perception nor the production of segmental sequences is robust or stable.

We can interpret the deployment of templates as a response to these difficulties in one of two ways. (i) From a sensorimotor developmental perspective, *familiar production routines* or *procedures* can be seen as being applied 'automatically' (i.e., with no intention or conscious 'strategy') to words that exceed the child's capacities.

(ii) From the point of view of implicit and explicit adult learning mechanisms, the templates can be seen as reflecting *distributional learning* over the database constituted by *repeatedly used child output forms*. In this sense, distributional learning can be termed 'secondary', as it is not a direct tallying of what is in the signal, the running speech stream itself, but rather a response to the repeatedly occurring structures of words the child has begun to produce.

Under either interpretation, the child begins by producing a few identifiable word forms relatively accurately, based on *item learning*. Thereafter, by account (i), the most practiced neuromotor production routines are extended to new forms that bear some similarity to what has already been produced. Alternatively, by account (ii), distributional learning – which, in the first year, supports advances in knowledge of many aspects of the input (prosodic, phonotactic, allophonic: see review in Vihman 2014: ch. 5) – will automatically apply to the child's output forms (which necessarily also constitute input for the child), leaving particularly strong traces of any repeatedly recurring elements (e.g., the long medial consonants in languages with geminates, the vocalic sequences in syllable-timed languages like French, the onset consonant in strongly trochaic and stress-timed languages like English or German). The two interpretations are essentially complementary and mutually compatible; the difference is rather one of emphasis and theoretical preference than of empirical justification or predictive value. These points have been discussed in greater detail elsewhere (for the role of the *production practice gained in babbling*, see McCune & Vihman 2001; Keren-Portoy et al. 2010; for the *matching of own production to perceived input* for individual 'intake', see Majorano, Vihman & DePaolis 2014; for the extent to which *familiar patterns provide mnemonic support* for new forms, see Menn 1983; Keren-Portoy et al. 2010). However, we assume that template formation is also a response to the challenge of constructing a multilinear phonological representation on the basis of the temporally sequential speech signal.

3.2 Representational challenge: The problem of linearity

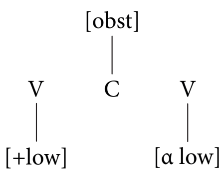
Many phonological phenomena, observed in a wide range of language families, show that the Saussurian analysis of the speech chain as consisting of a unilinear string of segmental units is inadequate (for a review, see Goldsmith 1995). Instead, speech is simultaneously organized in a multilinear way in terms of a variety of types of information (segmental, syllabic, tonal, accentual, harmonic) that are coded in parallel and that must be processed and segmented simultaneously by listener-speakers in real time (Wauquier-Gravelines 2005). These facts pose a certain number of problems for the way that we understand phonological development, such as

a. how do children arrive at an effective way of segmenting the signal to access the lexical level?
b. what mechanisms (of perception or production) constrain the units which emerge from the speech stream or which can be 'cut out' or chunked from input strings?

From this perspective, templates can be seen as output forms that constitute the child's cognitive response or 'adaptation' to the structural complexity of speech with its multiple levels of information. They would reflect children's attempts to reconcile the required segmental information (sound sequences) with the slots they are able to fill in the speech chain. In this sense templates make it possible to sketch out some of the possible lexical structures of the language and also to learn which phonological distributions are licensed (e.g., presence or absence of codas or geminates; presence or absence of branching onsets; constraints on the kinds of segments that can fill a given slot, such as the coda).

Beryl's data (Appendix 1a) provide a good example of the way in which an <aCV> template is constructed on the basis of an idiosyncratic structure [1], which can in turn be generalized and stabilized as the abstract structure <VCV>, a common French lexical form. Note that in many contexts in French, lexical items are preceded by a determinant that starts with a vowel (*un/une*), and that the canonical syllabic structure of French depends on sequences of open syllables (Wauquier & Yamaguchi 2013). In some sense Beryl's template constitutes a coherent and well-adapted output form, given the target language input.

[1]



This hypothesis makes it possible to account for the observations synthesized in 2: the fact that, on the one hand, templates seem to exist independently of the target language (2.1), yet, on the other hand, they manifest clear typological particularities (2.2), while nevertheless remaining restricted to a limited number of possible patterns (2.3).

4. Conclusion

In summary, we see templates as reflecting children's responses to challenges deriving from production (articulation, speech planning), perception (segmentation into words, retention of segmental sequencing under accentual variation) and memory (linking particular word forms to particular meanings). Purely *articulatory constraints* may be reflected in child failure to attempt certain segments (e.g., trilled 'r' in Estonian, voiced fricatives in English, front rounded vowels in French – though each of these may appear early in the output forms of individual children and may be learned earlier in languages that provide high-frequency exposure). *Speech planning issues* may account for the general preferences of children for mono- and disyllabic forms as well as for maintaining a single consonant across a word form, although memory may be implicated here as well. Differences in the importance of *segmentation as a perceptual challenge* are tied to differences in speech rhythm. Strongly stress-timed languages like English make lexical access relatively easier than it is in French, for example (e.g., Peters 1997). But at the same time the unaccented syllables of a language like English can remain poorly represented well into the period of word combination.

The challenge posed by *memory for form-meaning links* has been well-documented by Stager and Werker (1997), who showed that despite early precocity in the discrimination of consonantal contrasts, 14-month-olds are not easily able to retain non-word minimal pairs in relation to distinct nonsense objects (although 17-month-olds can do so); furthermore, vocabulary size is a relevant factor, permitting the children with larger *expressive* vocabularies to perform at the 17-month level at the earlier age of testing (Werker, Fennell, Corcoran & Stager 2002), which accords with the idea that production experience or practice supports memory for word forms (see Keren-Portnoy et al. 2010).

In short, templates reflect the child's (implicit) efforts to integrate the constraints imposed by perception and production. Templates can also be taken to mediate between input- and output-based learning. In this sense, distributional learning provides the child with knowledge of the phonotactic and prosodic patterns of the ambient language within the first year, but production is initially item-based. Once a small expressive lexicon has begun to accumulate, the child shows, through the deployment of one or more templates, that he is now learning 'distributionally' from the new database constituted by his own word forms.

Furthermore, templates show formally similar characteristics that are nevertheless manifested in quite different and varied ways across individual children and different languages and even within the same child at different times. According to this perspective, there are no fixed, innately given phonological templates or even principles constraining the possible shapes of templates: children's incipient phonological representations reflect dynamic and individual responses to the structures of the target language and reveal the beginnings of the grammaticalization process. This in turn serves to support the construction of the abstract representations that will lead to adult-like phonological knowledge. As Thelen and Smith (1994: 247) put it, "knowledge… is not a thing, but a continuous process; not a structure, but an action, embedded in, and derived from, a history of actions." In other words, template formation is neither the outcome of a pre-existing principle nor an end in itself but instead a dynamic (and momentary) child response, in the early stages of acquisition, to the phonological and lexical challenges of the language. And these individual responses rest on a general cognitive capacity that makes it possible to process the complexity of temporally organized linguistic structure as a foundation for language acquisition.

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Appendix 1a. VCV with vowel melody

Numbers of child repetitions of the same form are indicated in parentheses

French: <aCV> **Beryl** 1;7.26 (32/56, 57%)

Target word	Gloss	Adult form	Child form
(l')éléfant	elephant	(l)elefɑ̃	afɔ
agneau	sheep	aɲo	alo
badaboum	boom	badabum	abu
baleine	whale	balɛn	anɛ
bateau	ship	bato	ato (3)
cerceau	circle	sɛʁso	aço
crapeau	toad	kʁapo	ako (2)
dauphin	dolphin	dofɛ̃	afa (3)
encore	again	ɑ̃kɔʁ	ɑ̃kɔ
étoile	star	etwal	ata
hibou	owl	ibu	abu
la pieuvre	octopus	lapjoevʁ	apø
la tête	head	latɛt	atɛ (2)
lapin	rabbit	lapɛ̃	apa
le chat	cat	ləʃa	aça (3)
les cloches	bells	leklɔʃ	aχlo
les flaques	puddles	leflak	axa
lézard	lizard	lezaʁ	aza (2)
marteau	hammer	maʁto	ato
micro	micro(phone)	mikʁo	aχo (13)
musique	music	myzik	aɫi
nénuphar(s)	lilypads	nenyfaʁ	afa (4)
nuage	cloud	nɥaʒ	aça
parrain	godfather	paʁɛ̃	apa (2)
poisson	fish	pwasɔ̃	aço
requin	shark	ʁ ə k ɛ̃	apka
sapin	pine	sapɛ̃	apa (2)
sardine	sardine	saʁdin	ani
un coeur	heart	oẽ koeʁ	akɔ
un fleur	flower	ynfloeʁ	afa
une pomme	apple	ynpɔm	apɔ
verre de terre	worm	vɛʁdətɛʁ	ata (3)

cf., also Charles, 12/26 word forms in <aCa>, <aCo> (46%); Vincent, 14/42 word forms in <aCV> (33%). French children with over 20% VCV melodies: 3/11 children (27%).

Appendix 1b. VCV with no vowel melody

Finnish <VC:V, VCV> **Atte** 1;8 (16/26, 62%)

ääni	sound	æ:ni
äiti	mother	æit:i (*7)
aja	time?	aj:a (*2)
api(na)	monkey	api (*5)
ankka	duck	ak:a
A(n)tti	(name)	at:i (*9)
auto	car	auto (*20)
heppa	horsie	ep:a
isi	daddy	içi (*6)
kala	fish	ala
kello	clock	el:o (*2)
loppu	end, finished	op:u (*4)
nalle	teddy	al:e (*2)
pallo	ball	al:o (*2)
sammui (auto)	(car[‘s motor]) died	am:u.auto (*5)
ukko	old man	uk:o (*3)

cf., also Matti 44%, Eelis, 42%, Joel 42%, Ilari, 30%: 5/7 children

CHAPTER 2

Phonological categories and their manifestation in child phonology

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The nature of phonological representations and of their acquisition by language learners has been a subject of debate since at least the 1970s. Vihman and Croft (2007) recently proposed the 'Radical' Templatic approach to phonology, which formally rejects segmental features as independent units of phonological representation, in spite of their central relevance within mainstream theories of phonology since at least the 1940s. In this chapter, I emphasize that abstract categories are in fact central to our characterization of phonological systems and their acquisition by language learners. I discuss longitudinal data on the development of consonants and consonant clusters in the productions of Catootje, a Dutch-learning child. I highlight several categorical effects that are readily captured in models of phonological development which embrace abstract units such as features and syllable constituents.

Keywords: phonology, prosody, acquisition, category, first language, syllable constituents, variability

Introduction

One of the fundamental debates in phonology and phonological development concerns the nature and origin of the units represented within the speaker's lexicon. While models of phonology within structural and/or generative traditions posit units such as segmental features and syllable structure constituents, that is, abstract building blocks that capture generalizations about sounds and sound combinations (e.g. all 'labial' or 'fricative' segments; syllable 'onsets' or 'codas'), other models limit formalism to readily identifiable units such as words, syllables and phones. These latter, more holistic approaches to phonology generally consider sub-segmental units (features) and sub-syllabic constituents (e.g. onsets, codas) to be irrelevant to the functioning of human languages.

DOI 10.1075/tilar.22.03ros

This position, however, contradicts the bulk of the literature on phonetics and phonology. Phonological features have been fundamental to models of phonology since (at least) the seminal work of Nikolai Trubetzkoy and Roman Jakobson within the Prague Circle of Structural Linguistics and later developments within Generative Phonology (e.g. Jakobson 1941; Jakobson, Fant & Halle 1952; Chomsky & Halle 1968; Trubetzkoy 1969). Likewise, robust theories of syllable structure (and other levels of prosodic constituency) make crucial reference to constituents such as syllables onsets and codas to capture distributional and prosodic aspects of speech (e.g. Fudge 1969, 1987; Kahn 1976; Goldsmith 1976; Selkirk 1980a, b, 1982). In spite of this, features and syllable structure constituents remain at the heart of a number of controversies, for example concerning their psychological reality (e.g. Bybee 2001; Vihman & Croft 2007) or how they may shape natural language speech perception and production behaviours (e.g. Mielke 2011 for a recent summary).

In this chapter, I support the view that abstract categories are fundamental to phonological systems. Formally, I embrace the emergentist position that abstract categories are not innately available to the child but gradually emerge within his/her lexicon through learning. This proposal builds on earlier analyses by, e.g. Goad & Rose (2004), Fikkert & Freitas (2004, 2006), and Fikkert & Levelt (2008), each of which highlights the central importance of the learner's analysis for acquisition. I argue that human beings acquire the phonology of their first (and subsequent) languages as they make perceptual and articulatory generalizations about the segmental, distributional, and prosodic properties of these languages. In the spirit of Pierrehumbert (2003), these generalizations form the basis of abstract categories, which the child stores as part of his/her lexical representations. As these representations gain categorical abstractions, they offer as many shortcuts in all tasks related to speech perception and production. This emergentist approach to formal phonology predicts limited systematicity during early stages of word production, due in part to the incomplete development of the child's phonological system at early stages. As the learner acquires phonological categories, for example new phonological features or constituents within prosodic representations, we may observe abrupt and systematic shifts in phonological productions.

I illustrate these predictions through patterns of phonological development observed in the productions of Catootje, a child learning Dutch as her first language. I conclude with a discussion about the relevance of both holistic and finer-grained models of phonological representation, as the former is better suited to descriptions of early phonological productions, while the latter enables accounts of later phases in the acquisition process and, ultimately, of the functioning of adult phonological systems.

1. Background

1.1 Abstract phonological models

Models of phonology build on abstract categories to capture robust observations about phonological systems, for example the fact that natural classes of sounds, i.e. groups of phones that share one or many phonetic attributes, tend to pattern together in adult languages. Likewise, segmental distributions can be formally encoded in terms of rules and/or constraints making reference to structural positions within syllable, word, or larger domains. Natural classes of sounds can be defined in terms of phonological features, that is, sub-segmental units which represent their common phonetic properties, the functional relevance of which must be determined on a language-specific basis (e.g. Mielke 2011). Taking an example from acquisition, we can see in (1) that the child code-named W, a learner of English, seemingly 'moves' word-initial fricatives in target word forms to the word-final position (data from Leonard & McGregor 1991, as reported by Velleman 1996). This generalization, which transcends individual word forms, can be descriptively captured as a rule or mapping process that reorders initial fricatives in perceived forms into the word-final position of produced forms.

(1) Manner-conditioned metathesis (Leonard & McGregor 1991)[1]

|zu|	[uz]	'zoo'
|faɪn|	[aɪnf]	'fine'
|sop|	[ops]	'soap'
|snupi|	[nupis]	'Snoopy'
|stap|	[taps]	'stop'

As mentioned above, natural class effects and feature-based descriptions of these effects pervade the literature on adult phonology. However, how these systems come to be acquired raises questions about the origins of features. Indeed, while the literature on child phonology highlights systematic patterns such as that in (1), it also reveals significant patterns of variability. This variability poses challenges to formal models of phonology and acquisition, especially in approaches based on categorical representations or rules. This topic has been taken up as a central area of concern within competing, functionalist approaches to phonology, a strong version of which is discussed in the next section.

1. Target forms are represented between vertical bars; actual forms between brackets.

1.2 'Radical' Templatic Phonology

Templatic Phonology is rooted within the Firthian approach to phonology (e.g. Firth 1957). This approach rejects the phonemic principle as foundational to phonological systems. Within Templatic Phonology, the smallest segmental unit of speech is the phone; features and the natural classes they describe are seen as merely epiphenomenal. Phonological patterns are encoded in terms of prosodies, viewed as independent units positioned on an otherwise flat word 'template'. Prosodies describe phonological patterns in a *wysiwyg* (*what-you-see-is-what-you-get*) fashion: they indistinctly encode phonetic properties (e.g. vowel duration), segmental units (e.g. epenthetic vowels), and phonological processes (e.g. vowel harmony). Various versions of this general approach are expressed throughout the literature on phonological development (e.g. Menn 1971; Menn 1983; Waterson 1971; Waterson 1987; Macken 1979; Macken 1996; Vihman & Velleman 2000; Vihman & Croft 2007; Menn & Vihman 2011; Vihman 2014). In this section, I focus on the recently proposed 'Radical' version of Templatic Phonology, proposed by Vihman & Croft (2007; henceforth, V&C) as it offers one of the clearest contemporary definitions of the theory.

Consistent with the original model, V&C reject the feature as an independent category within phonological representations:

> In adult phonology, segment categories – natural classes, or features – are best defined in terms of their occurrence in positions in the templates in individual languages, not as independent universal categories. (V&C: 683)

V&C base their argument against the feature and, more generally, the natural classes of phones it defines, on a number of observations about the shapes of words generally observed in early child language productions. I summarize these observations in (2) (see, also, Waterson 1971; Ferguson & Farwell 1975; Macken 1979; Macken 1992; Vihman 2014).

(2) Properties of early word productions (adapted from V&C: 689–690)

- a. Variability in children's productions of words, between pronunciations of the same target sounds and/or words;
- b. Limited correspondences between sounds attempted/produced:
  - i. Homophony between different target forms attempted by the child (i.e. 'preferred word patterns');
  - ii. Limited relationships between child and adult forms.

Drawing heavily on Bybee (2001), V&C favour an approach to phonology which excludes any formal separation between phonological representations and their phonetic reality. Under this view, variable production patterns suggest "that the child has knowledge of particular words but has not yet developed abstract categories of sounds for production" (V&C: 689, after Ferguson & Farwell 1975).

Template-based analyses of phonological development have been primarily used to describe child production data ranging from the babbling stage to early word forms (e.g. MacNeilage & Davis 1990, 2000; Vihman 2014). While often associated with functional approaches to phonology, templates have also been used as descriptive devices within generative phonology (e.g. Levelt 1994; Fikkert 1994; Demuth 1995; Rose 1997; Wauquier-Gravelines & Yamaguchi 2013). From the perspective of development, crucial assumptions about innateness aside, these competing approaches share the view that children's phonological representations are initially impoverished, and gain in representational detail through learning (contra Hale & Reiss 1998, 2008). Among other debates, for example about the types of learning mechanisms involved, is the question as to what units must be posited within the model in order to encode the relevant type and amount of representational detail. On this topic, V&C explicitly contradict the often elaborate systems of categories developed within the generative tradition, as they restrict the number of categories to the following few:[2]

> [...] the only phonological categories posited by a templatic approach to phonology are (i) words; (ii) word templates of varying degrees of schematicity, and (iii) syllable and segment categories as subparts of those phonological templates, defined in terms of their occurrence in particular template positions.
> (V&C: 717)

Under this view, *schematicity* remains more or less undefined, but can be taken as the level of representational definition that syllables and phones afford, which are assumed to emerge from frequent or otherwise salient phonetic properties of the ambient language (in line with Bybee 2001). V&C further claim that individual word templates represent the child's 'preferred' productive abilities, which emerge during the babbling period, as the child begins to reproduce speech units relevant to the target language (see also MacNeilage & Davis 1990; Beckman & Edwards 2000). Templates can thus impose certain segmental or prosodic properties to word forms attempted by the child. A striking example of this comes from Priestly (1977), who documents the productions of an English-learning boy aged 1;10–2;2. As we can see in (3), the child substitutes the phone [j] for word-medial consonant across different CVjVC words, the remainder of which display some level of identity with the target forms.

2. In a more recent paper, Menn and Vihman (2011) offer a less 'radical' stance, which in fact allows for the possibility of phonological features as categories emerging from learning. This is in essence the hypothesis I support throughout this chapter.

(3) Word-level adaptation to a 'CVjVC' word template (Priestly 1977)

basket	[bajak]	tiger	[tajak]	fountain	[fajan]
blanket	[bajak]	turkey	[tajak]	flannel	[fajan]

Given that templates are virtually free of constraints as to what they may encode, they can in theory be used to describe every imaginable idiosyncratic pattern in children's productions. This is fitting in that most of the arguments brought in favour of templates come from studies documenting the earliest (and most idiosyncratic) period of phonological productions, based on babbles and early words from children with vocabulary sizes often restricted to 25 or 50 words (e.g. Vihman 2014).

However, beyond this early phase in phonological development, templatic approaches have been criticized for their failure to capture aspects of phonological development which transcend individual word forms (e.g. Rose & Inkelas 2011 for a general discussion). As we will see next, this problem also arises in the context of Catootje's phonological productions, which reveal segmental and syllable-level patterns of development that transcend word- or syllable-size units of representation. These data instead support models that incorporate features and syllable constituents within phonological representations.

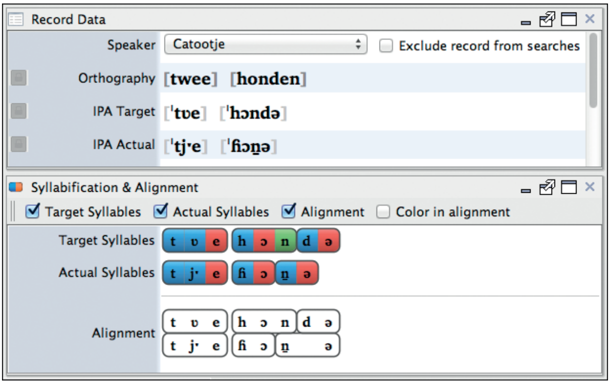
2. Case study

2.1 The corpus

Catootje's data constitute a subset of the Dutch-CLPF corpus, which documents the phonological development of 12 Dutch-learning children and is available through the CHILDES/PhonBank online database <http://childes.talkbank.org/phon/>. Catootje's patterns of segmental and prosodic development have been at the centre of several debates on phonological acquisition since (at least) the original publications by Fikkert (1994) and Levelt (1994). The description below, based on 4987 word forms recorded over a little less than nine months, between the child's ages of 1;10.10 and 2;7.4, adds a new angle to this body of work, as it highlights previously under-documented parallels between the development of segmental categories and that of onset clusters in Catootje's phonology.

These further descriptions of Catootje's data were performed with the Phon software program for phonological analysis (e.g. Rose et al. 2006; Rose & MacWhinney 2014). Within this relational database system, data records document utterances produced by the child, which were gathered during naturalistic recording sessions. Sets of phonetic transcriptions represent both the adult 'model' pronunciations of these utterances, the targets, and the child's actual renditions of these words. Target and actual transcriptions are labelled for syllable-level information and aligned against one another on a segment-by-segment basis for systematic comparisons. The screenshot below illustrates how this information is represented within the Phon graphical user interface.

(4) Transcription, syllabification and alignment data within Phon



This alignment provides the necessary grounds for data assessment, as the targets provide a baseline for evaluating the child's actual performance in her renditions of these word forms.

As we will see, the data reveal a high degree of phonological systematicity, suggesting generalizations on the child's part which transcend individual word or syllable shapes. I begin this discussion with a summary of the relevant properties of the Dutch phonological system.

2.2 The target system

The description of the Dutch phonological system presented in this section essentially follows that of Booij (1999). As we can see in (5), Dutch displays a relatively rich inventory of both vowels and consonants.

(5) Dutch inventory of segments (adapted from Booij 1999, Chapter 2)

a. Vowels (monophthongs):

i	y		u
ɪ	ʏ		
e	ø	ə	o
ɛ			ɔ
		a	ɑ

b. Diphthongs: [ɛi, œy, ɔu]

c. Consonants:

	Labial	Alveolar	Palatal	Velar	Glottal
Stop	p, b	t, d		k (g)[3]	
Fricative	f, v	s, z		x, ɣ	h
Nasal	m	n		ŋ	
Liquid		l, ʀ			
Glide	ʋ		j		

The discussion below primarily focuses on the lateral [l], uvular [ʀ], and palatal [j], and on onset clusters which contain these consonants. Except for [h], all obstruents may combine with [l] and [ʀ] in branching onsets, modulo restrictions on the combination of places and/or manners of articulation within these clusters.[4] Clusters with [j] are however more restricted. This yields the inventory of onset clusters in (6).

(6) C+approximant onsets, ignoring voicing contrasts (Booij 1999: 36)

pʀ	pl	pj	
tʀ		(tj)[5]	(tʋ)
kʀ	kl	kj	(kʋ)
fʀ	fl	(fj)	
(xʀ)	(xl)		

I discuss the acquisition of these clusters in the next section, except for those enclosed between parentheses, which either involve additional complications (e.g. footnote 5) or were not attested in sufficient numbers in the corpus to warrant analysis.

2.3 Catootje's general development of singleton and branching onsets

At the beginning of the recording period, Catootje was already in command of her target stops (both obstruent and nasal) [p, b, t, d, k, m, n], in addition to the laryngeal [h].

In the table below, the symbol "✓" indicates the age at which Catootje mastered target phones and phone combinations, except in the last case, in which ✓ indicates the emergence of a substitution pattern. The grey cells indicate that the target structure was attested in the words attempted but not yet acquired by the child; the black cells indicate that the relevant unit was not attested in the child's attempted

3. [g] is mostly peripheral to the Dutch system as it occurs only in loanwords (Booij 1999: 7).

4. Formal considerations concerning the source of these distributional constraints transcend the scope of this chapter (for discussion, see, e.g. Rice 1992; Goad & Rose 2004; Goad 2012).

5. All coronal+[j] clusters undergo palatalization in pronounced forms (e.g. /tj/ > [ʧ]).

forms. These data collapse voiced and voiceless obstruents as well as word-initial versus medial onsets, as no notable difference involving voicing or word position was found, except concerning the coronal voiced stop [d], which displays a noticeable level of variability. I discuss this issue below, where I show that this variability in fact emerges from interacting factors.

(7) Parallels between Catootje's development of segments and clusters

	1;10.10	1;10.24	1;11.09	1;11.22	2;00.06	2;00.19	2;01.03	2;02.14	2;02.28	2;03.25	2;04.11	2;04.25	2;05.08	2;05.22	2;06.06	2;07.04
[l]								✓								
[ʀ]										✓						
[j]			✓													
[pl, bl, kl]								✓								
[pʀ, bʀ, tʀ, dʀ, kʀ]										✓						
[kj, pj]									✓							
[kn] (> [kj])			✓													

The most central observation emerging from this table concerns the parallels between Catootje's acquisition of approximant consonants and that of branching onsets containing these approximants. These onset clusters were all mastered within the same six-week period (2;02.14–2;03.25), the development of which was also contingent on the mastery of [l] and [ʀ], itself evidenced in singleton onsets. Another parallel observed is the emergence of the [kn] > [kj] substitution pattern, which coincides to the mastery of [j] in singleton onsets. Similar to [kj] and [pj], [kn] was not attempted in the sessions prior to the mastery of [j]. Additional observations about the corpus which were left out of this table include the fact that Catootje mastered all target sC clusters within the same one-month period (2;04.11–2;05.08). Further, as Catootje did not master the production of fricative consonants [f, v, ʃ, ʒ, χ] in syllable onsets by the end of the observed period, she remained unable to produce target clusters containing these consonants (e.g. [fl, vl, sχ]).[6]

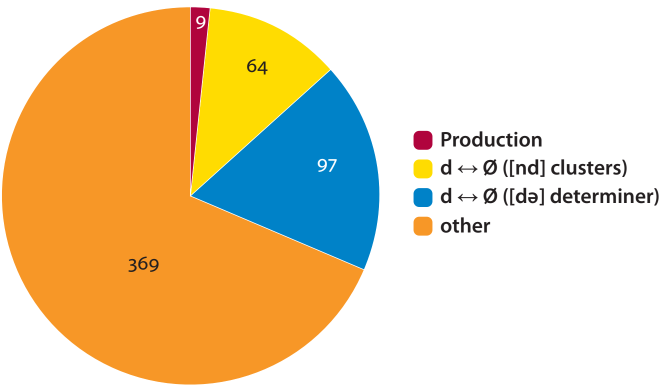
Taken together, these observations highlight systematic patterns of phonological development at both the segmental and sub-syllabic levels of representation. As we will see next, even the more variable aspects of Catootje's phonology can be predicted to occur, as the result of independent factors affecting the child's learning process.

6. See Fikkert (1994) and Levelt (1994) on the development of fricatives in Dutch.

2.4 Variability in the acquisition of [d] in onsets

Recall from above the claim that Catootje had already mastered target stops (and the laryngeal [h]) in syllable onsets at the beginning of the data recording period. This claim could be undermined by the apparently variable behaviour of [d] in onsets. Out of a total of 539 cases of onset [d] attested in the target forms, we find 170 (32%) cases of consonant deletion in Catootje's actual renditions, spanning virtually the entire observation period. This variation could be suggestive of a partially random system. However, it in fact derives from systematic interactions within the child's system. Of the 170 cases of [d] deletion, 97 arise from a single phonological context, that of onset [d] preceded by the coda consonant [n] (e.g. |ˈandəɹ| ↔ [ˈanə] 'other'; |ˈhɔndə| ↔ [ˈɦɔnə] 'dogs'; |ˈvlɪndəɹ| ↔ [ˈɦinːa] 'butterfly'), while 64 arise from attempts at producing the definite determiner de |də| 'the', as schematized in (8).

(8) Overall production of [d] in onsets (n = 539)



Starting with the [nd] context, we find 107 attempts at these coda-onset clusters in Catootje's attempted words. Of those, 97 (91%) undergo [d] deletion. I attribute this pattern to the acoustics of [nd] clusters, whose idiosyncratic patterning has also been documented in the acquisition of English (e.g. Smith 1973; Bernhardt & Stemberger 1998; Barlow 2003; see also Pater 1999 on nasal+C clusters in adult phonological systems). I argue that, in [nd] clusters, [n] casts a perceptual shadow over the following [d], a context which hinders the child's ability to represent a [d] in this position in her lexical representations. In a nutshell, if the child cannot properly perceive and, thus, cannot represent a phone within her lexical representations, she obviously cannot reproduce it in her speech productions. This analysis is reinforced by the additional observation that, out of the 130 attested attempts at [nt] clusters by Catootje (e.g. |ˈplantə| ←→ [ˈplantə] 'plants'; |ˈɦant| ←→ [ˈhant̪] 'hand'), the corpus contains only 15 occurrences of [t] deletion, some of which occur in word-medial, others in word-final contexts. This observation eliminates coronal homorganicity between the nasal and the stop as the leading explanation; Catootje's deletion pattern only affects voiced [d] in this context.

Turning now to the pattern of [d] deletion affecting the definite determiner *de* |də| 'the', of the 74 documented attempts at this function word in the corpus, Catootje fails to produce anything for [d] 64 times (86%). A plausible explanation for this observation relates to Catootje's development of the morpho-syntactic system of determiners in Dutch. Her production of phonologically indistinct [ə] for target |də| throughout the corpus is best characterized through the literature on 'filler' morphemes, in the tradition of Peters (1977, 1997, 2001) (see also Veneziano & Sinclair 2000), which reveals intricate interplays between morphological, syntactic, and semantic areas of knowledge involved in the acquisition of functional morphology (also, Peters & Menn 1993), which may also be hindered by the weak prosodic contexts in which these function words generally appear (e.g. Gerken 1996; Demuth 2001; Demuth et al. 2011).[7] An explanation based on prosody alone would not account for the observation that onset [d] only rarely undergoes deletion in words other than the determiner *de* (and the [nd] context discussed above), although prosody may well be a potential contributor.

Finally, the factors affecting the child's production of target [nd] clusters and the determiner *de* remain independent of any consideration about word shapes or input frequency. The [nd] clusters yield identical behaviours across frequent and comparably rare words (e.g. *ander/e* 'other/different,' attested 58 times in the corpus versus *Indiaan* 'Indian,' attested only 4 times). Similarly, while *de* is arguably a frequently-occurring word in the language, other factors such as those mentioned above obviously got in the way of its acquisition by Catootje.

2.5 Variability in the acquisition of onset clusters

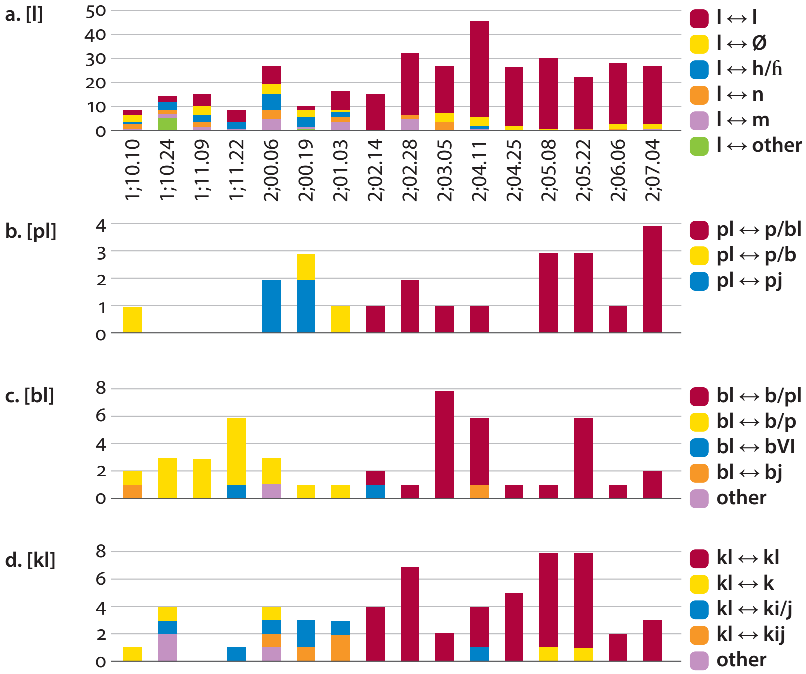
As already shown in (7), Catootje's development of branching onsets also reveals a great deal of systematicity. Again here, however, we observe some variability in these data, to which I turn now, and discuss in light of Catootje's acquisition of the target liquids [l] and [ʀ].[8]

7. Whether morphology, prosody, or a conspiracy between the two is ultimately responsible for this phenomenon is left for further research, as it calls for the investigation of languages with different rhythmic properties than English and Dutch.

8. I briefly return to the development of C[j] onset clusters in the discussion below.

As we can see in (9a), variable patterns of production for target [l] in singleton onsets are attested between 1;10.10 and 2;01.03, when target-like productions never exceed 50%. We then observe an abrupt change in performance level: as of 2;02.14, Catootje began producing target [l] in singleton onsets at rates of 80% or above. It is also at this exact same recording session that she began to produce target C[l] onsets with accuracy. We can observe this qualitative change in her phonological grammar in (9b–d) through the contrast between the period before 2;02.14, during which Catootje failed to produce even a single target branching onset accurately, and the overall pattern of accurate productions observed from that age onward.

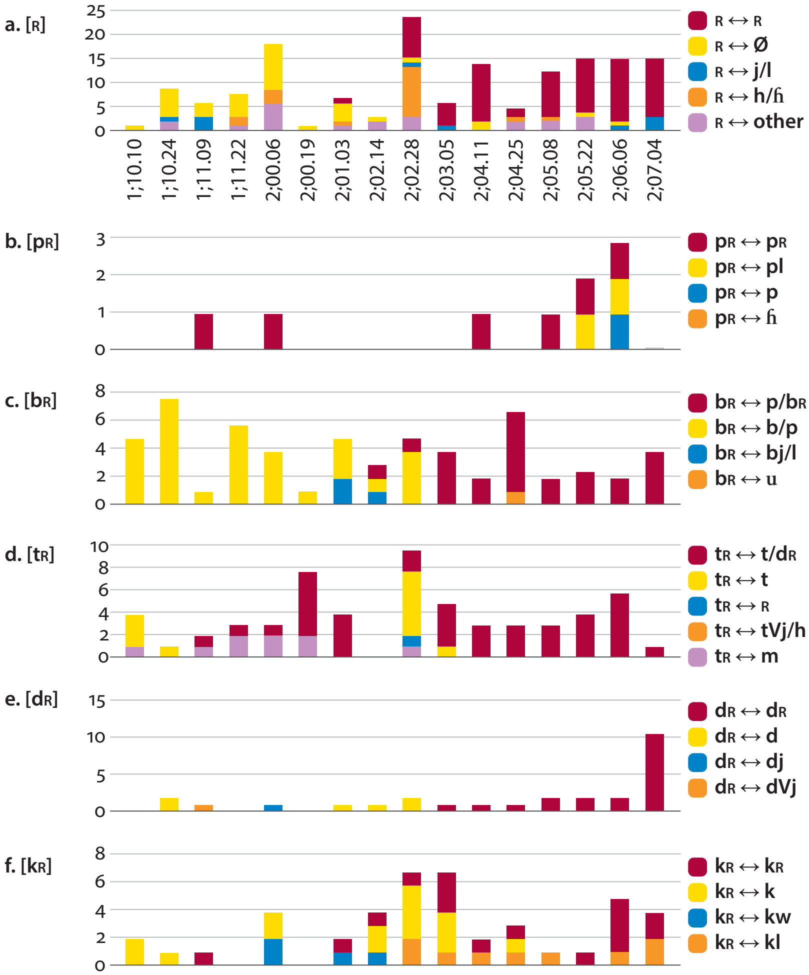
(9) Development of [l] in singleton onsets and onset clusters[9]



Similar transitions can be observed in the data on [ʀ] and stop+[ʀ] clusters in (10). As we can see in (10a), [ʀ] began to emerge in earnest at 2;02.28, and was mastered during the following session, at 2;03.25. Remarkably, and in spite of a few gaps in the data, both the emergence of the category in stop+[ʀ] clusters and its mastery can be observed at the same ages in the data in (10 b–e).

9. Here and below, the y-axis provides the number of attempts at the target consonant/cluster.

(10) Development of [ʀ] in singleton onsets and onset clusters



Only [kʀ] clusters, in (10f), fail to display the overall parallel between the development of [ʀ] in singleton onsets and that of branching onsets containing this consonant. However, as was the case for the development of [d] in singleton onsets above, motivation for this apparent counter-example is readily available. Recall that the target [ʀ] of Catootje is articulated in the uvular area of the vocal tract, near the same point of articulation of the velar [k]. The combination of these two consonants within an onset sequence thus involves extremely subtle articulatory transitions and related acoustic cues. I argue that these phonetic factors likely contributed to the child's slower development of this phonological context. However, in the absence of perceptual data, it is difficult to state which of these acoustic or articulatory factors, or a combination of both, ultimately yielded the outcome observed in the data.

Finally, coming back to the general observations in (7), in spite of all the regularities observed above, however, we did not find any parallel between the acquisition of [j] in singleton onsets and that of C[j] clusters. While this observation could be taken as contradicting the general view developed above in the context of liquids and C+liquid clusters, hastily jumping to this conclusion would obscure another key observation, the fact that all of the child's stop+approximant onset clusters (i.e. with [l], [ʀ], and [j]) were in fact acquired within a single, five-week time window. In the spirit of the original analysis by Fikkert (1994), this observation can be captured within representational models that afford the necessary level of detail, here the onset constituent as the relevant domain of analysis.

3. Discussion

In sum, Catootje's developmental patterns reveal systematic patterns both segmentally and prosodically (within syllable onsets), as well as interrelations between these two areas of phonological development. Such are the hallmarks of adult phonological systems, as described by models of phonological theory that embrace segmental features and prosodic constituency as relevant units of representation. While the variable nature of Catootje's early productions can be described within holistic approaches to phonology, the systematicity observed around her mastery stages as well as in contexts where independent factors hinder acquisition, poses just as many challenges for these models.

If taken from the perspective of frequency-based approaches to phonology and phonological development, the analysis above also raises questions about the types of units for which frequency information, if it is to be taken as a driving force in phonological development, may actually be compiled by the learner. For example, while individual onset clusters display a unique rate of occurrence in the signal, these clusters can also arguably be grouped within a more general category, formally the branching onset constituent which, if it is psychologically relevant, must be incorporated in statistical models. In sum, unless one adopts a completely structure-free model of representation and compiles statistics from raw phonetic forms only (e.g. Bybee 2001 for an exposition of this viewpoint), the integration of statistics with models of representation does raise a significant number of formal and empirical questions (e.g. Booij 2004; Rose 2009; see also Lieven 2010 and Ambridge & Lieven 2011 for similar considerations for other areas of grammatical organization).

In light of the general transitions we observed between relatively random patterns of liquid consonant productions, their categorical mastery, and related patterns in the child's productions of branching onsets, the overall picture appears to evolve from an initially impoverished system likely to produce the types of patterns summarized in (2) to a more systematic, category-rich system through which the child encodes learned generalizations about both segmental and prosodic properties of the target language. This transition in the child's phonological behaviours supports holistic and finer-grained models of phonological representation as relevant to two different phases of phonological development. While the earlier phase can be characterized as relatively idiosyncratic behaviours, the subsequent phase offers evidence for the levels of abstraction that learners may attain, as they come to organize their phonological knowledge into phonological categories. Again, this raises central questions as to whether, or how, word templates and finer-grained phonological abstractions may co-exist within a unified framework.

Acknowledgements

I would like to thank several attendees at the conference Variation in First and Second Language Acquisition: Comparative Perspectives, held in Paris in June 2011, for their useful comments and questions. In particular, I am grateful to Elena Lieven, Brian MacWhinney, Aliyah Morgenstern, Christophe dos Santos, Dan Slobin, Marilyn Vihman, and Sophie Wauquier-Gravelines for their constructive input and criticisms. I also would like to thank Laetitia Almeida, Paula Fikkert, Maria João Freitas as well as two anonymous reviewers for their feedback on earlier formulations of the argument presented in this chapter. All errors or omissions are my own.

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CHAPTER 3

Bootstrapping lexical and syntactic acquisition

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How does language acquisition start? Having access to words and their meaning should help infants to learn about syntax, but learning about word meaning would be facilitated if infants had access to syntactic structure (Gleitman 1990). Phrasal prosody and function words may bootstrap lexical and syntactic acquisition. Infants have access to phonological phrases, and they use these to constrain the syntactic analysis of utterances by 18 months. At that same age, they can use function words to infer the syntactic category of unknown content words (nouns vs. verbs) and guess their plausible meaning (object vs. action). Moreover, computational work suggests that infants might be able to learn noun and verb contexts by generalizing from a small number of known words (the semantic seed).

Keywords: first language acquisition, word meanings, phrasal prosody, syntactic bootstrapping.

1. Introduction

Children learning their native language have to discover the sound structure of their language, its vocabulary, and the syntactic regularities governing the organization of words within sentences. Even though it is tempting to assume that children start by learning sounds, then move on to words, and end up with syntax – following

DOI 10.1075/tilar.22.04bru

what infants typically produce: first babbling, then isolated words, and finally full sentences – in many cases synergies between domains of acquisition would greatly facilitate learning. For instance, since syntax spells out the relationship between the words in sentences, it makes sense to assume that infants need to have access to words and their meanings in order to learn about syntax. Conversely, learning about the meaning of words would be greatly facilitated if infants had access to the syntactic structure of the sentences in which these words occur (Gleitman 1990). These potential circularities can partially be solved if infants can learn some aspects of the structure of their language through a low-level, purely phonological analysis of the speech input they are exposed to (the phonological bootstrapping hypothesis; e.g., Morgan & Demuth 1996), and if acquisition operates simultaneously at different levels of linguistic analysis (e.g., Johnson 2013). In this chapter we focus on the synergies between lexical and syntactic acquisition. In particular, we examine the role of two sources of information that have been shown to be accessible to young infants: phrasal prosody and function words.

Phrasal prosody, the rhythm and the melody of utterances, is spontaneously produced by speakers and exploited by infants soon after birth (Mehler et al. 1988). The *prosodic bootstrapping* hypothesis postulates that infants may use the prosodic characteristics of sentences to extract critical information about their native language, such as its syntax (Christophe, Nespor, Guasti & van Ooyen 2003; Morgan 1986). We focus here on intermediate prosodic units, called phonological phrases (following the terminology of Nespor & Vogel 1986). The nature of these units depends on the syntactic structure of sentences and they usually contain one or two content words along with the function words associated with them (Nespor & Vogel 1986). Phonological phrases are typically marked by final lengthening and strengthening of the initial phoneme. They tend to have a single intonation contour with a possible discontinuity of the F0 (fundamental frequency) contour at the boundary between two prosodic units (cf. Shattuck-Hufnagel & Turk 1996, for a detailed review). Phonological phrase boundaries are detected from 9 months of age (e.g., Gerken, Jusczyk & Mandel 1994) and used to constrain lexical access by 10 months of age (Gout, Christophe & Morgan 2004; Millotte et al. 2010).

Function words and morphemes are grammatical elements such as articles, pronouns, auxiliaries, and inflectional affixes (such as conjugation endings). Children may discover them in the speech signal relatively early because they are extremely frequent syllables generally appearing at the boundaries of prosodic units (Shi, Morgan & Allopenna 1998), a position that seems to be specifically salient for the cognitive system (Ferry et al. 2016; Johnson, Seidl & Tyler 2014; Shukla, Nespor & Mehler 2007). A wealth of recent experimental work shows not only that infants younger than one year of age notice when the function words of their native language are replaced by nonsense syllables (e.g., Hallé, Durand & de

Boysson-Bardies 2008; Shi 2014, for a review; Shi, Cutler, Werker & Cruickshank 2006; Shi & Gauthier 2005), but also that from 14 months on, they expect nouns to be preceded by determiners rather than other types of function words, and by 18 months they expect verbs to be preceded by personal pronouns (e.g., Cauvet et al. 2014; Höhle, Weissenborn, Kiefer, Schulz & Schmitz 2004; Kedar, Casasola & Lust 2006; Shi & Melançon 2010).

Taking together these two sources of information, phrasal prosody and function words, may allow children to build an approximate syntactic structure of sentences, a *syntactic skeleton* (Christophe, Millotte, Bernal & Lidz 2008). More specifically, upon hearing a sentence such as *the little dog is eatin*g, the child may extract an initial syntactic representation of the kind [the XXX]$_{NP}$ [is Xing]$_{VP}$, where phrasal prosody delimitates units, and function words and morphemes supply the syntactic labels of each constituent (nouns are typically preceded by articles, verbs by pronouns or auxiliaries). This initial syntactic representation, or *syntactic skeleton*, may be available to infants even without having access to the content words making up the sentence (in our example these words are represented simply as syllables in the form of Xs).

In this chapter, we will present recent experimental and modeling results showing that infants exploit phrasal prosody and function words together to constrain syntactic analysis and to either speed up lexical access to known words, or to guess the probable meaning of unknown words, from their syntactic category.

2. Phrasal prosody constrains on-line syntactic analysis

One central ingredient of the syntactic skeleton model is phrasal prosody. Since prosodic phrase boundaries tend to coincide with the boundaries between syntactic constituents, it has been proposed that it could be used by listeners to recover the syntactic structures of sentences (e.g., Kjelgaard & Speer 1999; Millotte, René, Wales & Christophe 2008; Millotte, Wales & Christophe 2007; Snedeker & Yuan 2008). One should note that there is no one-to-one correspondence between prosodic and syntactic constituents,[1] however, whenever a prosodic boundary is

1. Note that the relationship between prosodic structure and syntactic structure is not one-to-one: many syntactic boundaries are not marked prosodically (for instance, in the sentence [he's eating] [his birthday cake], the boundary between the pronoun subject *he* and the verb phrase is not marked prosodically); and prosodic constituents do not coincide with syntactic constituents (for instance, in [the little boy] [is eating] [his birthday cake], the middle prosodic unit *is eating* does not correspond to any of the syntactic constituents of the sentence, since it is a fragment of the Verb Phrase; however, the boundary between *eating* and *his* corresponds to the left boundary of the object Noun Phrase, and does therefore correspond to a syntactic boundary).

perceived, the listener can assume that there is a syntactic boundary at that point in time – although the reverse is not true, and the absence of a prosodic boundary does not imply the absence of a syntactic boundary. To test this hypothesis with young children, we used pairs of homophones in French (e.g., *ferme*) belonging to different syntactic categories (noun and verb), to create locally ambiguous sentences (e.g., a noun sentence: *[la petite* ***ferme****][lui plaît beaucoup] / [The little* ***farm****] [pleases him a lot]"* vs. a verb sentence: *[la petite] [****ferme*** *le coffre à jouets] / [the little girl][****closes*** *the toy box]*, brackets indicate phonological phrase boundaries). Although both sentences start with the same three words (i.e., *la petite ferme*), they are distinguished by the place where the prosodic boundary falls, either directly preceding the critical word *ferme* when it is a verb or, directly following it when it is a noun.

The end of test sentences (that is, all the words following the homophone) was masked, so that phrasal prosody was the only cue listeners could rely on to figure out whether *ferme* was a noun or a verb. Preschoolers were presented with these sentence beginnings either in a free completion task (4.5-year-olds) in which they had to imagine an ending to the sentences they heard, or in a preferential looking task (3.5- and 4.5-year-olds) in which they were presented with two pictures illustrating the two possible meanings of the ambiguous word (e.g., a picture of a **farm**, and a picture of a little girl **closing** something). In both tasks, preschoolers adequately exploited prosody to recover the sentence meaning, giving more noun completions to noun sentences and more verb completions to verb sentences, as well as looking more at the noun image when listening to noun sentences and more at the verb image when listening to verb sentences (de Carvalho, Dautriche & Christophe 2016). In order to test even younger infants, we further simplified the experimental design, by using verbs which could be used without objects, such as [regarde le bébé souris!] 'Look at the baby mouse!' vs. [regarde], [le bébé] [sourit] 'Look, the baby smiles!'. In this second experiment, both 28-month-olds and 20-month-olds looked more towards the correct picture. Figure 1 shows the proportion of looks towards the noun image for the group of 20-month-olds.

When listening to a noun sentence, toddlers looked more towards the noun image, whereas they looked more towards the verb image when listening to a verb sentence. On the one hand, this experiment shows that toddlers are able to exploit phrasal prosody to disambiguate known noun/verb homophones, showing that they had access to the syntactic structure of the sentences. On the other hand, toddlers' ability to handle noun/verb homophones suggests that these do not pose particular problems for acquisition (see also Dautriche, Fibla & Christophe 2015; Veneziano & Parisse 2011; Veneziano & Parisse this volume), contrary to what had been suggested (Conwell & Morgan 2012).

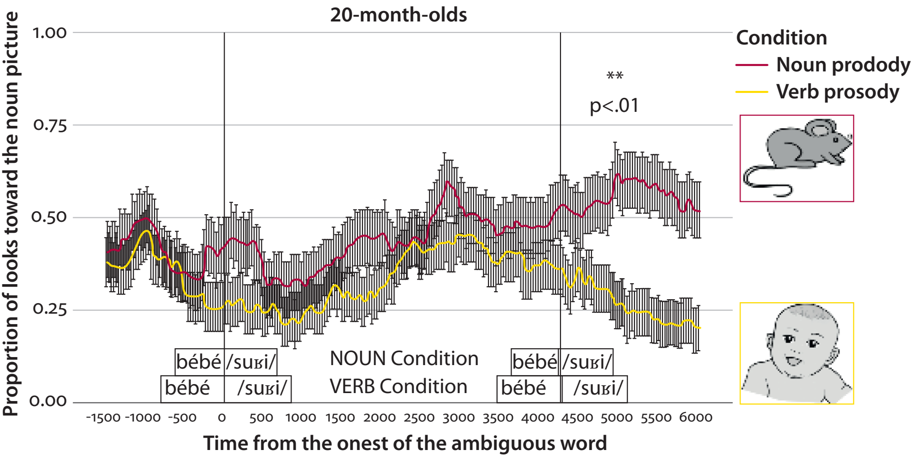

Figure 1. Proportion of looks to the noun image, in a preferential looking experiment in which 20- and 28-month-olds listened to ambiguous sentences. Children looked more towards the noun image when hearing a noun sentence (red curve), and more towards the verb image when hearing a verb sentence (yellow curve) (figure adapted from de Carvalho, Dautriche, Lin & Christophe, accepted)

3. Function words signal the syntactic category of the following content words

Once prosodic boundaries have been used to delimitate syntactic boundaries, children have to label the resulting units. To do so, they may use function words. Many studies have shown that children recognize function words very early on (e.g., Shi et al. 2014, for a review). Thus, because articles reliably appear before nouns (e.g., *the den*) and pronouns and auxiliaries before verbs (e.g., *they dax*$_V$), children might have learned which function words predict content word categories. Several studies support this hypothesis, showing for example that 14-months-olds are able to associate articles with nouns, or that infants look faster towards a known object if its label is appropriately preceded by an article (e.g., *Where's the* ***book***? compared to *Where's po* ***book***?) (Höhle et al. 2004; Shi & Melançon 2010; Van Heugten & Johnson 2011; Zangl & Fernald 2007). However, none of these studies showed the same ability when it comes to associate verbs with their syntactic contexts (see Höhle et al. 2004; Shi & Melançon 2010). Infants may find it harder to link verbs with their syntactic contexts for two main reasons: first, the syntactic contexts of verbs are more diverse that those of nouns, which occur mostly in the vicinity of articles and adjectives (Brusini, Amsili, Chemla & Christophe 2011; Veneziano &

Sinclair 2000); and second, verbs typically represent actions, which are conceptually more complex than objects.

To test whether infants may also be able to associate pronouns with verbs, we trained 18-month-old French infants to turn their head for a known word, either a noun (e.g., *une* ***balle*** 'a **ball**'), or a verb (e.g., *il* ***mange*** 'he **eats**'). In a second session, infants were tested on short sentences belonging to three experimental conditions: in *grammatical* sentences, the target word appeared in an appropriate context (e.g., *la* ***balle*** *est rouge et verte* 'the **ball** is red and green' for the noun target, or *je* ***mange*** *une petite pomme* 'I **eat** a small apple', for the verb target); in *ungrammatical* sentences, we exchanged noun and verb targets, so that they now occupied an incorrect position (e.g., *je* ***balle*** *une petite pomme* 'I **ball** a small apple' vs. *la* ***mange*** *est rouge et verte* 'the **eat** is red and green'); last, in distractor sentences, the target word did not appear at all (e.g., *la* ***fraise*** *est très bonne* 'the **strawberry** is really good' vs. *Tu* ***donnes*** *des cadeaux à ton frère* 'you **give** presents to your brother').

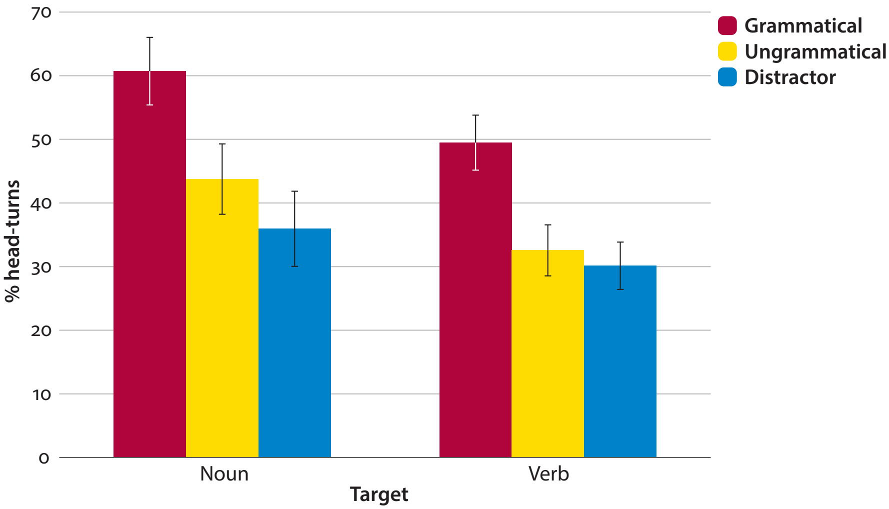

Figure 2. Results of a word-detection experiment with 18-month-old French infants trained to turn their head for either a noun (left-hand bars) or a verb (right-hand bars). In both cases, infants responded significantly more often when the target appeared in a syntactically appropriate context (grammatical sentences), than when it appeared in a syntactically inappropriate context (ungrammatical sentences) or did not appear at all (distractor sentences, figure adapted from Cauvet et al. 2014)

The results showed that 18-month-olds responded significantly more often when the target appeared in a syntactically appropriate context than when it appeared in an inappropriate position. In fact, there was no significant difference in infants' responses to sentences that contained the target in an inappropriate position, and to sentences that did not contain the target at all, suggesting that in the ungrammatical condition, children considered the target as an entirely new word, e.g., the verb *baller* 'to ball', or the noun *la mange* 'the eat', having nothing to do with the target word they were trying to identify. Here, 18-month-old French infants are shown to know (some of) the contexts in which nouns and verbs occur. They expect known nouns and verbs to occur in appropriate contexts relative to their syntactic category, and behave as if they considered items that occur in incorrect contexts to be different words.

However, simply looking at function words immediately preceding content words to label them is a strategy that could lead to errors, because some of these function words are ambiguous. For instance, the French function word *la* can either be a definite article and precede nouns, or be an object pronoun and precede verbs. Thus, if toddlers unilaterally associated function words with content word categories they might wrongly attempt to categorize the verb *mange* 'eat' as a noun in a sentence such as *Marie la mange*$_V$ *avec plaisir* 'Marie eats it with pleasure'. In another experiment, we used evoked potentials to study how young children handle these structures, and observed that French 18- and 24-month-olds exhibited differential brain responses to nouns and verbs that appeared either in appropriate or inappropriate contexts, but were always preceded by the ambiguous function word *la* 'the/it' (Bernal, Dehaene-Lambertz, Millotte & Christophe 2010; Brusini, Dehaene-Lambertz, Dutat, Goffinet & Christophe 2016; Brusini et al. 2016). For instance, the verb *mange* 'eat' appeared in a correct context in *je la mange* 'I eat it', but in an incorrect context in *je prends la mange* 'I take the eat', while the noun *poire* 'pear' appeared in a correct context in *je prends la poire* 'I take the pear' but in an incorrect context in *je la poire* 'I pear it'. Even though this ambiguous function word *la* (meaning 'the' or 'it' depending on its syntactic context) should make things harder for children, both 18- and 24-month-olds distinguished between correct and incorrect contexts on-line. This suggests that they already process complex contexts, integrating several preceding words, and that they differentiate articles and object pronouns, much before they start producing object pronouns (correct production starts between 2.5 and 3 years of age, see Jakubowicz, Nash, Rigaut & Gérard 1998).

In these experiments, however, toddlers might have relied on the fact that ungrammatical strings had never been heard before. For instance, **I pear it* is an ungrammatical sentence and therefore has a frequency of zero (or close to zero), whereas *I eat it* has probably been heard many times before. The only way to avoid this frequency confound is to use words that have just been taught to toddlers, and for which we can fully control the input. In a follow-up experiment, 2-year-olds were taught 4 novel words during an interactive play session (Brusini et al. 2016). These words were presented in many adequate contexts but never in the context used in the test sentences. For instance the noun *rane* meaning 'vulture' was inserted in noun contexts such as *un rane* 'a vulture', *ce rane* 'this vulture' or *notre rane* 'our vulture' but never *le rane* 'the vulture'. One week later, toddlers' EEG were recorded while they listened to grammatical and ungrammatical sentences built on the same pattern as the previous experiment with known words.

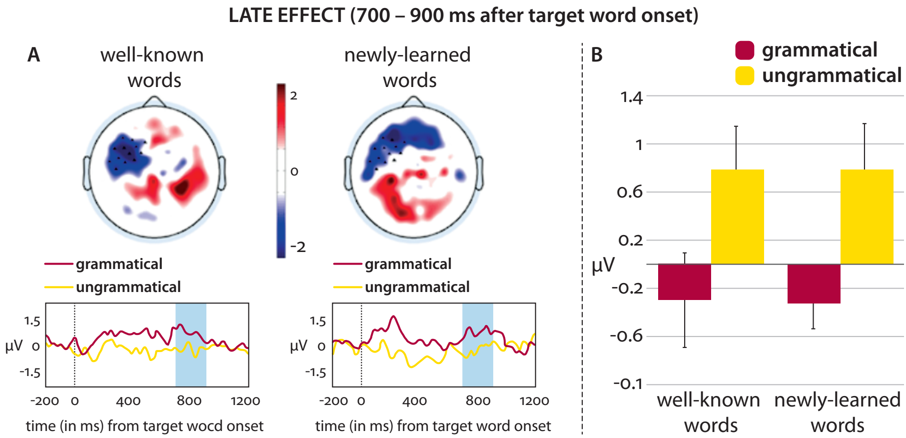

Figure 3. Results for the EEG experiments with newly-learnt words (left), and well-known words (right). A. Maps of statistical significance (Z-score) of the difference Ungrammatical – Grammatical, averaged between 700–900ms, and time-course of the activation for the selected cluster of electrodes (selected time-window in blue). B. Mean voltage over the selected time-window and electrodes, split by Grammaticality and Familiarity (for the color figure, see Brusini et al. 2016)

Ungrammatical and grammatical sentences elicited different potentials, even though toddlers had never heard the strings of words presented in any of the test sentences. In this case, participants could not have reacted to the greater frequency of grammatical sentences relative to ungrammatical sentences, since they had heard none of them before. Therefore, they must have relied on their knowledge of the contexts in which nouns and verbs may occur.

In an attempt to figure out how young infants might have learned in which contexts nouns and verbs occur, we implemented a model that keeps track of the frequency of triplets of adjacent words (Brusini, Amsili et al. 2011; Brusini, Amsili, Chemla & Christophe 2014). The model started out knowing a few nouns and verbs, a highly plausible hypothesis given that 6- and 9-month-olds already know the meaning of some nouns and some verbs (as tested in a comprehension task, see Bergelson & Swingley 2012; Bergelson & Swingley 2013). Additionally, it has been proposed that infants are able to group concepts semantically, and form categories such as agents, artefacts, or actions (Carey 2009; Saxe & Carey 2006). Thus, if infants group together words referring to objects, and words referring to actions, they may have already built the roots of the basic categories noun and verb. Thus, in the model, a handful of nouns and verbs are assumed to be known and categorized. All other items were not categorized *a priori*. During training, the model simply gathered trigram frequencies of words. At test, it attempted to predict the category of a word by looking at the two words immediately preceding it (its left context): if these two words were part of trigrams encountered during training, the model picked as answer the most frequent item occurring after these two words. For noun and verb categorization, the model achieved excellent precision (between 75% and 85%) that did not depend on the size of the vocabulary initially known (varied parametrically between 2 verbs / 6 nouns to 48 verbs / 96 nouns). In contrast, the recall (the capacity of the model to find all the nouns and verbs), started rather low and improved with the size of the initial vocabulary, suggesting that when more words are known initially, more noun and verb contexts can be learned. Moreover, additional analyses showed that even though function words were not specifically coded by the model, they played a crucial role in the categorization (simply because they were so frequent). These results support the hypothesis that infants may be able to initially group words together on the basis of their immediate contexts (see also Chemla, Mintz, Bernal & Christophe 2009; Mintz 2003).

Once infants know in which syntactic contexts nouns and verbs are supposed to occur, they may exploit this knowledge to assign a syntactic category to a newly-encountered word, then use this information to constrain its meaning. Toddlers of 2 years of age interpret a novel word inserted in a nominal syntactic context as referring to an object, and a novel word presented in a verbal syntactic context as referring to an action (Bernal, Lidz, Millotte & Christophe 2007; Waxman, Lidz, Braun & Lavin 2009): e.g., *dax* is likely to refer to an object in *the dax* but to an action in *they dax*. Overall, the results discussed in this section strongly suggest that infants as young as 18-months-old could make the same kind of inference when learning novel words.

4. Building a *syntactic skeleton* with phrasal prosody and function words

We have seen thus far that young children have access to phrasal prosody and function words. We hypothesized that they might exploit these pieces of information simultaneously in order to compute a first-pass syntactic analysis of sentences. To do so, infants need to identify prosodic units and use function words to determine the syntactic category of these constituents, which would then serve as a proxy for syntactic analysis. We tested this last step of the syntactic skeleton hypothesis in three different ways: first, we built a model that attempts to label prosodic phrases (from the information available in the input), second, we simulated 18-month-old toddlers by depriving adults from access to content words (presenting them with jabberwocky sentences), and third, we directly investigated 18-month-old toddlers' ability to infer something about the meaning of a word from its syntactic context.

To estimate whether it is possible to learn to categorize prosodic phrases, we built a Naïve Bayes model that took as input a corpus of child-directed speech, in which prosodic boundaries were marked (the corpus was parsed syntactically, then the prosodic structure was derived from the syntactic structure by relying on the definitions provided by Nespor & Vogel 1986). Just like the word-categorization model presented above (Brusini, Amsili et al. 2011; Brusini et al. 2014), this model assumes that a handful of nouns and verbs are known by the infant and constitute a seed for creating prototypical noun and verb grammatical categories (Gutman, Dautriche, Crabbé & Christophe 2015). It initially assigns a label to the few prosodic units that contain one of these known words (Noun Phrase, Verb Nucleus),[2] then attributes probabilistically a label to all the prosodic phrases of the corpus (Noun Phrase, Verb Nucleus, and Unknown) based on some observed features for each prosodic unit: its two first words, and its last word (edge words are especially salient, e.g., Johnson et al. 2014). Results show excellent precision for this model (between 75 and 85%), that does not depend on the size of the vocabulary initially known, i.e., the semantic seed. In addition, although the initial categories are based on a few known words, the learning process relies ultimately on function words. These results show that it is possible to categorize prosodic units with very little initial knowledge: If children can segment the speech stream into prosodic phrases, they can learn to categorize them simply by paying attention to edge-words (first and last words of a phrase) and knowing the labels of a few objects and actions (two highly plausible assumptions).

To test the syntactic skeleton hypothesis at the cognitive level, we presented French adults with spoken 'jabberwocky' sentences in which we replaced all the French content words by non-words, while preserving the elements of the syntactic skeleton, namely phrasal prosody and function words. With these stimuli, adults are placed in the situation of infants who already know the phrasal prosody and function words of their language, but not yet all the content words. In this situation, would they be able to recover the syntactic category of words on-line? Adults had to perform a word detection task in which target words were specified with their syntactic category. Several experimental conditions were tested, which varied in

2. As we mentioned above, prosodic constituents do not correspond to syntactic constituent in a one-to-one fashion. Thus, it may happen that a Verb Phrase is separated in two prosodic constituents, as in '[the little boy] [is eating] [his birthday cake]': in such a case the first and last prosodic units would be labelled as Noun Phrases, appropriately, and the middle one would be labelled as *Verb Nucleus* rather than 'Verb phrase' because it is only a fragment of the Verb Phrase (which contains the last two prosodic units). The concept of *Verb Nucleus*, which groups the verb and its neighbouring words (auxiliaries, adverbs) corresponds much better to the phonological phrase that contains the verb.

the difficulty to find the target words. In the 'Adjacent function word' condition, the target words were immediately preceded by an unambiguous function word, which should make word detection relatively easy (nouns were preceded by articles, e.g., *un pirdale* 'a pirdale', and verbs by pronouns, e.g., *elle pirdale* 'she pirdales'). The second condition ('Function word and prosody'), was expected to be harder, since adults had to use prosody and function words together to categorize the target words, which were always preceded by another content word (e.g., [Un gouminet$_{\mathrm{N}}$]$_{\mathrm{NP}}$ [**pirdale**$_{\mathrm{V}}$ …], vs. [Un gouminet$_{\mathrm{Adj}}$ **pirdale**$_{\mathrm{N}}$]$_{\mathrm{NP}}$ … ; for instance, adults had to detect either a verb, e.g., *pirdaler* 'to pirdale', or a noun, e.g., *le pirdale* 'the pirdale'). If the target was a verb, participants had to respond if the test sentence contained that verb, but refrain from responding if it contained a noun homophonous to that verb (and vice versa for the detection of target nouns).

As Figure 4 shows, participants were perfectly able to use the presence of an unambiguous function word to infer the syntactic category of the following non-word: a non-word preceded by an article was correctly interpreted as a noun 93% of the time, whereas it was interpreted as a verb 88% of the time when preceded by a pronoun. In addition, they were able to integrate phrasal prosody and function words to conclude that a target word was a verb, with random answers when it was a noun ('Function word and prosody' condition). More fine-grained analyses revealed that adults initially interpreted the word immediately following the article as a noun, and the next word as a verb, and then revised their interpretation to article+adjective+noun when they heard a prosodic boundary just after the target item.

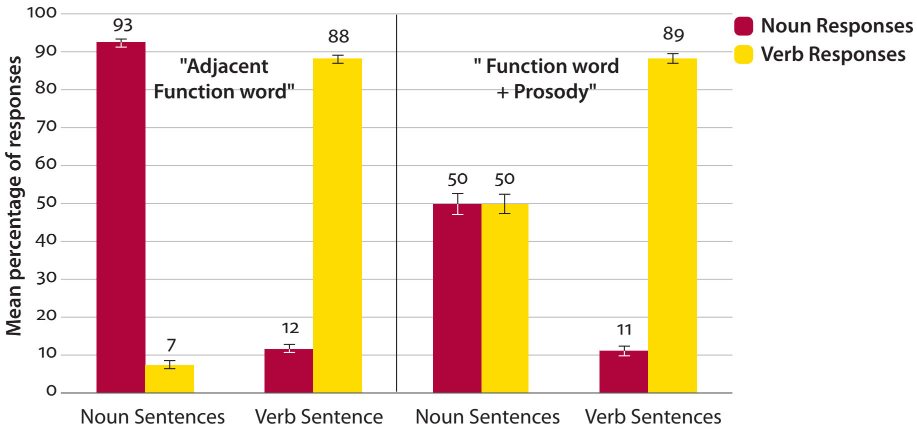

Figure 4. Results of an abstract word-detection task with jabberwocky sentences: subjects correctly identified the syntactic category of an unknown content word immediately preceded by a function word (left-hand bars). When the target word was preceded by another content non-word, subjects performed better than chance overall (figure adapted from Millotte, Wales, Dupoux & Christophe 2006)

This result proves that function words and phonological phrase boundaries allowed listeners to construct a skeleton of the syntactic structure of sentences, even when they did not know the meaning of the content words. Listeners were able to correctly interpret sentences without any lexical information, such as [*Un gouminet*] [***pirdale***…], using phonological phrase boundaries to determine syntactic constituent boundaries and function words to infer the category of the first constituent.

In a third study, we directly tested the ability of 18-month-old toddlers to infer the probable meaning of a word from its position within the syntactic structure of a sentence. This experiment used a habituation paradigm: toddlers were first shown a video of a penguin spinning, while listening to a novel verb, e.g., *look, it's pratching!*, then a video of a penguin cartwheeling, while listening to a novel noun, e.g., *look, it's a doke!* (He & Lidz 2014). Adults placed in such a situation would infer that *to pratch* means 'cartwheeling', while *a doke* refers to 'a penguin'. To test whether toddlers made the same inference, He and Lidz (2014) exchanged the sound tracks of the two videos, in the test phase (after a habituation criterion had been reached on the first two videos, with their original sound tracks). They observed that toddlers recovered their interest in the video in the 'verb-switch' condition in which the verb was presented with the other video (*look, it's pratching!*, while watching the cartwheeling video), but not in the 'noun-switch' condition in which the noun was presented with the other video (e.g., *look, it's a doke!*, while watching the penguin spinning): this makes sense if toddlers, like adults, interpreted the noun 'doke' to mean 'penguin', since there is a penguin in both videos, therefore the change is not surprising. In contrast, if they assigned the verb to the action in the first video, then they should be surprised to hear the same verb now paired with a different action, and this is precisely what the results showed.

We exploited this same experimental design to test the joint use of phrasal prosody and function word. In a first group of infants, we replicated the He & Lidz (2014) experiment with French sentences (e.g., *regarde la bamoule!* 'look at the bamoule' vs. *regarde, elle doripe!* 'Look, she's doriping'), and observed the same results. In a second group of infants, we created sentences in which phrasal prosody had to be taken into account to compute the syntactic category of the unknown word: [*Regarde la petite bamoule!*] 'Look at the little bamoule!' for the noun sentence, and [*Regarde*,] [*la petite*] [*doripe*] 'Look, the little one is doriping!', for the verb sentence (with the intonation of [*Regarde*], [*la petite*] [*dessine*]! 'Look, the little one is drawing!'). In these sentences, the string of words is the same (*regarde-la-petite-bamoule/doripe*), but the prosodic structure allows listeners to recover the syntactic structure of the sentence, just as in the experiments presented in the first section with the noun/verb homophones (*Regarde le bébé souris/t!* 'Look at the baby mouse!' vs. 'Look, the baby smiles!'). The results of this experiment are presented in Figure 5.

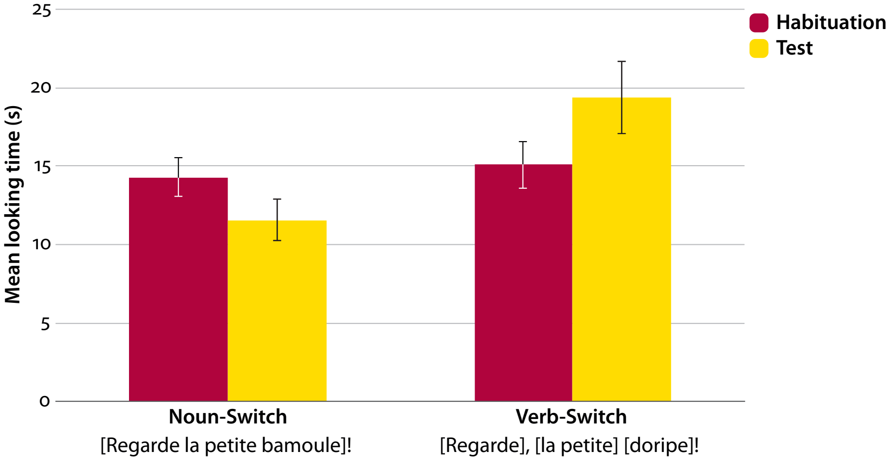

Figure 5. Mean looking times for the 2 test trials (yellow bars), and the last 2 habituation trials (red bars): toddlers recover their interest for the 'verb-switch' condition, but not for the 'noun-switch' condition (figure adapted from de Carvalho, He, Lidz & Christophe 2015)

These results replicate exactly those found when a disambiguating function word immediately preceded the novel word. Toddlers recovered their interest only in the 'verb-switch' condition, when the verb was presented with the video of the penguin doing the other action, consistent with the interpretation that they had assumed that the verb referred to the action in the video. In contrast, in the 'noun-switch' condition, they did not dishabituate, which is to be expected if they had assumed that the noun referred to the penguin, since the penguin was present in both videos.

Overall, these data show that the syntactic skeleton can be computed even without knowing the content words of a sentence, and that 18-month-old toddlers are already able to jointly exploit the information provided by phrasal prosody and function words in order to assign a syntactic category to an unknown content word.

5. Conclusions and perspectives

To sum up the data presented in this chapter, we suggest that children might be able to construct a first-pass syntactic structure of the sentences they hear by relying on two sources of information available early on: phrasal prosody and function words. We showed that toddlers exploit the presence of phonological phrase boundaries to constrain their on-line syntactic analysis of sentences (de Carvalho, Dautriche & Christophe 2014; de Carvalho et al. 2016, 2017), and that they compute on-line expectations as to the syntactic category of upcoming content words, by relying on function words (Cauvet et al. 2014; Höhle et al. 2004; Shi & Melançon 2010), even when these function words are ambiguous (Bernal et al. 2010; Brusini, Dehaene-Lambertz & Christophe 2011; Brusini et al. 2016). This ability allows them to infer the syntactic category of novel words and deduce their probable meaning by the age of 18 months (Bernal et al. 2007; de Carvalho et al. 2015; He & Lidz 2014; Waxman et al. 2009). As to the mechanisms through which toddlers may have managed to learn which function words go with which word categories, or more generally what syntactic contexts signal nouns and verbs, modeling work suggests that they might succeed by relying on a very small number of known object and action labels, a *semantic seed* (Brusini, Amsili et al. 2011; Brusini et al. 2014; Gutman et al. 2015).

One may wonder how universal such a process would be, given that most of the data presented here was obtained on either French or English. Since phrasal prosody is found in all the world's languages (e.g., Shattuck-Hufnagel & Turk 1996, for a review), and since the links between syntactic structure and prosodic structure are described in a universal way (Nespor & Vogel 1986; Selkirk 1984), we would expect learners of all languages to be able to rely on phrasal prosody to help recover the syntactic structure of sentences. In fact, recent studies suggest that infants can even use non-native phrasal prosody for the purposes of finding syntactic constituents, in an artificial language (Hawthorne & Gerken 2014; Hawthorne, Mazuka & Gerken 2015). Regarding function words, not all languages have free function words like French and English; for instance, agglutinative languages such as Turkish use mostly bound functional morphemes. Other languages, such as Mandarin Chinese, are sometimes said to lack function words entirely. However, a closer examination of these languages show that even though they may lack some categories of function words, they possess other categories of function words which may play a similar role For instance, although Mandarin Chinese does not use determiners, it does use noun classifiers, which will not only give children the information that a given word is a noun and probably refers to an object, but also more precise information as to the kind of object that is referred to. In fact, Shi, Morgan and Allopenna (1998) conducted a cross-linguistic study of the cues which may allow infants to discover functional morphemes in the speech signal, comparing English, Turkish and Mandarin Chinese (three extremely well-chosen languages, as shown by the discussion above), and found that function morphemes in all of these languages possessed similar properties that may allow young children to identify them: high frequency, position with respect to utterance and prosodic edges, and a tendency to be reduced, both phonologically and acoustically. As a result, we would expect a strategy relying on phrasal prosody and function words/morphemes to be efficient universally, across the world's languages, although of course direct experimental proof should be obtained.

Taken together, these results suggest that listeners (both adults and children) may construct a first-pass syntactic analysis of sentences by relying on prosodic boundaries, which generally coincide with syntactic boundaries, and function words which signal the syntactic category of neighboring words. This approximate syntactic structure may help infants to constrain the meaning of novel words.

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CHAPTER 4

Retrieving meaning from noun and verb grammatical contexts

Interindividual variation among 2- to 4-year-old French-speaking children

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Ninety French-speaking children aged 2 to 4 years were presented with short utterances containing homophonous or nonce words whose object or action meaning was identifiable on the sole basis of the preceding grammatical morpheme. Items in noun and verb contexts were presented to the same children in order to assess their ability to provide appropriate contrastive interpretations. Results show that, at all ages, items were correctly identified beyond chance, with 4-year-olds outperforming the 2- and 3-year-olds. Individually, however, only part of the children, even in the older group, performed beyond chance level, suggesting substantial interindividual variability and difficulties, still present at these ages, to tackle situations offering minimal information. A case study of the developmental relation between production and comprehension is also presented.

Keywords: first language acquisition, French, grammatical morphemes, noun-verb distinction, production and comprehension

1. Introduction

Nouns and verbs are considered as the two most basic word categories in language and are found in the linguistic description of every language (Pullum 1999). Lexical categories determine the way in which words are allowed to follow each other in a sentence, the contexts in which a word is allowed to appear, the transformations that words can or should undergo as well as the inferences that can be made about the

DOI 10.1075/tilar.22.05ven

meaning of words encountered for the first time (e.g., Gillette, Gleitman, Gleitman & Lederer 1999; Surugue 1984). Although there is no biunivocal relation between word category and meaning,[1] words that are nouns tend to refer to objects and entities, while words that are verbs tend to refer to actions or states. However, what best reveals a word's category is the morphosyntactic context in which it occurs (e.g., Clairis 1984; Lazard 1984; Maratsos & Chalkley 1980).

Languages vary as to how they distinguish nouns and verbs morphosyntactically. In French, the grammatical contexts in which words are embedded greatly contribute to their identification as Nouns or Verbs. Common Nouns are usually preceded by determiners while Verbs may be preceded by different grammatical elements such as a subject NP (a clitic pronoun or a nominal), may occur in VPs preceded by an auxiliary, a modal or a preposition, but may also occur "bare" in the imperative form.

When and how are children able to use morphosyntactic information of this kind in their language? This information is especially important for retrieving the meaning of words encountered for the first time, or in cases of homophony.

In production, young children utter words that are nouns and verbs in the language (Bassano 2000), but it is not until the second half of the second year that children start distinguishing these words using primitive morphosyntactic means such as *fillers* (e.g., Kilani-Schoch & Dressler 2000; Lléo 1997; Pepinsky, Demuth & Roark 2001; Taelman, Durieux & Gillis 2009; Veneziano & Sinclair 2000; Veneziano 2003), and different kinds of bound morphology on words that are verbs (*casse/cassé*) (e.g., Tomasello 1992; Veneziano & Parisse 2010), a competence that improves with age (e.g., Bassano, Eme & Champaud 2005).

However, production data may both underestimate and overestimate children's morphosyntactic knowledge. On the one hand, it may underestimate it because of performance factors, such as children's poor motor control over the phonological complexities of articulation (Smith 1988; Thelen 1991) and the slow development of articulatory fluidity and planning abilities. On the other hand, it may overestimate children's morphosyntactic knowledge because production relies on familiar and recurrent contexts, both situational and linguistic, and on cooperative interactional partners. Moreover, with production data alone, children may be credited with more syntactic knowledge than they actually have. It may be the case that nouns

1. This is only meant as a rough statement. In fact, in any language that has a clear Noun-Verb distinction, nouns can refer to actions (English and French do not seem to have semantic restrictions on what a noun can denote), and verbs do not always denote actions (e.g., for English and French, verbs such as *contain* or the static position verb *stand)*, although verbs have stronger restrictions, e.g., they do not denote objects or substances.

and verbs embedded in categorially-appropriate syntactic contexts (i.e., determiners before nouns and personal pronouns before verbs in French) may in fact be 'amalgams' or 'frozen forms' (e.g., Lieven, Pine & Baldwin 1997).

In reception, several studies have demonstrated the existence of children's sensitivity to prelexical markers (see Shi 2014, for a review). Perception studies have shown young infants' sensitivity to differences between function and non-function words (Shi, Werker & Morgan 1999). Children between 12 and 16 months can use function words (but not nonce segments or infrequent morphemes) to isolate the nonce item that follows the function word (Shi & Lepage 2008). They look longer at sequences containing real English functors than at sequences containing nonce functors (Shi, Werker & Cutler 2006), and they differentiate noun from verb contexts for pseudowords (Höhle, Weissenborn, Kiefer, Schulz & Schmitz 2004; Mintz 2006).

In studies requiring more active comprehension by the child, it was shown, for example, that children in their second year responded better to utterances containing function morphemes than to telegraphic utterances (Petretic & Tweney 1977; Shipley, Smith & Gleitman 1969) and to utterances containing grammatical instead of ungrammatical function words (Gerken & MacIntosh 1993). Katz, Baker and MacNamara (1974) showed that two-year-olds (boys and girls) and 18-month-olds (girls) have a tendency to consider nonce words presented with an indefinite article (e.g., *a dax*) as common nouns and nonce words presented without an article as proper names. More recently, Bernal, Lidz, Millotte and Christophe (2007) focused more specifically on children's comprehension of verb frames, where nonce words were preceded by a subject pronoun (e.g., *il /pun/ là* 'he/it /pun/ there'). Using a fairly complex experimental procedure, they showed that children chose more often the clip containing the object undergoing the specific movement to which the nonce word was associated during the training phase (e.g., a flower rotating), compared to the clip in which the same object underwent a different movement (e.g., a flower jumping). By contrast, a control group of children trained with noun frames for the same nonce words on the same visual stimuli – used to control that the choice of the verb frame group was not dictated by familiarization or holistic preferences – showed the opposite pattern of preferences.[2]

Studies such as those mentioned above indeed suggest that young children can pay attention to function words, distinguish nominal from verbal contexts, and infer respectively object or action meanings accordingly (see also Naigles 1990;

2. The hypothesis should have predicted an outcome showing no preference. It is possible that the result obtained could be explained by the greater interest of the clip showing the novel action. However, the important point here is the difference observed between the two groups.

Waxman, Lidz, Braun & Lavin 2009). However, even in studies that require active behavior from the children, it is not clear what children actually understand about the category-specific morphological functors present in the utterances (e.g., Tomasello & Abbot-Smith 2002). Moreover, studies do not always compare verb and noun frames directly in the same children, or do not always present the frames in minimally contrasted grammatical contexts. For example, in the Bernal et al. (2007) study, nonce words inserted in noun and verb frames occurred in various grammatical contexts. For noun frames, children heard not only *la x est là* 'the x is there', but also *tu vois ce que fait la x* 'you see what the x is doing', or *la x est encore là* 'the x is there again', and for verb frames, *elle x par là* 'she/it x-es there', as well as *tu vois comment elle x* 'you see how she/it x-es', or *elle x encore là* 'she/it x-es there again', where 'x' represents the same nonce word.

The present study aims at providing further and clearer information on children's ability to retrieve the object or action meanings of words on the sole basis of category-specific minimally contrasted grammatical morphemes, without the help of any other syntactic information. It presents several original features: (1) It uses homophones, words existing in spoken French, whose object or action meaning can be disambiguated only by the noun or verb grammatical functors that precede them. For example /pus/ can correspond to either the noun *pouce* 'thumb' or the verb *pousse* 'push', depending on whether it is preceded by the definite article /lə/, /lə pus/, in which case it is interpreted as 'the thumb',[3] or by a subject pronoun like /il/, and then it is interpreted as /il pus/ 'he pushes'; (2) The grammatical context differentiating the interpretation as noun or as verb was kept to its minimal expression – a definite article for nouns and a subject clitic pronoun for verbs; (3) Each child was presented with both noun and verb contexts (but not for the same lexical item so as to avoid testing simultaneously lexical categorial flexibility) in order to assess children's capacity to provide contrastive interpretations according to the grammatical context; (4) Children's choices required their active engagement, by pointing to the chosen interpretation; (5) Results were analyzed not only in terms of grouped data – as is most often done in studies of this kind – but also in terms of the performance individual children showed for the whole set of items.

Considering how each individual child performs on the whole set of items presented provides important information about the individual children's ability to

3. In French /lə/, /la/ and /le/ may be both definite articles, respectively, masc. sing (*le*), fem sing (*la*). and plural (*les*), or object clitics that occur before the verb. In the context of the experiment, however, the interpretation of /lə/ and /la/ as preposed object clitics would be unlikely and implausible given the structure presented, *le X* – e.g., *le lit* – where *le* as a preposed object clitic pronoun would imply an ungrammatical subjectless structure (*__*le lit* '__the bed').

attribute contrastive interpretations according to the differential grammatical contexts in which the words appear, and contributes valuable information about both individual and age group variation. Information about individual differences in studies of early speech/language perception or comprehension is seldom provided (but see Höhle et al. (2004) who reported that only 35% of the subjects performed in line with the results indicated by the group analyses). However, since individual differences are increasingly taken into account in studies that aim at predicting later developmental outcomes (e.g., Cristia et al. 2014; Martin, Ziv & Sommerville 2016), information about these differences is particularly needed for tasks such as those under study, for which group differences are most often the main, if not only, source of information; and, (6) the same paradigm was presented to 2- 3- and 4-year-old children to evaluate the developmental pattern of the abilities focused on here.

Finally, we considered the developmental relation between production and comprehension, as these two facets of children's language skills do not always coincide. To this effect, we present the results of a longitudinal study in which grammatical competence was assessed monthly with the same procedure as that used in the present cross-sectional study (for comprehension), while spontaneous interactional data was videorecorded and analyzed monthly (for production).

2. Method

Participants

Ninety children from monolingual, middle-class, French-speaking homes participated in the study: 47 girls, mean age 3;5 months (*SD* = 0;11), 43 boys, mean age 3;7 (*SD* = 0;11). There were 30 children in each of three age groups: 2-year-olds (mean age = 2;4 years, *SD* = 0;5), 3-year-olds (mean age = 3;7 years, *SD* = 0;3), and 4-year-olds (mean age = 4;7 years, *SD* = 0;3). The 2-year-olds were recruited in a daycare center; the 3- and 4-year-olds were recruited in a public preschool. Both schools were located in Paris. All the children were described as typically-developing by the professional caretakers or teachers in contact with them. All the parents signed a form authorizing the child to participate in the study.

Procedure

For the 2-year-old group, the experimenter visited the daycare center for three half days before starting the procedure, in order to familiarize the young children with the experimenter, and minimize the unwillingness of children to participate in the study.[4] All children were tested individually in a quiet room. The experimenter ensured that the child was comfortable by engaging him/her in a brief conversation, talking about nursery and/or home activities, and exchanging over a picture book.

With the 3- and 4-year-olds, no familiarization was necessary and the procedure started right away upon the arrival of the child in the testing room. During the experimental procedure, all children were seated in front of a computer screen presenting two pictures side by side (see Appendix 1). They were instructed to point to the picture corresponding to what the experimenter said.

The test items were preceded by four training items. The first two presented a single picture and were meant to ensure that children knew how to point to pictures on the screen. The next two items presented two pictures simultaneously – first two objects, and then an object and an action performed by a person – and were meant to ensure that children understood the instruction and could point to one of the two pictures depending on what they heard.

The testing phase began immediately after with the presentation of the 15 test items shown one after the other. For each item, children were asked: 'show me [short pause, signalled hereafter by the colon sign]: definite article/third person pronoun X', where X was either a homophonous or a nonce word that could function as either a noun or a verb, depending on whether it was preceded by the definite article or by the third person pronoun (see Table 1 for the list of items). For example, for the homophonous word /li/ the item presented to children was either *montre-moi: le lit* 'show me: the bed' or *montre-moi: elle lit* 'show me: she reads'. Each child was presented with only one of the two grammatical contexts per homophonous or nonce word. The noun and verb contexts for each of the homophonous or nonce words were evenly distributed among the children within each age group.

All the sessions were videorecorded. The pointing responses of the children were coded during the experiment and were double-checked later from the videorecordings.

4. This familiarization phase was introduced because, in a pilot study carried out without this phase, several two-year-olds were intimidated and could not cooperate with the experimenter, some even crying immediately after starting the experiment. With the familiarization phase, all the children contacted for the present study participated willingly.

Material

The list of all items is presented in Table 1. The meanings of the words presented in the noun and verb contexts were represented by pairs of pictures, one of an object and one of an action performed by a person. Children were asked to point to the picture that corresponded to what they heard.

Table 1. The 15 items used in the study, divided into homophonous and nonce words, and listed in alphabetical order within each of the two categories

Homophones	Noun context	Phonetics	English meaning	Verb context	Phonetics	English meaning
			Homophonous words			
/bwa/	le bois	/lə bwa/	the wood (pieces of)	elle boit	/ɛl bwa/	she drinks
/kuʁ/	la cour	/la kuʁ/	the courtyard	il court	/il kuʁ/	he runs
/fɛʁm/	la ferme	/la fɛʁm/	the farm	elle ferme	/ ɛl fɛʁm/	she closes
/ʒu/	la joue	/la ʒu/	the cheek	ils jouent	/il ʒu/	they play
/li/	le lit	/lə li/	the bed	elle lit	/ɛl li/	she reads
/maʁʃ/	les marches	/le maʁʃ/	the steps	ils marchent	/il maʁʃ/	they walk
/mɔ̃tʁ/	la montre	/la mɔ̃tʁ/	the watch	elle montre	/ɛl mɔ̃tʁ/	she shows
/pɔʁt/	la porte	/la pɔʁt/	the door	il porte	/il pɔʁt/	he carries
/pus/	le pouce	/lə pus/	the thumb	il pousse	/il pus/	he pushes
/ʁi/	le riz	/lə ʁi/	the rice	elle rit	/ɛl ʁi/	she laughs
/tɛlɛfɔn/	le téléphone	/lə telefɔn/	the telephone	il téléphone	/il telefɔn/	he telephones
/tʁɑ̃ʃ/	la tranche	/la tʁɑ̃ʃ/	the slice	elle tranche	/ɛl tʁɑ̃ʃ/	she slices
			Nonce words used homophonously			
/ʃim/	la chime	/la ʃim/		elle chime	/ɛl ʃim/	
/dav/	le dave	/lə dav/		elle dave	/ɛl dav/	
/gɔt/	la gotte	/la gɔt/		elle gotte	/ɛl gɔt/	

To control for the order in which items were presented, for which item was presented in relation to a particular word or nonce (either the noun or the verb context), and for the position on the screen of the picture corresponding to the requested item (on the right or on the left of the screen), four lists were prepared and each child was presented with one of them. The lists were used in a sequential order (list 1 with child A, list 2 with child B, list 3 with child C, list 4 with child D, and then starting again, list 1 with child E, and so on).

For the noun context of nonce words, the corresponding picture represented an unfamiliar object that did not have a precise name in adult language (see

Appendix 1 for an example). For the verb context of nonce words, the corresponding picture represented a person performing an action that could not be described in French by an available verb (see picture b in Appendix 1).

Since frequency has an impact on children's lexical knowledge (Huttenlocher, Haight, Bryk, Seltzer, Lyons 1991), the frequency of the homophonous words used was checked.

Since no reference on word frequencies exists for French child-directed speech (CDS), nor even for oral adult French (see below), we analyzed the French data available in the CHILDES database (MacWhinney 2000) and the data used in Veneziano and Parisse (2010), to obtain information about word frequencies in CDS. We analyzed a corpus containing 1,913,796 words. Results show that with the exception of the verb *trancher* [to slice], all the French words used in our experiment were present in the CDS samples analyzed, some occurring with greater frequency than others. The frequencies of the noun and verb homophones were close. In only one case was there a disparity between them: the noun *marche* ('step' in a stairway) occurred infrequently whereas the verb *marche* ('walk') occurred very frequently. The results obtained on the CDS corpus were confirmed by the frequencies of the Lexique 3.55 database (http://www.lexique.org, New et al. 2001, 2004) for French. This 50-million-word database consists of books and movie subtitles, with the latter considered to provide a better frequency estimate for oral language than written texts. Table 2 presents the frequencies in words per million of occurrences of the homophonous words, as nouns and verbs, in both the CHILDES CDS and the *Lexique Subtitles* databases.

Given that the verb version of the homophonous words was used in the experiment with only one argument (the subject as agent), we checked whether these verbs were usually used with one or with more arguments (object and/or beneficiary). The Veneziano and Parisse corpus of child-directed speech – consisting of 46,397 words – was used as the database for this analysis. Of the nine verbs found in the corpus,[5] only *porter* 'to carry', was used more often in a two-argument than in a one-argument structure (3.5 times more). All the other verbs were used more frequently in a one-argument structure (one-argument structure $M = 36.6$, $SD = 35.5$; two-argument structure, $M = 7.6$, $SD = 7.12$; Wilcoxon rank sum test, $W = 13.5$, $p = .019$), which corresponds to the structure used in the present study.

5. *rire* 'to laugh', *trancher* 'to slice' and *téléphoner* 'to phone' were not found in this corpus.

Table 2. Frequencies of the homophonous words used in the test items, in their noun and verb uses, in two kinds of databases: CHILDES CDS and Lexique Subtitles[a]

Word category	Orthographic form	Phonological form	CDS raw frequency	Subtitles frequency
Noun	ferme (farm)	/fɛʁm/	105	73.53
Verb	fermer (close)		258	48.85
Noun	joue (cheek)	/ʒu/	105	25.57
Verb	jouer (play)		623	225.84
Noun	marche (step)	/maʁʃ/	65	46.61
Verb	marcher (walk)		547	85.34
Noun	cour (courtyard)	/kuʁ/	24	71.8
Verb	courir (run)		131	47.19
Noun	lit (bed)	/li/	443	176.1
Verb	lire (read)		202	89.58
Noun	porte (door)	/pɔʁt/	381	288.39
Verb	porter (carry)		98	79.04
Noun	bois (wood)	/bwa/	126	115.56
Verb	boire (drink)		214	142.15
Noun	pouce (thumb)	/pus/	67	11.89
Verb	pousser (push)		235	27.51
Noun	riz (rice)	/ʁi/	27	18.49
Verb	rire (laugh)		30	63.29
Noun	montre (watch)	/mɔtʁ/	381	43.91
Verb	montrer (show)		582	136.2
Noun	tranche (slice)	/ tʁɑ̃ʃ/	11	5.28
Verb	trancher (slice)		0	3.88
Noun	téléphone (phone)	/telefɔn/	131	155.68
Verb	téléphoner (phone)		34	20.22

a Frequencies correspond to words per million of occurrences. The correlation between the Lexique Subtitles and the CHILDES CDS databases is significant, $r = .63$, $t(22) = 3.88$, $p = .0008$. The only notable differences between the Lexique Subtitles and CHILDES CDS are: the opposite frequencies of 'ferme' as a noun (farm) and as a verb (close); 'rire' as verb (laugh) is less frequent in CHILDES CDS; 'tranche' as verb (slice) is not found in the CHILDES CDS database.The average frequencies are higher for the CHILDES CDS (M = 200/million, SD = 191/million) than for the Lexique Subtitles (M = 107/million, SD = 120/million), suggesting that most of the words used in our experiment are quite likely to have been heard by the children at one time or another.

3. Results

3.1 Group results

3.1.1 *Success rate: All items*

Children chose the picture corresponding to the expected response relative to the requested item 74% of the time. That is, they chose the picture of the object when the homophonous or nonce word was presented in a noun grammatical context, and the picture of the person performing an action when the homophonous or nonce word was presented in a verb grammatical context. No significant correlation was found between the frequency of the words in CDS and the percentage of correct responses (Kendall's rank correlation, $z = 1.28$, $p = 0.19$).

This rate of success was significantly higher than expected by chance (50%)[6] for the whole group: $t(178) = 15.97$, $p < .001$[7] ($M = 11.14$, $SD = 4.68$), and was observed in each of the three age groups separately: for the 2-year-old group, $t(58) = 6.69$, $p < .001$ ($M = 10.16$, $SD = 4.76$); for the 3-year-old group: $t(58) = 9.89$, $p < .001$ ($M = 10.96$, $SD = 3.68$); for the 4-year-old group: $t(58) = 13.99$, $p < .001$ ($M = 12.3$, $SD = 3.52$).

Figure 1 shows the mean number of items correctly identified (that is, pointing to the picture of an object for items presented in noun contexts, and to the picture of an action for verb contexts), overall and by age group. The horizontal line is set at the 50% level of success expected by chance.

3.1.2 *Success rate: Meaningful and nonce words*

Overall, children correctly identified as many meaningful homophonous words as nonce words (75% of correct identification for both) and both were identified correctly significantly more than expected by chance. The t-test, applied in the same way as above to the scores obtained for meaningful homophonous words[8], showed that children succeeded significantly better than chance level ($M = 8.95$, $SD = 3.46$, $t(178) = 15.07$, $p < .001$). This was the case in each of the three age groups: for the 2-year-olds: $t(58) = 6.67$, $p < .001$ ($M = 8.33$, $SD = 3.68$); for the 3-year-olds: $t(58) = 8.76$, $p < .001$ ($M = 8.67$, $SD = 2.78$); and for the 4-year-olds: $t(58) = 12.63$, $p < .001$ ($M = 9.87$, $SD = 2.8$).

6. The difference was tested by comparing the subjects' scores to a theoretical sample succeeding by chance (15 x 0.5 = 7.5 items).

7. Since we were interested in the probability of succeeding at a level higher than chance, all probabilities in the current and following sections are one-tailed.

8. The difference was tested by comparing the subjects' scores obtained on homophonous words to a theoretical sample succeeding by chance (12 x 0.5 = 6 items).

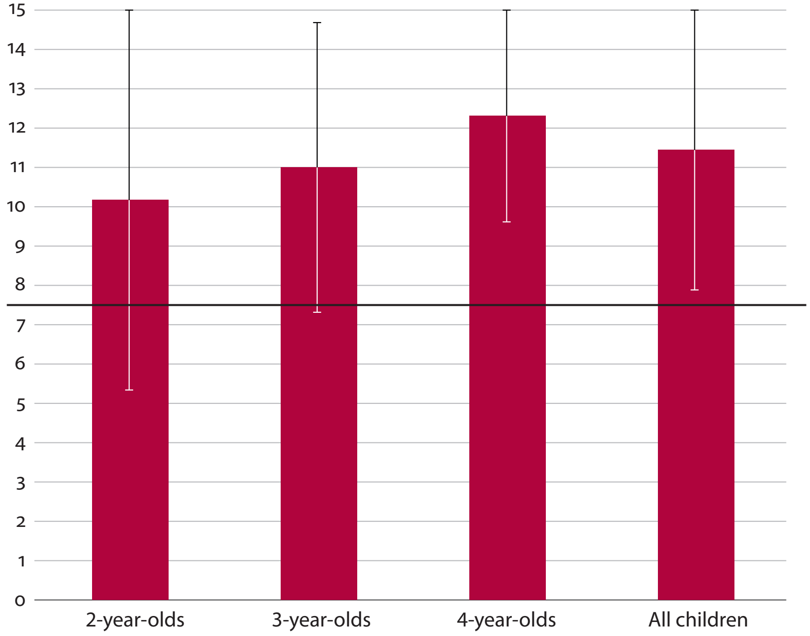

Figure 1. Mean number of items correctly interpreted, overall and by age group (the horizontal line is set at the 50% chance level)

Similar results were obtained for nonce words: the success rate for nonce items was significantly better than expected by chance[9] ($M = 2.18$, $SD = 0.53$, $t(178) = 8.92$, $p < .001$). This was the case in each of the three age groups: for the 2-year-olds: $t(58) = 2.30$, $p = .012$ ($M = 1.83$, $SD = 0.63$); for the 3-year-olds: $t(58) = 7.35$, $p < .001$ ($M = 2.3$, $SD = 0.35$); and for the 4-year-olds: $t(58) = 7.53$, $p < .001$ ($M = 2.43$, $SD = 0.46$).

3.1.3 *Effect of age on success rate: All items*

The effect of age on children's success rate was tested by means of a one-way analysis of variance. Results of the ANOVA showed a significant difference in the number of items correctly identified by the three age groups: $F(2, 87) = 6.31$, $p = .0027$. Post-hoc comparisons[10] indicate that the 4-year-olds ($M = 12.3$, $SD = 1.88$) performed better than the 2-year-olds ($M = 10.17$, $SD = 2.18$, $p = .0002$), and 3-year-olds ($M = 10.97$, $SD = 1.92$, $p = .03$). No significant differences were found between the 2- and 3-year-olds ($p = .272$).

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9. The difference was tested by comparing the subjects' scores obtained on nonce words to a theoretical sample succeeding by chance (3 x .05 = 1.5 items).

10. Results of post-hoc comparisons used the Tukey's HSD criterion with the Bonferroni adjustment of the alpha level to .017 for three comparisons (0.05/3 = 0.017).

3.1.4 *Effect of age on success rate: Meaningful and nonce words*

Very similar results were obtained for the meaningful homophonous words considered separately. The one-way analysis of variance showed a significant difference by age: $F(2, 87) = 8.72$, $p = .00035$. The post-hoc comparisons indicate that the 4-year-olds ($M = 9.86$, $SD = 1.67$) performed better than the 2-year-olds ($M = 8.33$, $SD = 1.92$, $p = .003$) and 3-year-olds ($M = 8.67$, $SD = 1.67$, $p = .026$). No significant differences were found between the 2- and 3 year olds ($p = .743$).

Concerning nonce words, the one-way ANOVA again showed a significant difference among the three age groups: $F(2, 87) = 6.19$, $p = .0003$. The post-hoc comparisons indicate that 2-year-olds ($M = 1.83$, $SD = 0.79$) performed significantly less well than 4-year-olds ($M = 2.43$, $SD = 0.68$, $p = .003$) and 3-year-olds ($M = 2.3$, $SD = 0.59$, $p = .028$). No significant differences were found between the 3- and 4-year-olds ($p = .737$).

To summarize the results obtained for group analyses, children in all three age groups correctly interpreted all kinds of items better than would have been expected if they were choosing the picture on a chance basis. For all items, 2-year-olds succeeded less well than the older children; the scores of 3-year-olds were close to those of the 4-year-olds for the nonce items, but closer to those of the 2-year-olds for the meaningful homophonous words.

3.2 Individual subjects' results

In order to understand how each individual child performed on the entire set of items, we conducted an analysis by subject. Individual performance not only provides information on interindividual variation, but also a much clearer picture of children's ability to correctly identify, beyond chance level, a sufficient number of minimally contrasted items where homophonous or nonce words occur in either noun or verb grammatical contexts.

3.2.1 *All items*

Setting the α level at .05, the number of total items that was needed for the set to be considered correctly identified beyond chance was at least 12 out of the 15 items proposed[11]. This criterion was reached by 30% of the 2-year-olds, 33% of the 3-year-olds and 67% of the 4-year-olds (see Figure 2). The chi-square test[12] shows a highly significant overall age difference (χ^2 (2, $N = 90$) = 22.35, $p = .0000012$).

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11. The probability of correctly identifying 12 out of 15 items by chance is .011, with $p = q = 0.5$.

12. The chi-square test was applied to a 3 x 2 contingency table, for 3 age levels x 2 outcomes.

The post-hoc comparisons[13] show that the criterion was reached by more 4-year-olds than 2- and 3-year-olds (4 vs. 2: χ^2 (1, N = 60) = 6.67, p = .009; 4 vs. 3: χ^2 (1, N = 60) = 5.4, p = .02). No significant difference was found between the 2- and 3-year-olds (2 vs. 3: χ^2 (1, N = 60) = 0, p = 1.0).

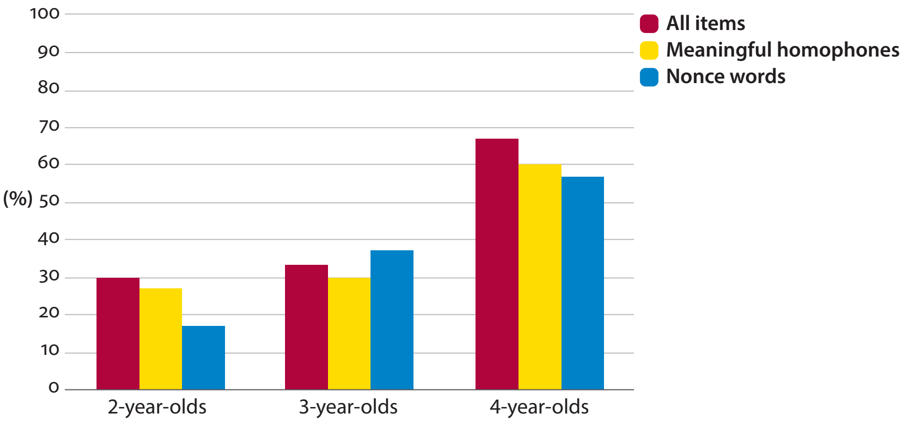

Figure 2. Percentage of children correctly interpreting, beyond chance level, all words, meaningful homophones, and nonce words, by age

3.2.2 *Meaningful homophonous and nonce words*

The number of meaningful homophones that children needed to correctly identify was at least 10 out of the 12 items proposed[14]. This criterion was reached by 27%, 30% and 60% respectively of the 2-, 3- and 4-year-olds (see Figure 2). The chi-square test showed an overall age difference (χ^2 (2, N = 90) = 10.04, p = .0015). The post-hoc comparisons showed that the criterion was reached by more 4-year-olds than 2-year-olds (4 vs. 2: χ^2 (1, N = 60) = 5.49, p = .019) and 3-year-olds (4 vs. 3: χ^2 (1, N = 60) = 4.30, p = .037). No significant difference was found between the 2- and 3-year-olds (2 vs. 3: χ^2 (1, N = 60) = 0, p = 1.0).

Concerning homophonous nonce words, the correct identification of all the three items has a chance probability of .112, which is greater than the α-level of .05. It is nevertheless interesting to note that the three items were correctly identified by an increasing number of children as a function of age, 17%, 37% and 57% respectively of the 2-, 3- and 4-year-olds (see Figure 2). The chi-square test showed an overall age difference (χ^2 (2, N = 90) = 8.82, p = .003). The post-hoc comparisons showed that the number of children who successfully identified all

13. The post-hoc comparisons were performed with 2 x 2 contingency tables, with the Bonferroni adjustment of the alpha level to .017 for three comparisons.

14. The probability of correctly identifying 10 out of 12 items by chance is .019, with $p = q = 0.5$.

three nonce words was significantly greater at 4 years than at 2 years (4 vs. 2: χ^2 (1, N = 60) = 7.32, p = .006). The number of 3-year-olds fell between the other two, and was not statistically different from either group (4 vs. 3: χ^2 (1, N = 60) = 1.07, p = .299; 3 vs. 2: χ^2 (1, N = 60) = 2.13, p = .14).

3.3 A case study of the relation between production and comprehension

How do these results on children's comprehension relate to children's production? Some indications come from studies of the production of *fillers* – underdetermined, mainly vocalic, elements occurring most frequently in prelexical position (e.g., Bassano 2000; Peters & Menn 1993; Taelman, Durieux & Gillis 2009; Veneziano & Sinclair 2000). It has been shown that, between 18 and 22 months, children differentiate nouns and verbs by producing fillers differently in prenominal and preverbal positions (for more details, see Veneziano & Sinclair 2000; Veneziano 2003, in press). From this age on, these protomorphemes are progressively substituted by phonologically well-formed grammatical morphemes, although children still make errors of omission and of commission (that is, in the choice of grammatical morphemes). These finer-grained production analyses call for a re-evaluation of the relation between production and comprehension of grammatical morphemes.

A case study of a middle-class French-acquiring child living in a Parisian suburb was used for this purpose[15]. The child was followed once a month from age 1;6 to age 3;4. One-hour long observational sessions were videorecorded while the child interacted naturally with familiar adults in her home environment. Each session began with the administration of the comprehension task that was used for the cross-sectional study described above. One list of items among the four available was presented each month in a rotating order (list 1 at the first session, 2 at the scond, etc., starting again with list 1 at the fifth session, and so on till the end of the study). The repetition of the task at monthly intervals did not seem to strongly affect the child's score. In fact, progress was gradual and it took a few months before the child succeeded on the items at a rate higher than expected by chance. The comparison between the results of the comprehension task and her spontaneous production was performed across the period where changes were observed in comprehension on the one hand, and in production on the other.

In her spontaneous production this child started to produce fillers at 1;6 (Figure 3 shows the proportional occurrence of fillers and of phonologically well-formed grammatical morphemes between 1;5 and 2;0).

15. We thank Marie Collombel-Leroy and Aliyah Morgenstern for the collection of the production and comprehension data, and the ANR (project EMERGRAM to Edy Veneziano) for financial support.

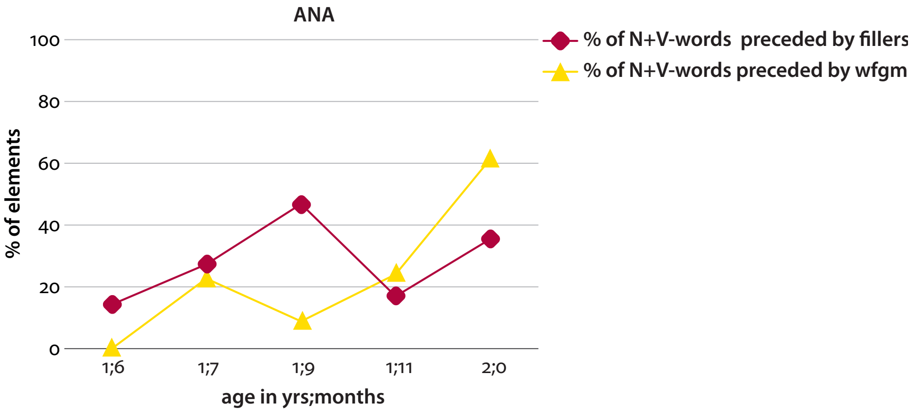

Figure 3. Proportion of words that are nouns and verbs in the language immediately preceded by a filler or a well-formed grammatical morphemes, per age

Until 1;10, fillers were not produced differently in prenominal and preverbal positions. At 1;10 the types of fillers produced in those positions started to be significantly different, with /a/, /e/, /ə/,/o/, /n/ and /yn/ in prenominal position and /i/, /ɔ̃/ and a higher proportion of /o/ in preverbal position. Figure 4 shows the distribution of fillers in prenominal and in preverbal positions, before the differentiation, and at 1;10, when the first differentiation between the two positions was observed (see also Veneziano, in press, for more details on the development of fillers for this child). At 2;0, full-fledged grammatical morphemes increased significantly (from 16% at 1;10 to 69% of nouns and verbs together at 2;0, see Figure 3).

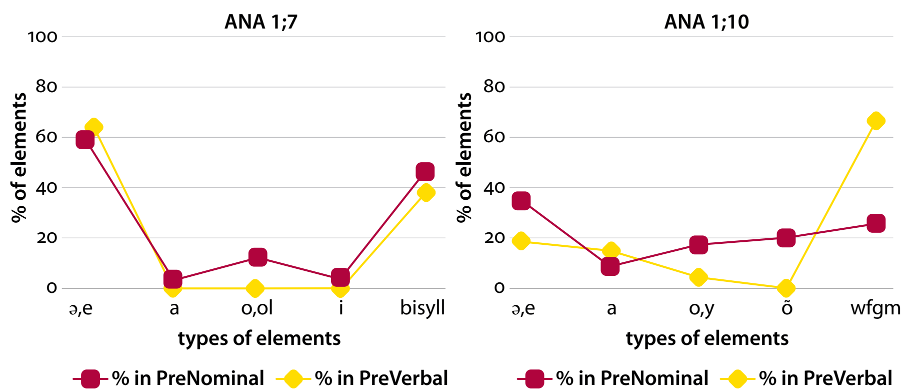

Figure 4. Proportional distribution of the kinds of fillers occurring in prenominal and in preverbal positions at two observational sessions: before (at 1;7) and at the time of the first differentiation (at 1;10)

However it was only two months later, at 2;2 that, in the comprehension task, the child correctly associated homophonous or nonce words in noun contexts with objects and in verb contexts with actions. This occurred about four months after she started differentiating nouns from verbs with fillers, and two months after the proportional increase in full-fledged grammatical morphemes.

It might seem then that when production is assessed in a fine-grained way, it precedes comprehension. It should however be pointed out that producing fillers differentially before nouns and verbs, or even producing phonologically well-formed grammatical morphemes in the expected positions, does not require the same knowledge that children need to perform correctly in our comprehension study. It might be the case that the differentiation of fillers and the production of full-fledged grammatical morphemes later on, instead of reflecting a clear understanding of the structural meaning of these grammatical elements, might rather reflect children's apprehension and memorization of surface regularities and distributional co- occurrences present in the input.

4. Discussion

The aim of this study was to assess the extent to which 2- to 4-year-old children were able to use category-specific grammatical morphemes – a definite article for nouns, a third person subject clitic pronoun for verbs – to retrieve the meaning of homophonous words that are either nouns or verbs in adult language, or of nonce words produced in noun or verb syntactic contexts. Thus if the homophone /pus/ was preceded by the definite article /lə/, it should have been identified as 'the thumb'; if it was preceded by the subject clitic pronoun /il/ it should have been identified as 'he pushes'. The nonce words were introduced to see whether children could identify an unknown word as having either noun or verb value as a function of the grammatical functor preceding it, and thus infer accordingly that the nonce word referred to an object or to an action.

Results show that children tended to choose the picture of an object when the homophonous or nonce word was in a noun grammatical context, and the picture of a person performing an action when the homophonous or nonce word was in a verb grammatical context. This was the case for children in the three age groups, with 4-year-olds making the right choices more often than the 2- and 3-year-olds, the latter two age groups performing at about the same level.

Since children could choose solely on the basis of the category-specific grammatical functors that preceded the meaningful homophones or nonce words, it can be stated that they seem to know the structural meaning of these grammatical morphemes and of the related noun and verb prevalent meaning associations. It might be argued that since the pictures corresponding to the choices required by the verb contexts always included a person, children simply associated the pronoun preceding the homophonous or nonce word to the person without understanding the syntactic context as a whole. This is a possibility that cannot be excluded. However, it would be rather strange to think that children could link the article to the following lexeme in the case of nominal contexts, but systematically attended only to the initial pronoun in the case of verbal contexts.

This result is in agreement with the comprehension studies presented above and demonstrates children's ability to use this grammatical information with even greater clarity. Indeed, in the present study, the same children were confronted with both noun and verb contexts and, when they made correct choices (beyond chance level), they revealed their ability to interpret *contrastively* the two grammatical contexts.

Earlier studies using children's pointing choices provide only group results. In Bernal et al. (2007), for example, a small number of children might have been responsible for the difference found between the experimental group (where the children were confronted only with verb grammatical contexts) and the control group (where the children were confronted only with noun grammatical contexts).

To better understand the extent to which children grasp the function of category-specific grammatical morphemes, we also assessed the individual performance of each participant in the study. In this way, we found that only 30% of the 2-year-olds made at least 12/15 correct choices (the number of items needed to consider the performance as being beyond chance level). This percentage is close to that reported by Höhle et al. (2004), one of the very few studies where this analysis by subject was performed. They reported that only 17 of the 48 subjects aged 14–16 months (35%) showed a dishabituation response to a change from noun to verb grammatical context. In our study, developmental data indicate that the percentage of 3-year-olds who correctly identified 12/15 items (33%) was similar to that of 2-year-olds (30%), while twice as many 4-year-olds (67%) reached the criterion. Children who correctly identified this many items may be thought to already have a good grasp of the distinctive significance of the grammatical functors that distinguish nouns from verbs. However, as we have seen, the proportion of children who can accomplish this is not very high until four years of age. In a future study it would be interesting to consider children's competence in language production, in particular concerning measures related to morphological development. It might be the case that some of the variance found in the comprehension task could be explained by variance in this kind of production abilities.

What about the children who do not reach the criterion? These children do not seem to respond on a random basis, since most of them inspect the two pictures before pointing. Some of these children may use the immediately preceding syntactic context to attribute noun or verb meaning to the content words but their knowledge may not be as yet sufficiently abstract to be easily generalized.

The results of the individual profiles point to substantial interindividual variation in this capacity, particularly at the earlier ages, a variation that needs to be seriously taken into account for a better understanding of development, and that may prove to be essential in predicting later outcomes in language proficiency, with implications for the efficient planning of intervention studies.

Although in the longitudinal study presented the child seems to differentiate nouns from verbs in production before she succeeds to criterion our comprehension task, it can be argued that the former does not require the same knowledge as the latter. While the early differentiation found in production might rely on the child's treatment of surface regularities and distributional co-occurrences in the input, the systematic correct interpretations of the minimally contrasted noun and verb contexts require a higher-order understanding of the structural meaning of grammatical morphemes. Further research conducted with the comprehension task paradigm presented here should use a greater number of nonce words to test more stringently the capacity of individual children to identify novel words as either nouns or verbs on the basis of their syntactic context and to attribute to them an object or action meaning accordingly.

It should be pointed out that these results concern the acquisition of French and obviously cannot be generalized cross-linguistically. Languages vary considerably in how they distinguish noun from verb contexts, in particular in relation to the presence or absence of nominal determiners, in the degree to which they rely on nominal and verbal morphology, on the presence or absence of obligatory subjects, serial verb constructions or whether a language is agglutinative or not. As a function of such language-specific features, children encounter different configurations that may lead them to pay attention to different aspects of their language and therefore impact how they go about learning the noun-verb distinction.

Even if the present study concerns the aquisition of French it does, however, provide some insights for language acquisition more in general. Indeed, it shows that children only gradually learn that there are different kinds of words that have different privileges of occurrences, and how these differences are handled in the language they are exposed to. Moreover, the study clearly shows that, as is the case in production, comprehension also presents individual differences in the pace at which these acquisitions are achieved.

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Appendix 1. Examples of screen display for the items presented to the children

a. Choice for /*li*/ ('bed/read'): on the left corresponding to the noun frame (*le lit* 'the bed'); on the right corresponding to the verb frame (*elle lit* 'she reads')

b. Choice for nonce word /ʃim/*:* on the left corresponding to the noun frame (*la chime*); on the right corresponding to the verb frame (*elle chime*)

CHAPTER 5

Language-specificity in motion expression

Early acquisition in Korean compared to French and English

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This chapter examines the development of motion expression in two Korean children (1;11 to 4;2), compared to children acquiring French and English (from Hickmann et al. 2009). Korean is a *verb-framed* language (like French but unlike English which is *satellite-framed;* cf. Talmy 1985, 2000), and offers the following devices for motion expression: Serial verb constructions (SVC) in which Manner and Path verbs can co-occur within a single clause, and Manner adverbs including mimetics. Analyses show that from two years on, Korean children use SVCs and start producing Manner adverbs (particularly mimetics). As a result, they express more motion information and their motion expression is therefore semantically denser than in French (but less dense than in English). These findings support the view that language-specific features influence children's motion expression from an early stage.

Keywords: development of Motion event expression, language-specificity in acquisition, acquisition of Korean, spatial semantics and syntax, Manner adverbs

1. Introduction

The present study examines the development of motion event expression in young Korean learners and compares the results to the French and English acquisition data reported in Hickmann, Taranne & Bonnet (2009). In Talmy's typology (1985, 2000), Korean is a verb-framed/Path language (Choi & Bowerman 1991) similar to French, as it typically encodes Path in verb roots, but different from English (a satellite-framed/Manner language). However, unlike both languages, Korean allows *serial verb constructions* (SVC) where Manner and Path verbs can co-occur serially in a single clause. In addition, Korean differs from both languages in that it has a

DOI 10.1075/tilar.22.06cho

large lexicon of Manner adverbs that are frequently used in spoken discourse. Given these language-specific devices for motion event expression in Korean, this chapter addresses the following questions: (1) How and when do Korean children acquire SVC and a Manner lexicon, and (2) how does acquisition of such grammatical devices affect the degree of semantic richness in expressing motion events in comparison to other languages? To answer these questions, I analyze the developmental patterns of motion event expression in the spontaneous speech of two Korean children recorded from two to four years of age. I use the methodology established by Hickmann et al. (2009) for assessing semantic richness (termed *Utterance Density* (UD) by Hickmann et al.) so that the Korean results can be directly compared to their French and English data.

In Talmy's (1985) typology for the expression of motion events, languages are largely categorized into two types: *satellite-framed* and *verb-framed* languages. In satellite-framed languages (also labeled *Manner* languages), Manner of motion (e.g., Eng. *jump*, *slide*) is expressed in the verb root while *Path* of motion (e.g., *into*, *up*) is expressed in other grammatical elements such as prepositions or particles. In verb-framed languages (also labeled *Path* languages) it is Path that is typically expressed in the verb root (e.g., Fr. *entrer* 'enter') and Manner that is expressed in other grammatical devices, such as the gerundive construction (e.g., Fr. *en courant* 'running').

However, more recent studies have noted considerable variation among languages that fall into the same type. In particular, Slobin (2004) has shown in detail that languages of the same type may differ in the degree to which speakers express Path and Manner in their narration. For example, between Russian and English, both satellite-framed/Manner languages, Russian speakers express Manner in the main verb consistently more often than English speakers. Slobin explains that the frequency of encoding Manner or Path in the main verb is influenced by the language-specific morpho-syntactic properties and constraints. In Russian, the main verb position is exclusively allotted for expressing Manner, thus leaving all types of Path, including deictic information (e.g., *come*, *go*), to satellites (e.g., prepositions, prefixes). But in English, division of form and function for Path and Manner is not so clear-cut – the main verb slot is *not* exclusive for expressing Manner, as it can also encode Path information (e.g., *John **went** into the room*). Consequently, Manner is encoded in the main verb less frequently in English than in Russian.

Choi (2009) also notes variation among languages of the same type, specifically, significant differences in the frequency of Path expressions among three verb-framed languages: Korean, Japanese, and Spanish. Speakers in this study were shown short video clips of motion events which they were asked to describe. Some events consisted of several paths: for example, in one event, a fan started to blow and a ball of paper (which was in front of the fan) rolled off the table and fell into a basket. The trajectory of motion involved three paths: paper going *off* the table, falling *downward* and going *into* the basket. This type of scene presents an option of expressing all three Paths or highlighting just one or two of these paths. Overall, speakers rarely expressed all three Paths in a single utterance. However, Japanese and Korean speakers expressed both *downward* and *into* paths in a single clause much more frequently than Spanish speakers. Japanese and Korean speakers did so by using language-specific morpho-syntactic tools (such as the case marker NP-*ulo* 'towards NP') that marks direction, a Path verb (*tteleci*-, 'fall') and a serial verb construction (*tule-ka*-, 'enter-go', see later section for more detail). In contrast, Spanish speakers mostly encoded one Path per clause using the main verb slot (e.g., *caer* 'fall'). In sum, Japanese and Korean speakers encoded more information about motion in a clause than Spanish speakers.

In a series of cross-linguistic studies, Hickmann and colleagues have recently systematically compared the extent to which speakers of various languages (e.g., English, French, Chinese) encode semantic information per utterance unit (Hickmann et al. 2009; Ji, Hendriks & Hickmann 2011). An *utterance unit* refers to a clause that can stand alone or a unit that is hierarchically tied together, i.e., main+subordinate clause (Ji et al. 2011). In their analysis, Hickmann et al. included the following semantic components of motion: Path, Manner, Cause, and Manner of Cause. All types of linguistic forms were examined, including not only verbs and particles/prepositions, but also adverbs, case markers, gerundive and serial verb constructions. The aim was to assess overall *utterance density* (henceforth UD), namely, the average number of semantic components speakers provide per utterance unit regardless of whether the meaning of motion was encoded in verb roots or other morphological devices. Hickmann et al. (2009) found that UD systematically differs across languages and that the differences relate to structural constraints in the language or to possibilities for combining Manner, Path, and Cause in a single clause. For example, English provides an almost obligatory [Verb+Particle] structure (e.g., *run in*) enabling speakers to routinely combine Manner and Path within a clausal unit. In contrast, French mainly uses the verb to express Path. The option exists to express Manner by by adding an adverbial or a gerundive construction (e.g., *en courant,* 'running') as illustrated in (1), but French speakers do not use this option frequently. Accordingly, English speakers consistently provided a higher UD than did French speakers (Hickmann et al. 2009).

(1) *Jean entre dans la salle* ***en courant****.*
John enters in the room by running.
'John enters the room running.'

Chinese uses serial verb constructions (SVC) in which two or more verbs are serially strung together within one utterance unit (see next section; this type of construction is used in various languages (Aikhenvald & Dixon 2006), including Korean.) In Example (2) (taken from Ji et al. 2011) both the Manner of 'rolling' and the 'descending' Path are expressed by verbs, V1 and V2 respectively, that are serially positioned.

(2) *Qiu2* ***gun*3-*xia*4** *le* *shan*1.
v1 -v2
bal roll-descend ASP hill
'The ball rolled down the hill.'

Note that languages like Chinese, where both Manner and Path are expressed in verb roots, cannot be categorized as either verb-framed or satellite-framed languages. As discussed in detail in Slobin (2004), this type of language should form another type in the typology that can be labeled as *complex-verb-framed* or *equipollently-framed* languages.

Hickmann and colleagues have shown that the language-specific structural properties of Motion expressions in French, English, and Chinese shape children's UD pattern from an early age. Spontaneous naturalistic data (Hickmann et al. 2009) revealed that from as early as two years of age, English learners take advantage of the [Verb+Particle] construction, thereby providing more information about motion per utterance (i.e., higher UD) than learners of French who primarily encode motion only in the main verb. This difference was also confirmed in an experimental study (Hickmann & Hendriks 2010). In addition, Ji et al. (2011) showed that Chinese children, from three years of age (the youngest age group tested), make use of the complex utterance structure (i.e., SVC) to produce higher UD than age-matched English-learning children.

Of interest in the present study is how Korean acquisition compares to other languages. Korean is a Path language (Choi & Bowerman 1991) similar to French, but it allows SVC similar to Chinese. SVC is a prevalent feature of the Korean grammar and is ubiquitous in both written and spoken Korean (Suh 2000; You 1996). In addition, Korean has its own characteristics, namely, a large lexicon and frequent use of Manner adverbs in spoken discourse (see below). In this study, I examine how and when young Korean learners acquire the typological patterns and the language-specific structure of the input language. I begin with a brief summary of the characteristics of Korean grammar that are important for expressing motion events.

2. Grammatical characteristics of motion event expression in Korean

2.1 Serial Verb Construction (SVC)

Korean is a verb-final (SOV) language. As shown in (3), information about Path (e.g., *enter, go*) is typically encoded in verb roots. Example (3) also illustrates a serial verb construction (SVC), where two verbs, *tul-* 'enter' (Path) and *ka-* 'go' (Path: deixis), are conjoined by the connective *-e* in a single clause. In (3), *tul-* encodes the Path of 'entering' or 'ending up being inside' and the deictic Path verb *ka-* encodes the dynamic motion of displacement away from the speaker.

(3)	*John-i*	*pang-ey*	*tul-e*	*ka-ss-ta.*
			v1	v2
	John-SBJ	room-LOC	enter-CN	go-PST-DECL
			[PATH	PATH: DEIXIS]

'John went into the room (away from the speaker).'

SVCs can consist of more than two verbs as, in principle, there are no restrictions about how many verbs can be strung together. In (4), the three verbs, *ttwi-* 'run' (Manner), *nayli-* 'descend' (Path) and *ka-* 'go' (Path: deixis) are verb roots denoting different aspects of a single event. The connective *-e* does not have any semantic content and simply connects one verb stem to the next (Lee 1992). It is neither a subordinate nor a coordinate conjunction. In addition, all verbs in the SVC share the same tense and the same subject (Lee 1992; Suh 2000). Tense and other modalities are marked once, on the right-most verb, in this case, *ka-*.

(4)	*John-i*	*il-chung-ulo*	*ttwi-e*	*nayli-e*	*ka-ss-ta.*
			v1	v2	v3
	John-SBJ	first-floor-to	run-CN	descend-CN	go-PST-DECL
			[MANNER	PATH	PATH: DEIXIS]

'John descended to the first floor running (away from the speaker).'

In (4), the Path verb, *nayli-* expresses a downward trajectory, thus specifying Path of motion. In addition, when the event involves spontaneous displacement of the agent (as in (4)), a deictic verb, *ka-* 'go' (or *o-* 'come'), typically follows the Path verb indicating the direction of the motion with respect to the speaker[1] (Choi &

1. In certain contexts the deictic verb *ka-* 'go' also encodes the dynamic process of displacement. Thus, in (4), without the deictic verb *ka-* 'go' (i.e., *John-i il-chung-ulo ttwi-e nayli-ess-ta*, John-SBJ first-floor-to run-CN descend-PST-DECL), the sentence conveys the event of the descent as a whole and implies that John descended to the first floor in one jump (cf., Choi & Bowerman 1991).

Bowerman 1991). The verb *ttwi-* 'run' (v1) expresses Manner of motion and is an optional element in an expression of a bounded motion event as in (4).[2] The three verbs are independent in that each verb can occur as a single main verb or serially with one or more verbs. Thus, for example, it is possible to use the deictic Path verb *ka-* 'go' alone, or just the Manner and the deictic Path verbs serially together (i.e., *ttwi-e ka-* 'run-go'). But without the Path verb *nayli-* 'descend,' the sentence would not express the downward trajectory.

Notice that sentence (4) has an intransitive SVC expressing spontaneous and voluntary motion. On the other hand, the SVC in (5) below denotes causative motion where the agent causes an object to move. In (5), both *kkwuki-* 'crumple' and *neh-* 'put.in' are monomorphemic transitive verbs where Manner (V1) and Path (V2) verbs respectively have each incorporated a causal meaning.

(5)	*John-i*	*phyenci-lul*	*pongthwu-ey*	***kkwuki**-e*	***neh**-ess-ta.*
				v1	v2
	John-SBJ	letter-OBJ	envelope-LOC	crumple-CN	put.in-PST-DECL
				[MANNER+CAUSE	PATH+CAUSE]

'John crumpled the letter into an envelope.'

As mentioned earlier, the SVC is a prevalent construction in Korean, typically expressing motion events. A corpus-based study shows that 70% of clauses with SVC express physical actions and motion events (Pyoun 2011). Among the latter, the most frequent final verb is the deictic verb, *ka-* 'go', as in *nayli-e ka-*, descend-CN go, 'go down' expressing displacement (see 3 & 4 above).

2.2 Manner adverbs

Korean offers a large lexicon of adverbs to express Manner of motion. In addition to 'regular' adverbs denoting Manner (e.g., *ppalli* 'quickly' in (6)), which are also found in other languages, the Manner adverb lexicon in Korean includes a wide variety of mimetics and ideophones (similar to Japanese (cf., Imai et al. 2008) expressing different aspects of Manner, such as acoustic properties, degree of intensity and speed (see examples in (7)). These forms are conventionalized and are not ad-hoc pantomimic forms.

2. When *ttwi-* is used alone as a single verb, the sentence would simply express unbounded motion of running toward an unspecified destination (or running in place).

(6) Manner adverbs with "abstract" forms:

i. *ppalli*: quickly (example: *ppalli ota,* quickly come, 'come quickly')
ii. *mak*: intensely or with brute force (example: *mak ttwita,* intensely run, 'run with intensity').

(7) Mimetics and ideophones expressing Manner of motion

i. *hwik:* speedily with light motion. (example: *hwik nala-kata*, speedily fly-go, 'fly away speedily and lightly').
ii. *phwungdeng*: go into water in a brisk manner (resulting in some splashing sound. example: *pwungdeng ppacita*, briskly fall.into, 'fall into water with some noise').
iii. *twuittwung-twuittung*: shaky and unstable movement of walking.

In the spoken register, Manner adverbs of both types are quite prevalent and young children hear them frequently (a high frequency of mimetics is similarly reported in Japanese adults in Allen et al. (2007)). Choi et al. (2009) reported that Korean caregivers often use Manner adverbs to intensify spatial motion performed while playing with children (e.g., *ssok* 'deeply and surely' when putting something into a container). In a longitudinal study conducted with four Korean mother-child pairs when the children were from 1;8 to 2;5, such manner adverbs occupied 20% of the total spatial lexicon of all mothers' input taken together (Choi et al. 2009).

3. The present study

The present study examines the development of motion event expression in two Korean children. The children's speech was analyzed following the methodology developed by Hickmann et al. (2009) so that the results could be directly compared to their French and English data.

Given that the SVC is a prevalent construction in Korean, I expected Korean learners to produce SVCs from an early age on, particularly to express motion events. In addition, the high availability of Manner adverbs in Korean discourse allows young children to also use other grammatical devices to express Manner of motion.[3] Thus, I expected Korean children to produce higher utterance density compared to French children from a young age. On the other hand, it was harder to predict how Korean children would compare with young English learners. While Korean has SVCs and other devices that can express several semantic components

3. See Imai et al. (2008) for early acquisition of verbs when they are facilitated by sound symbolism.

in a clause, these grammatical devices are not obligatory for motion event expression. In contrast, English provides an almost obligatory [Verb+Particle] construction (e.g., *run away*), which English learners acquire from an early age (Choi & Bowerman 1991). The present analysis reveals how young learners of Korean compare with English learners.

4. Data and analysis

For the present study, longitudinal naturalistic data of two Korean boys, JW and TJ, were analyzed. The children's spontaneous speech was collected during their interaction with their mother from 1;10 (TJ)/1;11 (JW) to 4;2. Both children grew up in monolingual homes where the parents spoke only Korean to them. The environments outside the home were different between the two children, however. JW was growing up in Seoul, Korea, while TJ was growing up in Southern California. It should be noted, however, that TJ's immediate environment was monolingual Korean: His parents lived in a community where many Koreans lived, and his father's workplace was located within the Korean community. The social circle of the parents was almost exclusively Korean.

All recordings took place in the child's home. In TJ's sessions, the interactions occurred between the mother, the investigator and TJ, whereas in JW's sessions, they involved solely JW and his mother. TJ's speech was recorded once every 3–4 weeks, for about 50 minutes at each session. JW's speech was recorded twice a month, for about 20–30 minutes per session. The amount of recording time was comparable for the two children.

Of all the utterances produced by the children, I analyzed those that expressed motion events. The total number of motion event utterances in the data was about 1,400 per child. The methodology of data collection and the size of database were comparable to Hickmann et al.'s (2009) study.

All semantic components of motion (Manner, Path, Cause, Manner of Cause) were coded in terms of whether they occurred in the verb root or other devices (e.g., case marker, adverb). Analysis of Path included the deictic forms, *o-* 'come' and *ka-* 'go', which can indicate motion towards and away from the speaker respectively when they are in the V2 or V3 position. Following Hickmann et al. (2009), for the calculation of UD, the form *ka-* 'go' was considered neutral with respect to Path information when rarely used as a single main verb and was thus excluded from the analysis. For each session, the average number of semantic components per utterance unit was calculated for types and for tokens (see next section). Although Hickmann et al. (2009) reported only a type analysis, in this study I have conducted both type and token analyses as they provide different kinds of information (see the next section).

5. Results

5.1 Utterance Density

Figure 1 shows the overall UD of both Korean children compared with the UD data in French and English learners. For the cross-linguistic comparison, UD was counted by *semantic type* following Hickmann et al.'s coding system. Thus, all Path expressions within an utterance were counted as one semantic type (see Example (8) (a–e) for spontaneous motion and 9 (a–e) for caused motion). For example, in (8b) both *nayli-* 'descend' and *o-* 'come' encode Path, therefore the utterance has UD1 in type (but UD2 in token). Counting the number of semantic components by type assesses how many different types of semantic concepts children express in an utterance. Token counts assess how much detail and how many different aspects of motion children express.

(8) Voluntary Motion

a. ([Path], UD1 in type & in token) (TJ 2;1)
emma *an* ***o**-a.*
mommy not **come**-DECL
'Mommy is not coming.'

b. ([Path – Path], UD1 in type; UD2 in token) (TJ 2;4)
nayli-e ***o**-a*
descend **come**-REQ
'come down.'

c. ([Manner – Manner – Path], UD2 in type; UD3 in token) (JW 1;11)
pwung pihayngki-ka ***nala-ka***
pwung (sound of plane/car engine) plane-SBJ **fly-go**
'The plane flew off "pwung".'

d. ([Manner – Manner+Path – Path], UD2 in type; UD4 in token) (JW 2;11)
pwul-i ***mak*** ***sosa*** ***olla***
fire-SBJ **intensely** **burst.up** **ascend**
'The fire is intensely bursting upward.'

e. ([Path – Manner – Path – Path], UD2 in type; UD4 in token) (JW 3;4)
appa-ka *pawuisan-**ulo*** ***ttwi**-ese* ***naylye-ka**-ss-tay*
father-SBJ rock-**toward** **run**-by.means.of[4] **descend-go**-PAST-HEARSAY
'Someone told me that Father went down towards the rock by running.'

4. The form *-ese* in (8e) is a conjunctive form suffixed to the predicate of a subordinate clause expressing the means by which (or the reason why) the event in the main clause was carried out.

(9) Caused Motion

a. ([Cause+Path], UD 2 in type & in token) (TJ 2;0)
tam-e
put.in (multiple things in a container)-DECL
'(I) put (them) in.'

b. ([Path Cause+Path], UD2 in type; UD3 in token) (TJ 2;8)
nwu-ka i an-***eyta*** ***cipeneh***-ess-nyakwu?[5]
who-SBJ this inside-**to** **put.in**-PAST-Q?
'Who put (it) to the inside?'

c. ([Manner – Path – Cause], UD3 in type & in token) (JW 2;10)
kulayse yenmos-ey ***phong*** ***ppa-ttuli****-lyeko*[6]
so pond-LOC **phong** **drop-CAUSE**-PURPOSE
'So in order to drop (it) into the pond.'

d. ([Manner Cause+Manner Cause+Path], UD3 in type and UD5 in token) (JW 3;0)
emma-ka ***mak*** ***ccocha-nay****-ss-e*
mother-SBJ **forcefully** **chase-send.out**-PAST-DECL
'Mother chased (someone) out forcefully.'

e. ([Path – Manner – Cause+Manner], UD3 in type; UD4 in token) (TJ 3;3)
*koyangi-**hanthey*** *khep-ul* ***phwuk*** ***cha****-lyeko.*[7]
cat-**toward** cup-obj **phwuk** **kick**-PURPOSE
'(He)'s about to kick the cup toward the cat in one push.'

Note that in Figure 1, UD results are collapsed for all age periods. This is because proportions of UD1, UD2, and UD3+ remained stable in the Korean children throughout the recording period. This was also the case for the French- and English-learning children. Compared to French, the Korean children produced much higher proportions of UD2 and less of UD1. This means that they provided more diverse semantic information per utterance than the French children did and that they did so from age 1;10/1;11 onward.

However, compared to the English learners, the Korean children produced relatively lower UD. Specifically, the English children produced fewer UD1 but

5. The case marker *-eyta* denotes a dynamic caused motion to a goal, thus expresses Path.

6. *Phong* represents the sound of something dropping into water. The form *-ttuli* is a suffix denoting causation after a particular set of intransitive verbs.

7. *Phwuk* indicates doing something in one movement in a somewhat sloppy manner.

more UD2 and UD3+ than the Korean children (English: 38% (UD1), 52% (UD2), 10% (UD3); Korean: 50% (UD1), 45% (UD2), 5% (UD3)). From an early age, the English learners acquired the typical and consistent combination of Manner and Path (i.e., two types of semantic components), using the [Verb+Particle] construction (Hickmann et al. 2009).

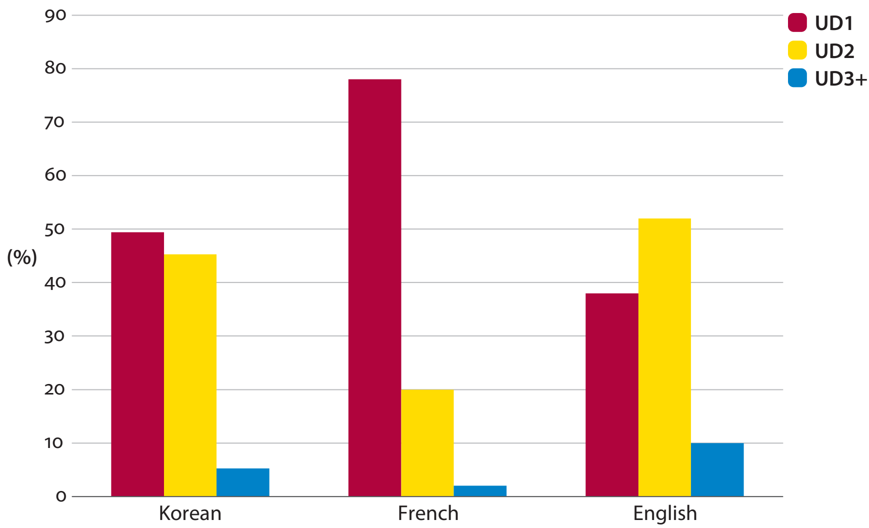

Figure 1. Percentages of UD1, UD2 and UD3+ (in TYPE) in the speech of two Korean children (combined data of all age periods) compared to data of the French and English children reported in Hickmann et al. (2009)

Although there was not much developmental change in semantic type, there was a developmental progression in terms of *token* numbers for the Korean children. Figure 2 shows proportions of UD in token by age period (grouped by 6 months). In both children's speech, proportions of UD1 decreased while proportions of UD2 and UD3+ increased, which shows that the children included more tokens of motion expression per utterance unit as they got older. It should also be noted that from the beginning (1;11–2;5), the Korean children produced two or more tokens of motion expressions (59% (UD2 & UD3+combined)) more often than one token per utterance (41% (UD1). From an early stage, both children serially combined Path and deictic Path verbs and used other devices for Manner and Path in addition to verbs (see more details in the next two sections).

The increase of token number reveals that over time the Korean children could conjoin several motion verbs and add Manner adverbs and/or case markers in a single utterance. For example, using the SVC they expressed both a Path such as ascend/descend/enter/exit. and the deictic aspect of the Path (8b & 8e). They added a case marker (e.g., -*ulo* 'toward', -*eyta* 'to (for caused motion)') to an NP denoting motion toward or to a goal (8e & 9b). They used both Manner adverbs (e.g., *mak*) and Manner verbs to express different aspects of Manner (8c–d & 9c–e). In the next two sections, I examine the children's developmental patterns of SVCs and Manner adverbs in some detail.

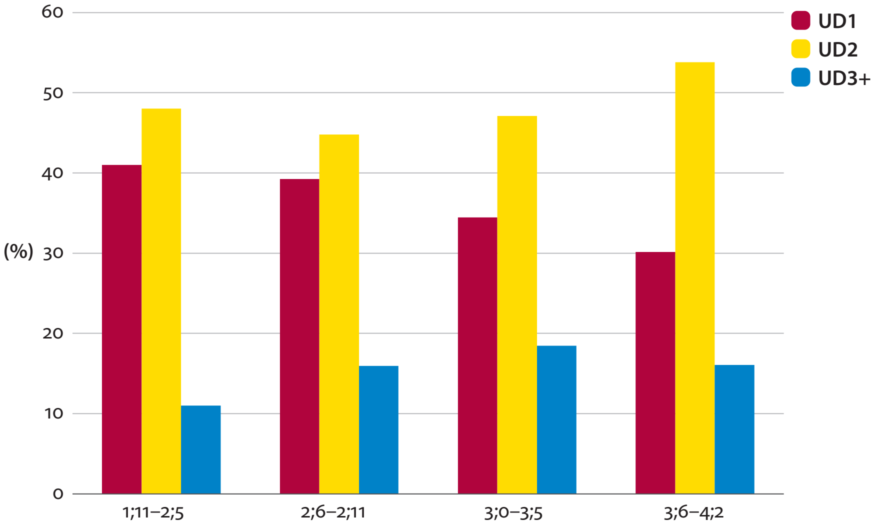

Figure 2. Development of Utterance Density by TOKEN in two Korean children: Percentages of UD in token during four developmental periods

5.2 Development of SVC in Korean

Table 1 shows the children's developmental patterns of SVCs during the study period. Both children started with very frequent, almost formulaic expressions of intransitive SVC constructions combining [Path+Path: deixis] (such as *olla-ka* 'ascend-go' or *na-wa* 'exit-come'), describing the spontaneous motion of going up or coming out. In the input of both mothers as well as in a corpus-based analysis (Pyoun 2011), these are the most frequent combinations in Korean SVCs. In the input of both mothers, from 1;11 to 2;6, the most frequent SVCs were *tule-ka* ('enter-go, go in'), *na-wa* ('exit-come, come out'), *kacye-wa* (take-come 'bring'), and *olla-ka* (ascend-go 'go up'). In addition, JW's mother frequently said *naylye-wa* (descend-come 'come down'). (Note: the verb *o-* 'come' and the sentence-ending form *a* together phonologically reduces to /*wa*/.)

Table 1. Development of Serial Verb Construction types, 1;11–3;5

	Child: JW	**SVC%**[i]	**Child: TJ**	**SVC%**
1;11–2;2[ii]	**[Path – Path: deixis]**[iii] **(intransitive)** *olla kata* 'ascend-go'	**25%**	**[Path – Path: deixis]** **(intransitive)** *na-ota* 'exit-come'	**27%**
2;3–2;5	[Path – Path: deixis] *olla-ka-* 'go' & *olla-ota* 'come' **[Manner – Path: deixis] (typical)** *nala kata* 'fly-go'	**45%**	[Path – Path: deixis] *na-kata* 'go' & *na-ota* 'come'	23%
2;6–2;8	Same pattern as 2;3–2;5,	20%	Same pattern as 2;3–2;5.	20%
2;9–2;11	**[Manner – Path – Path: deixis]** **(novel)** *milkkulecye-naylye-kata* 'slide (intr.)-descend-go' **[Path+Cause – Path+Cause]** **(transitive)** *nay-ponayta* 'make.sth.go.out-send.away'	**33%**	**[Manner – Path: deixis]** **(typical)** *nala kata* 'fly-go'	20%
3;0–3;5	Same pattern as 2;9–2;11.	32%	**[Manner – Path] (novel)** *kele-tanita* 'walk-go&come.repeatedly' **[Path+Cause – Path+Cause]** **(transitive)** *ollye nohta* 'raise-put.on'	**36%**

[i] SVC%: Proportion of SVCs of all VPs expressing Motion events.
[ii] Age periods were divided up by sharp increase or decrease of SVC in one child.
[iii] Boldface refers to developmental change in type of SVC.

During the first three months, each child used just one deictic verb as final verb: JW used only *ka-* 'go,' whereas TJ used only *o-*'come.' Both mothers used both *ka-* 'go' and *o-* 'come' as final verb of SVCs but each child produced only one at the initial stage of SVC acquisition. This perhaps reflects an early cognitive limitation, i.e., children start with a single V2 type using it as a syntactic placeholder for the SVC. A more detailed analysis of the mothers' input would be necessary to examine whether there is a specific variable (e.g., input frequency, perceptual saliency) that led the child to pick one deictic form for their early SVC production. Between 2;3 and 2;5, however, JW doubled his usage of SVCs, producing both *ka-* 'go' and *o-* 'come' as final verb. In addition, JW began to produce [Manner – Path] SVCs (such as *nal-a ka-* 'fly-CN go' and *ttwi-e o-* 'run-CN come') that are quite frequent V1-V2 combinations in Korean discourse. Notice that all SVCs up to 2;8 are intransitive constructions, in which each verb expresses one motion component only. From 2;9, JW began three-verb SVCs of [Manner – Path – Path] and moreover combined verbs in a novel way (e.g., *mikkuleci-e nayli-e ka-* 'slide-descend-go'), creating combinations that were not found in the mother's input. At this time, he also started producing transitive SVCs expressing caused motion (such as *olli-e noh-* 'raise-put.on'), where each verb conflates two components, Path and Cause. Note that Korean children do produce transitive spatial verbs (such as *kki-* 'fit tightly' and *neh-* 'put.in') from the one-word stage as single main verbs expressing caused motion (Choi & Bowerman 1991). What the present study indicates is that putting together two transitive verbs serially takes some time. As shown in Table 1, TJ showed the same developmental pattern but the rate of development was slower than JW by about 6 months.

Both children produced comparable proportions of SVCs: from 1;11, SVCs figured in about 25% of all verb phrases and the proportion increased to about 33% between age 2;9 and 3;0. In JW's case, the proportion went up to 45% in the second period (2;3–2;5) during which he seemed to practice SVCs. The results show that SVCs are prominent syntactic constructions for Motion event expression from two years of age. At an initial stage the children may have produced SVCs without any analysis (i.e., unanalyzed phrases), but they soon recognized the combinatorial nature of the construction and produced novel combinations.

5.3 Development of Manner adverbs

The large lexicon of Manner adverbs present in Korean discourse allows its learners to use another device, i.e., adverbs, to express Manner of motion. Choi (2011) reported that compared to French children, Korean children used "other devices" more frequently (25% for Korean vs. 14% for French). As expected, English learners showed the highest proportion (60%) of "other devices." As they were acquiring a satellite-framed language, English learners used particles (i.e., other device) to express Path (Choi 2011). Both the content and the forms of the other devices were different between French and Korean learners. French children's other devices expressed mostly Path or Location, using prepositions. In contrast, the Korean children frequently expressed Manner through adverbs.

Table 2 shows the development of Manner adverbs in the Korean children by age. Proportions of Manner adverbs among all types of motion expressions (e.g., verb, case markers) are shown by child, with examples. The rate of acquisition and the frequency of Manner adverbs differed between the two children: While JW used Manner adverbs relatively often – 7% of cases from the earliest period increasing to 13% in the last period – TJ used them much less, starting from just 1% and ending with 8%.

Table 2. Development of Manner adverbs, 1;11–4;2

Age	Child: JW	ADV%[i]	Child: TJ	ADV%
1;11–2;5[ii]	*mak* 'speedily with brute force' *ppalli* 'quickly' *phak* 'quickly with force'	7%	*kkwuk* 'push strongly'	1%
2;6–2;11	*phwungdeng* 'go into water briskly' *huntul-huntul* 'shaky motion'	10%	*twuittwung-twuittwung* 'awkwardly shaky motion' *mak* 'speedily'	1%
3;0–3;5	*whak* 'with brisk motion' *cwulcwul* 'steadily' *cciccicik* 'noise of breaking'	14%	*ppalli* 'quickly' *chembeng-chembeng* 'stepping into water with noise'	7%
3;6–4;2	*khwang* 'noise of heavy contact' *phwuk* 'noise of falling w/weight'	13%	*whik* 'light and speedily' *phang* 'with sudden noise' *kkok* 'tightly'	8%

[i] ADV%: Proportion of Manner adverbs of all Motion expressions (i.e. Verb and Other devices combined)
[ii] As Manner adverbs developed gradually, age periods were equally divided by 5–6 months.

However, the content of the adverbs was quite consistent in the speech of both children. Almost all the adverbs were ideophones and mimetics that marked a high degree of intensity of actions, such as falling, running, pushing, and swimming (see Examples (10) and (11)).

(10) (JW 2;5)
halmeni-ka *pay-ka* *aph-ase* *nay-ka* ***kkok*** *ccil*-ess-e.*[8]
grandmother-SBJ stomach-SBJ hurt-CONJ I-SBJ **hard** poke-PST-DECL
'Grandmother's stomach was hurting so I poked (it) hard.'

(11) (TJ 3;3)
chembengchembeng ***ppalli*** *swuyeng-ha-e.*
splash-splash **fast** swim-do-DECL
'(I) swim fast with lots of splash.'

In (10) *kkok* 'hard' expresses that the child poked her grandmother's stomach hard and deeply and in (11) the child says that he swam fast and vigorously, which made water splash.

Adverbs of low intensity (e.g., *chenchenhi* 'slowly') started later in development, at 3;0 for JW and 4;0 for TJ, and even then such adverbs were only occasional during the study period. Development of Manner expression from high to low intensity

8. The intention of *ccil-* 'poking' is to heal the stomach ache by applying pressure, as is often done in oriental medicine.

may reflect children's earlier cognitive readiness to acquire the expression of more visibly salient actions.

JW started producing Manner adverbs earlier and also much more frequently than TJ. These individual differences are probably due to differences in input frequency. In the mothers' speech to the children between ages 1;11 and 2;11, JW's mother provided far more Manner adverbs (300 tokens total) than TJ's mother (30 tokens total). In addition, JW's mother used them from the first recording session (when JW was 1;11) whereas TJ's mother started using adverbs when TJ was 2;4. The mothers' input data suggest that frequency of Manner adverbs can vary greatly among speakers, probably due to the adverb being an optional element in the grammar.

6. Summary and discussion

6.1 Influence of language-specific grammar

In this study, I have analyzed the development of motion event expression in two Korean children (from 1;11 to 4;2) comparing it particularly to French, a Romance language which is also verb-framed, and to English, a satellite-framed language. Although Korean is a verb-framed language like French, its grammar offers some unique characteristics for motion event expression that are not present in French: Korean uses SVC, a grammatical device that allows co-occurrence of several motion verbs (expressing Path, deixis, and Manner) in a single clause. In addition, Korean has a large lexicon of Manner adverbs including mimetics and ideophones. These adverbs are prominent in Korean spoken discourse and are frequent in the input to young children (Choi et al. 2009). Both Korean children in this study took advantage of these devices offered in the input language from an early age on. They produced SVCs essentially from the beginning, starting with very frequent phrasal combinations of Path and deixis, and once the structure was in place (2;6–3;0), they began to produce novel combinations of verbs. Furthermore, they produced Manner adverbs from a much earlier age than French children, showing an advantage of mimetics in the early phase of language acquisition for expressing Manner of motion (cf., Imai et al. 2008).

The early acquisition of SVCs and adverbs led to a higher utterance density in both Korean children compared to French children from the beginning of language acquisition. Considering that both languages are verb-framed, the differences reveal an influence of language-specific grammar that goes beyond the typological similarities of verb-framed languages. On the other hand, Korean children produced lower UD overall than learners of English, a satellite-framed language. English learners acquired the ubiquitous and almost obligatory construction of [Verb+Particle] and expressed Manner and Path in a single clause (i.e., UD2), and used it consistently from an early age (Hickmann et al. 2009). To this extent, satellite-framed languages have an overall advantage over verb-framed languages in terms of semantic density, at least in early phases of language development.

While both Korean children showed a similar developmental trajectory in their acquisition of motion event expression, they differed in the pace of acquisition of SVC and in the amount of Manner adverbs. TJ was generally slower than JW: in SVC, TJ lagged behind JW by three to six months in producing [Manner – Path] combination and causative motion event expressions. Concerning Manner adverbs, TJ produced them much less than JW during the study period. The individual differences between the two Korean children are likely to be at least partly due to differences in their input environment.[9] JW grew up in Seoul (i.e., a Korean-speaking society) with input from a variety of adult speakers of Korean, while TJ grew up in southern California with input of Korean mostly from his parents, thus a narrower range of Korean speakers. Such limited input environment may have slowed down his linguistic development.

6.2 General cognitive development

Language development also unfolds as a function of general cognitive development, of course. This is evident in several areas in the present study. First, as both Korean children grew from two to four years of age, they produced more tokens of motion event expressions (cf., Figure 2), combining several types of Path information and/or several types of Manner in a single utterance, using verbs and other devices. This suggests that children can gradually parse more details of the Path and Manner of an event, e.g., raising raising something upward from the floor and putting it on a high surface (*olli-e nohta* ‘raise-put.on’) or several aspects of Manner of swimming (*chembengchembeng ppalli swuyeng-ha-e* ‘splash.splash quickly swim’ (11 above)) and encode them as their grammar allows it.

Second, in terms of syntactic development, both children started with intransitive SVCs, and later (nine months to a year) produced transitive SVCs (Table 1). In an intransitive SVC each verb encodes one semantic component (e.g., *ttwi-e tul-e ka-* ‘run-enter-go’ [Manner – Path – deixis]). From an early age, the children produced such SVCs expressing two or more aspects of voluntary motion in a

9. With regards to TJ’s production of lesser amount of Manner adverbs (compared to JW’s), the language environment could be a second factor in addition to the caregiver’s input frequency mentioned in the Results section. The present data do not allow a systematic analysis of which factor plays a more important role in generating individual differences.

single utterance. On the other hand, in a transitive SVC, each transitive verb has at least two semantic components incorporating causative meaning into the verb stem. For example, in *mil-e neh-*, push-CN put.in, 'push in,' *mil-* (v1) conflates Manner and Cause, and *neh-* (v2) conflates Path and Cause. These two transitive verbs express caused Manner and caused Path of a single motion event. Previous studies (e.g., Choi & Bowerman 1991; Choi 1999) have reported that Korean children express caused motion from the one-word stage with a single transitive verb at a time (e.g., *mil-* 'push' alone or *neh-* 'put.in' alone), each denoting one causal aspect, Manner or Path, of the motion. The present data suggest that putting two transitive verbs together in an SVC to express two or more aspects of a single causal event takes some time, although longitudinal data from more children are needed to confirm this finding.

The effect of general cognitive development is also shown in the development of Manner expressions. Although both children acquired Manner adverbs at different rates, the semantic content of early adverbs was similar. Both children started by marking high intensity of action (e.g., *ppalli* 'quickly,' *kkwuk* 'push with force'). Expressions of low intensity of action (e.g., *chenchenhi* 'slowly') did not appear in the children's speech until 3;0. Marking the high end of intensity is probably cognitively easier for children (due to higher perceptibility/visibility of such feature) than marking the low end of the scale.

To conclude, while general cognitive development explains growth in the degree of semantic density in lexicalization (e.g., from intransitive SVC to transitive SVC) and in the number of tokens in children's Motion event expressions, language-specific grammar accounts for the characteristics we saw in the development in Korean. Korean children differed from French children and also from English learners in the way they encoded Motion in verbs vs. other devices and in the amount of information per utterance unit. Given that Korean and French are both verb-framed languages, the present study shows that cross-linguistic variation can go beyond a typology based simply on whether or not Path or Manner is encoded in the verb root. These results support similar findings in recent years (Choi 2006; Hickmann et al. 2009; Ji et al. 2011; Slobin 2004).

The present study reveals differences of UD across languages as well as language-specific characteristics of Korean development, when all linguistic devices (i.e., not only verbs and particles/prepositions but also adverbs and case markers) were analyzed, following the methodology developed by Hickmann et al. (2009). The present study thus highlights the importance of examining all types of linguistic devices for a comprehensive understanding of how languages encode various aspects of Motion events and how they may differ.

The present study also raises a number of questions on the relationship between spatial language and cognition: To what extent does higher Utterance Density in

Korean impact speakers' non-verbal conceptualization of Motion event? For example, do Korean children process more aspects of Motion of an event within a given time constraint than French children? Are Korean children more sensitive to some detailed aspects of Manner of motion (e.g., degree of speed and force) than French speakers? These are questions that future research needs to answer.

Acknowledgements

I would like to thank Professor Hyunjin Lee for generously donating JW's data for the present analysis. I also thank TJ and his mother for participating in the longitudinal study that I conducted. I am indebted to Wona Lee for all the coding and transcription of TJ's files. Last but not least, I am grateful to Asli Özyürek and the anonymous reviewer for their very helpful comments on an earlier version of this chapter.

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CHAPTER 6

Cross-linguistic variation in children's multimodal utterances

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Our ability to use language is multimodal and requires tight coordination between what is expressed in speech and in gesture, such as pointing or iconic gestures that convey semantic, syntactic and pragmatic information related to speakers' messages. Interestingly, what is expressed in gesture and how it is coordinated with speech differs in speakers of different languages. This paper discusses recent findings on the development of children's multimodal expressions taking cross-linguistic variation into account. Although some aspects of speech-gesture development show language-specificity from an early age, it might still take children until nine years of age to exhibit fully adult patterns of cross-linguistic variation. These findings reveal insights about how children coordinate different levels of representations given that their development is constrained by patterns that are specific to their languages.

Keywords: gesture, pointing, manner of motion, path of motion, Turkish, multimodal, Interface Hypothesis

1. Introduction

Language is a multimodal activity involving not only speech but also co-speech gestures that are used to refer to people, entities and event components in ways that are semantically, syntactically, and pragmatically related to the speaker's verbal message (McNeill 1992; Kendon 2004). We point to entities and locations around us while using speech (e.g., point to a ball while saying *the ball is here*) as well as use iconic gestures that represent selected features of objects or events we talk about (e.g., moving both our fist-shaped hands in a circular manner while saying *I biked to the store*). Pointing and iconic gestures can convey similar or additional non-redundant information (e.g., saying *I went to the store* and performing a biking gesture) to what is expressed in accompanying speech in both adults' and children's

DOI 10.1075/tilar.22.07ozy

utterances. Thus any research agenda that tries to explain children's language and communicative development (typical or atypical) needs to take into account the types of representations expressed in both the gestural and the spoken channels.

Most research on children's gesture development has considered gestures as reflecting or facilitating children's developing cognitive or language abilities in general (e.g., Goldin-Meadow & Alibali, 2013). However there is growing evidence that the adult use of such gestures is language-specific to some extent. Previous research has shown that the specific semantic, syntactic and pragmatic distinctions in languages seem to influence the type of representations that are expressed by gestures and the semantic relations between speech and gesture, as will be explained below. Such language-specificity of gestures has consequences for the different types of input children can get from speech and gestures, and can influence the speech-gesture development in children learning different languages.

This chapter will review recent literature on the development of children's multimodal utterances, considering to what extent and how gestural representations develop in relation to the type of language learned at the levels of semantics, syntax and discourse/pragmatics. It reviews research conducted on this topic so far, drawing upon recent findings on development (early and late) of children's multimodal utterances about location, space, motion, and reference to entities across typologically different spoken languages. More specifically it focuses on the literature about gesture development that is related to the lexicalization of Path and Manner information as well as to the growing syntactic complexity needed to express both of these components (where most cross-linguistic differences are found). Recent research related to the development of discourse cohesion is also discussed.

2. Gesture and language development: General milestones

Previous research on children's gesture development has indicated some general developmental milestones with regard to the relations between gesture and language development. Children use their gestures (and interpret those around them) in the context of communication from an early age. Before starting to speak, young children communicate by using gestures (Bates 1976; Bates et al. 1979; Greenfield & Smith 1976). These are typically pointing gestures that refer to entities present in the immediate environment of the child (e.g., pointing at a teddy bear) and appear around 10–12 months of age, at similar time scales across many cultures (Liszkowski et al. 2012). From the time children start uttering their first words, speech and gesture develop in close relation to each other during early and late childhood (e.g., Bates 1976; Iverson & Goldin-Meadow 2005; Özçalışkan & Goldin-Meadow 2005; Colletta et al. 2014). This research has shown in general that gestures with different functions (e.g., pointing and iconic) and their semantic relation to speech (i.e., gestures reinforcing, supplementing or disambiguating what is expressed in speech) might be supporting and even crucial for language development (Cartmill, Demir & Goldin-Meadow 2012). While the use of pointing gestures has been found to correlate with vocabulary development (Rowe & Goldin-Meadow 2009), complementary speech-gesture combinations (e.g., saying *give* while pointing at ball) have been found to pave the way for the transition from one- to two- and from two- to three-word combinations in the first three years of life (Özçalışkan & Goldin-Meadow 2005). Children at the one-word stage supplement their speech via mostly pointing gestures to produce a variety of constructions such as Argument-plus-Argument (e.g., saying *Mommy* while pointing at a shoe to mean 'Mommy's shoe') or Verb-plus-Argument (e.g., saying *eat* while pointing at an apple).

Another general pattern observed in gesture development is that iconic gestures develop later than pointing gestures. In contrast to the abundant use of pointing, early iconic gestures are reported to comprise 5% of young children's spontaneous gesture repertoire (Iverson, Capirci & Caselli 1994; Nicoladis, Mayberry & Genesee 1999; Özçalışkan & Goldin-Meadow 2005, 2009). The frequency of use of iconic gestures has been found to increase around 26 months (Özçalışkan & Goldin-Meadow 2011), and comprehension of these gestures also progresses around this age (e.g., Namy, Campbell & Tomasello 2004). It has been proposed that this increase may be due to a general development in children's representational and/or relational thinking which occurs after age two (Özçalışkan, Gentner & Goldin-Meadow 2014). Interestingly, a facilitation effect was found for pointing gestures in language development (i.e., in relation to vocabulary development or more complex speech) but not for iconic gestures (Özçalışkan et al. 2014). Another recent study examined how English-speaking children aged two-and-a-half to five talked and gestured about a particular caused motion event, eliciting descriptions of a stimulus item: the experimenter pushing a ball across a small pool with the help of a stick (Göksun, Hirsh-Pasek & Golinkoff 2010). The results of this study also confirmed previous findings on the late emergence of iconic gestures in an elicitation paradigm, used with 4- to 5-year-olds.

Despite the fact that most of this research comes from English-speaking children (plus a few studies on children speaking other languages, such as Italian),[1] it

1. Although Iverson, Capirci, Volterra and Goldin-Meadow (2008) show that Italian children, from a very early age, use more gestures and have a bigger gesture repertoire than American children in referential communication tasks, it is not clear whether this effect is due to linguistic or cultural differences.

has been assumed to reveal a general or universal pattern of gestural development. Given our current knowledge that co-speech gestures do vary in relation to the typology of languages as well as to the cultural and pragmatic factors in adult usage (Kita & Özyürek 2003; Özyürek et al. 2005, 2008; Colletta et al. 2014; see Gu et al. 2014 and Kita 2009 for a review of differences in gestures in relation to culture and/or language), two central questions arise with regard to how children's gestures become language-specific. First, are gestures language-specific from an early age or do they become language-specific later? Second, does the development of the semantic relation between speech and gesture vary across languages? Due to an increase in the technological ease of collecting multimodal developmental corpora in different types of languages, recent research has begun to address these and related questions. This research is reviewed below, following an overview of the cross-linguistic differences in adult gesture patterns.

3. Cross-linguistic variation in adult multimodal utterances

Pointing and iconic gestures vary in relation to the semantic and syntactic distinctions that languages make. One domain that has led to particular differences between spoken languages and their corresponding gestures is in the domain of expressions of motion events. Talmy (1985, 2000) proposed a typology accounting for variation in the expression of motion events across the world's languages, based on how Path of motion is expressed syntactically. In *satellite-framed languages* (S-languages, e.g. English, German), Manner of motion is typically expressed in the verb, while Path of motion appears in a particle outside the verb (e.g., 'The boy ran down'). In contrast, in *verb-framed languages* (V-languages, e.g., Turkish, Spanish), the verb usually encodes the Path of motion, while Manner information is optionally expressed with gerunds (e.g., Spanish), adverbs, or subordinate clauses (e.g., Turkish) outside the verb.

(1) Turkish:

çocuk	*koş-arak*	*merdiven-den*	*in-di*
child	run-CONN	stairs-ABL	descend-PAST

'The boy ran down the stairs (lit. descended the stairs while running)'

One consequence of this difference is the presence/absence of the expression of Manner. While speakers of S-framed languages such as English use a significantly larger number and variety of verbs indicating Manner (e.g., 'walk', 'run', 'jump'), speakers of V-framed languages such as Turkish rely on a limited set of Path verbs (e.g., 'ascend', 'exit', 'cross') and use them at significantly greater rates than English speakers (Özçalışkan & Slobin 1999, 2009), a pattern that has been shown to be true for various other S- (mostly English) versus V-languages (see Allen et al. 2007 for Japanese; Cardini 2010 for Italian; Choi & Bowerman 1991; Oh 2003 for Korean; Hickmann, Taranne & Bonnet 2009 for French; Papafragou, Massey & Gleitman 2002, 2006 for Greek). This difference has been attributed to the fact that since Manner is expressed outside of the verb phrase in V-framed languages, and often requires more complex constructions (e.g. gerunds), the expression of Manner becomes optional and is more likely to be dropped.

What are the consequences of these typological differences for the gestural representations? According to one view, gestures should be generated directly from the imagistic and motoric representations of events and thus are not expected to vary with the way events are encoded linguistically (e.g., McNeill 1992; Hottsteter and Alibali 2008). However researchers examining native speakers' gesture production across a variety of languages show that the content and type of iconic gestures co-vary with the preferences that are observed in different languages. For example in V-framed languages adult speakers tend to express the same motion information both in their speech and gesture, namely Path of motion – a pattern that has been shown to be true for French (Gullberg et al. 2008), Turkish and Japanese (Kita & Özyürek 2003; Özyürek et al. 2005). Furthermore when both Manner and Path are expressed in both speech and gesture, English speakers typically synthesize Manner and Path components into a single gesture just as they express them together within one clause in speech, while Turkish and Japanese speakers produce separate gestures for Manner and Path and tend to produce more Path-only gestures than English speakers, replicating the patterns found in their speech (Kita & Özyürek 2003; Özçalışkan 2012).[2]

Furthermore what is represented in iconic gestures also seems to vary according to verb semantics of the specific language. For instance, placement events are encoded using the simple verb *mettre* 'put' in French. In contrast, speakers of Dutch encode these events by using positional verbs such as *leggen* 'lay' and *zetten* 'set/stand' depending on the shape of the object that is placed. Paralleling these distinctions, adult French speakers have been found to use iconic gestures that encode only the Path or direction of motion in their placement descriptions, whereas Dutch speakers' gestures represent the form of the moved object (i.e., the Figure via the hand shape) as well as the direction of motion (Gullberg 2011). A recent study has shown that the influence of language on gesture can also extend to other abstract

2. Note that when English (or other S-framed languages) speakers express both Path and Manner in their speech, they do not always express both components in their gestures. They might also choose to produce Path-only gestures, depending on the type of information relevant for discourse purposes, e.g., when Goal/Path is the relevant information to convey or when manner is not salient in the event (Özyürek et al. 2005) domains such as time. For example, Chinese speakers talk and gesture about time in a vertical manner more than English speakers (e.g., in Chinese 'above week' means 'last week' and is typically accompanied by vertical gestures depicting moving up; Gu et al. 2014).[3]

These findings suggest a strong influence of language-specific patterns in gesture. One powerful explanation of how this influence works is the Interface Hypothesis (Kita & Özyürek 2003). According to this hypothesis, iconic gestures are generated initially from the imagery of the event, and this imagery is partially reflected in the shape of the iconic representation. However, gestures are also involved in the conceptual planning of the speakers' message and are shaped by the speakers' online lexical choices (e.g., whether Manner is expressed or not) and syntactic choices (e.g., whether multiple semantic elements can be packaged in one clause or not). Evidence for this hypothesis comes from the findings that English speakers use a single gesture to encode both Manner and Path since they conceptualize both elements in one conceptual unit of speech, i.e., one clause, whereas Turkish and Japanese speakers process each component in a separate clause, which is reflected in their gestures – a gesture unit representing either Manner or Path information separately, depending on the clause they accompany. Additional studies have also found that the gestures of English speakers vary when they are used with one-clause or two-clause constructions encoding both Manner and Path (Kita et al. 2007). This variation found in English speakers rules out the possibility that mere cultural differences could explain the differences between the gestures of Turkish and Japanese speakers on the one hand and those of English speakers on the other. Speakers' gestural choices can vary within one language depending on online lexical and syntactic choices and related to online conceptualization while speaking.

So, how do children's multimodal utterances compare to those of adults?

4. Cross-linguistic variation in children's multimodal utterances

In learning specific languages, children need to tune into not only language-specific distinctions in the spoken utterances of adult languages but also to language-specific gestural representations. Research, albeit quite limited at this point, has found overall that while some aspects of language specificity are evident in children's gestures from an early age, there is also a developmental trajectory in the way gestures

3. Note that in all these studies, these are trends in gestural representations and should not be taken as absolute ways of encoding information in gesture in a given language. Gestures, like spoken expressions, are partially influenced by the typological constraints of a language, but also vary with discourse constraints and information structure, and in the case of gestures, also with the imagery of the event depicted. This is in line with the Interface Hypothesis.

tune into the language specificity of the spoken expressions, which is dependent on the type of distinctions encoded in the specific language and the way they are encoded. Below I will focus on findings in late (3, 5 and 9 years) and early (1 and 3 years) development.

4.1 Late development: Mastering motion event expressions and discourse

Previous research in spoken languages has shown that, in general, children tune into the specifics of their language from an early age. For example, when it comes to expressions of Manner and Path, children (as early as 2–3 years of age), learning V- and S-framed languages have been found to use spoken expressions of motion events in line with the lexical and grammatical options of their target language. While children speaking S-framed languages are likely to encode and lexicalize Manner, those learning V-framed languages prefer mostly to express Path in their utterances like adults (Özçalışkan & Slobin 1999; Choi & Bowerman 1991; Furman 2012; Furman et al. 2014). However, when it comes to syntactic packaging of both Manner and Path, both language-specific and general tendencies have been found in children's utterances (Allen et al. 2007; Özyürek et al. 2008). For example, when describing motion events that were salient both in Manner and Path, English-speaking children acquired the adult target Verb+satellite constructions from an early age on and used them more frequently than Japanese- and Turkish-speaking children did. In comparison, Turkish- and Japanese-speaking children used constructions that expressed Manner and Path in separate clauses more often than English-speaking children did, even though they did not use them as often as adults did. Instead, they used one-clause constructions like English-speaking adults and children and, interestingly, they used them more than the Turkish- and Japanese-speaking adults. In such cases, both Japanese- and Turkish-speaking children made use of mimetic words for Manner expressions and combined them with Path expressions.

(2) Japanese: one-clause expression of Manner and Path (3 yrs)

Guruguru-tto	*ue-ni*	*agat-te*
Mimetic(rotation)-Complementizer	top-Dative	ascend-Connective

'(He/she/it) ascends guruguru [rotatingly] to the top'. (Allen et al. 2007)

Thus, child speakers of Turkish, Japanese and English showed a common preference for encoding both Manner and Path in one clause from an early age, while Turkish- and Japanese-speaking children reached adult-like frequencies in using two-clause constructions later (even though they still used them more than English-speaking children initially).

Given these developmental patterns across languages, how do children's gestural expressions become adult-like? One possibility is that the co-speech gestures are tuned to linguistic differences from early ages on (as most linguistic differences in speech appear early). Alternatively, co-speech gestures are similar across languages at the early ages (even though language-specific differences appear early), and only gradually become language-specific due to increased exposure to the patterns of the target language. Compared to speech, we know relatively little about cross-linguistic differences in children's gesture. However, the studies conducted so far show that while some aspects of gestures look target-like from the beginning, other aspects must further tune to language-specific patterns. One also observes some variation regarding which spoken language distinctions (semantic, syntactic and discursive) gestures become tuned to.

One of the few existing studies (Özyürek et al. 2008) focuses on how Manner and Path are expressed in speech and gesture by children as they are learning V-framed or S-framed languages. This study shows that children learning English or Turkish (even though their speech is adult-like) start by producing separate gestures for Manner and Path at age 3 when describing motion events (regardless of whether they use one- or two-clause constructions). These early patterns change into adult-like patterns around 9 years of age. Children learning English express Manner and Path components in a single gesture accompanying their one-clause utterances and children learning Turkish continue to produce separate gestures for each motion component like the adults, corresponding to their increasing use of two-clause constructions. So, with English-speaking children, we see more of a tuning of gestures to language-specific patterns.

Özyürek et al. (2008) have interpreted these findings as being in line with the Interface Hypothesis (Kita & Özyürek 2003). The proposal is that at younger ages the unit of linguistic conceptualization is not a clause (as in adults) but a word unit (i.e., "jump" and "up"). Unlike the adults, English-speaking children gesture for Manner (verb) and Path (satellite) separately or gesture for one component or the other (depending on the saliency or discursive importance). As children develop a clausal unit of conceptualization for speaking (around 9 years), their gestures adapt as well. Thus the link between speech and gesture changes over time as the unit of conceptualization for speaking changes. One can therefore predict that in languages which package more components in a clausal unit, children's gestures will become adult-like later than those in a language that expresses one unit per clause. More research in different languages (especially S-framed) is needed to support this claim.

Other research on the early specificity of children's gestures has focused on whether the type of semantic information mentioned by children early on (i.e., as a consequence of verb/semantic typology) is reflected in their gestures. This research suggests that this level of language specificity is evident earlier than the one found for the packaging of Manner and Path mentioned above. For example, 3- to 5-year-old English-speaking children produce gestures that convey primarily Manner information when talking about both *physical* (e.g., 'boy runs through the park'; Özçalışkan, Gentner & Goldin-Meadow 2013; Özçalışkan & Goldin-Meadow 2011) and *metaphorical* motion events (e.g., "ideas run through the mind", Özçalışkan 2007) as they do in speech. In contrast, at this age Turkish-speaking children seem to prefer predominantly talking and gesturing about Path (Özyürek et al. 2014). Furthermore, the claim that the early Path gestures of Turkish-speaking children are shaped by the typological patterns of spoken Turkish is corroborated by the finding that deaf children who are homesigners do not show this Path-only preference in their gestures/signs but rather encode both Manner and Path.

More evidence for how gesture development goes hand in hand with early speech comes from Gullberg et al. (2008), who show early attunement to Path-only gestures among children learning French, another V-language. Finally, in a recent study, Gullberg and Narasimhan (2010) show that in the domain of placement events, developing knowledge of verb semantics in Dutch-speaking children influences the development of representations in iconic gestures, especially in the use of the positional verbs that appear in adult usage with language-specific gestures. In talking about placement events, Dutch-speaking adults and five-year-olds represented both the moving Figure and the Path of motion in their gestures (e.g., fist-shaped hands moving from right to left), whereas three-year-olds encoded only the Path in gestures (e.g., a flat hand with no discernable shape moving from right to left). Gesture use was linked to what could be expressed in the verb. That is, those children who erroneously generalized *leggen* 'lay' for all placement events only gestured about Path. In contrast, those who used *leggen* 'lay' and *zetten* 'set/stand' correctly for horizontal and vertical placement respectively (thus indicating an understanding of the role of Figure orientation in verb use) also represented Figures in their gestures, as did the adults. Note that the results of this study echo those of Özyürek et al. (2008), since both studies indicate that it takes children some time to represent two semantic components in one gesture when it is required by the language-specific ways of tightly packaging semantic information.

Recent research has also investigated the cultural specificity of narrative cohesion and the development of gestures in this aspect. It has been found that the more complex narratives are on the syntactic and pragmatic levels, the more gestures they include, specifically cohesive gestures (Colletta et al. 2014). This study, comparing multimodal narrative development in children (aged 5–10) speaking American English, French and Italian, found cross-linguistic similarities in the development of complexity and rate of iconic gestures used for framing, connecting, and event components. Despite cross-linguistic variation, such as the use of null subjects, no differences were found in gesture development (also see Colletta et al., this volume).

The influence of differences in argument omission across languages on children's gesture productions has been found, however, in pointing gestures referring to entities in the extra-linguistic context. Demir et al. (2012) have found that 5-year-old Turkish-speaking children point more to objects in pictures visible both to the speaker and to the addressee when they omitted arguments in their speech (i.e., supplementing them) in comparison to English-speaking children. However, whether this difference reflects adult patterns of both languages has not yet been investigated.

4.2 Early development: Action and motion event representations

While previous cross-linguistic studies examined older children's gestures, only a few studies have examined the language-specificity of children's gestures between ages 1 and 3 years. This issue was first examined in a study of English-French bilingual children, which revealed that the emergence of iconic gestures was linked to children's proficiency (measured by mean length of utterance) in each language (Nicoladis, Mayberry & Genesee 1999). A correlation emerged wherein children used more iconic gestures in language when they were producing longer utterances, showing early links between type of gesture and language (Nicoladis 2002; Nicoladis et al. 1999). However, this study did not examine whether such differences could be linked to the nature and complexity of children's linguistic representations nor what was semantically represented and with which grammatical constructions.

A recent longitudinal study (Furman, Kuntay & Özyürek 2014) of spontaneous interactions of Turkish-speaking children (aged 1–3 years) with their caregivers has further examined how the semantic and grammatical encoding of events in Turkish influences the emergence and frequency of children's early pointing and iconic gestures (reported to be very few for English-speaking children at this age, Özçalışkan et al. 2014) and how they semantically encode information in relation to what is expressed in speech. This study examined the spontaneous speech and co-speech gestures of eight Turkish-speaking children (data from the Koç University Longitudinal Database) and focused on their caused motion event expressions (e.g., *the man carried the flower pot to the truck*). In Turkish, but not in English, the main semantic elements of caused motion such as Action and Path can be encoded in the verb (e.g., *sok* 'put in') and the arguments of a verb can be easily omitted. It was found that Turkish-speaking children's speech indeed displayed these language-specific features at an early age and focused on verbs to encode caused motion, omitting arguments (Agent and Patient) at least until age 3. More interestingly, their early gestures also manifested this specificity. Children used iconic co-speech gestures representing actions as often as pointing gestures from

19 months onwards, and represented semantic elements such as Action with Figure and/or Path that reinforced or supplemented speech in language-specific ways until the age of 3. Furthermore, the degree of supplementation of verbal argument with gesture was not reduced, and continued even when children were using two or more argument constructions.

These results are in contrast to the scarcity of iconic gestures in relation to the utterances of English-speaking children, as well as to the general finding that supplementary gestures reduce once verb argument constructions are learned (Özçalışkan & Goldin-Meadow 2005). Turkish-speaking children used supplementary gestures as frequently as reinforcing ones. However, the use of supplementary gestures did not decrease significantly as children started expressing more semantic information in speech, unlike previous results in English (Özçalışkan & Goldin-Meadow 2005, 2009). That is, 27- to 36-month-olds still used gestures as supplementary – i.e., to express semantic information that is not encoded in their speech – as frequently as at earlier ages, suggesting that some semantic elements continue to be encoded exclusively in gesture even after children are able to express all elements in speech. The continued use of supplementary gestures might be related to argument ellipsis in Turkish. Arguments representing Figure, Goal and Path can be easily dropped since they can be recovered from the discourse context and verb semantics (see similar arguments for Tzetzal in Brown 2008). In such instances, gestures might be highlighting certain aspects of the visual context that can be omitted from speech and as such serve a pragmatic function throughout development. In support of this result, Furman (2012) found that Turkish-speaking adults and children aged 3 to 5 years continue to use supplementary gestures to represent core semantic information (Figure and Path) not expressed in their verbal descriptions of caused motion events.

Thus, it seems like the language being acquired shapes the type of gestures that children might produce (i.e., pointing only versus pointing and iconic), as well as how they are integrated with speech, in the first three years of life. This suggests that the development of iconic gestures, rather than being guided by general relational thinking (as claimed by Özçalışkan et al. 2014), is in fact sensitive to the information expressed in speech – particularly in verbs (i.e., in a language where verbs emerge simultaneously with nouns (Ketrez & Aksu-Koc 2002) and to the omission of arguments (Kuntay & Slobin 1996). Thus, English-speaking children's late and scarce use of iconic gestures before age 3 might not be due to the cognitive demands that these gestures pose, compared to pointing gestures, as has been previously argued (Özçalışkan & Goldin-Meadow 2011), but is rather attributable to children's frequent (and explicit) use of nouns in English at an early age (Gentner 1982). In Turkish and other languages (Choi & Bowerman 1992), the early acquisition of verbs (e.g., in the domain of caused motion expressions) might modulate not only the content of iconic gestures but even their emergence and frequency in the first years of life as compared to other languages.

5. Conclusions

Although the studies reviewed in this chapter are still relatively few, they show that some aspects of gestures tune into language-specific patterns at an early age and that the timing of this tuning process is affected by language-specific features. This depends on the variation found in multimodal utterances of adults, on the types of linguistic variation (lexicalization, syntactic packaging of information, discourse cohesion) with which gestures align, and on the semantic coordination between speech and gesture (i.e., supplementing or reinforcing in adult patterns). The early tuning of gestures to speech patterns provides evidence for the claim that speech and gesture systems are linked from the very beginning and mutually impact developmental trajectories (McNeill 1992). However, those aspects of gestures that take longer to tune into language-specific patterns might provide a window into general constraints regarding, for example, the development of online conceptualization of speaking, or the development of discourse cohesion. More research on multimodal corpora from different languages is needed to reveal the development of the complex interplay between speech and gesture across languages to determine how children learn to coordinate different levels of representations required in face-to-face multimodal communication.

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CHAPTER 7

Gesture and speech in adults' and children's narratives

A cross-linguistic investigation of Zulu and French

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This chapter reports on a cross-linguistic developmental study comparing speech and gesture produced in narratives by adults and children speaking either French (a non-pro-drop Romance language) or Zulu (a pro-drop Bantu language). We asked 72 participants (French: 12 adults and 24 children; Zulu: 12 adults and 24 children) to narrate a short silent cartoon. Zulu narratives were more detailed and contained fewer comments than the French. Zulu-speaking participants produced more representational and fewer pragmatic gestures than their French-speaking counterparts. Language differences do not explain this result. Rather, the findings support the gesture-speech co-expressivity framework and suggest an impact of literacy practice norms on multimodal narrative performance during later language acquisition.

Keywords: multimodality, development, narratives, Zulu, French, gesture-speech co-expressivity

1. Introduction

In the current study, we examine the relative effects of general cognitive factors (linked to age) and of language-specific factors (linked to the particular system to be acquired) on children's speech and gesture production during a narrative retelling task. We show differences and similarities in narrative ability – from both a cross-linguistic and a developmental perspective – that occur within French (non-pro-drop Romance language) and Zulu (pro-drop Bantu language). The

DOI 10.1075/tilar.22.08col

findings support a model of narrative development that explains changes in the speech-gesture system during later language acquisition despite language differences. However, as will be seen below in the results and discussion sections, Zulu differs from French in other respects that need not rest on purely linguistic features, such as its cultural tradition of oral narration.

1.1 The role of gesture in the development of multimodal communication

As part of the adults' gesture repertoire, gesture studies show that school-aged children start to develop the use of metaphoric gestures, beats, and gestures related to discourse cohesion that help track referents throughout a narrative (Colletta 2004; McNeill 1992; McNeill & Levy 1993). Studies on multimodal dimensions of narratives by French-speaking children and adults (Colletta 2009), Italian-speaking children (Capirci, Cristilli, De Angelis & Graziano 2011), and Zulu-speaking children and adults (Kunene 2010) have revealed that the development of gestural behavior accompanies the development of language. For example, with age, French-speaking children produce longer and more detailed narratives, including reported speech. On the pragmatic dimension of narrative performance, older French-speaking children and adults frame their narratives and include various types of comments (explanations, meta- and para-narrative comments) while wording the events, thus delivering a heterogeneous monologue text (Colletta, Pellenq & Guidetti 2010). Gestures and expressive mimics contribute to this complex information, acting as markers on both structural and pragmatic levels (Colletta 2009).

1.2 The role of language-specific factors in the development of multimodal communication

The structure of languages seems to influence multimodal language development. In terms of syntactic differences, some languages require an explicit subject, such as English and French, whereas others are *null-subject* (or *pro-drop*) languages, such as Italian, Spanish, and Zulu. The status of different languages in relation to this feature implies distinct uses that contribute to the "textual" function of language (Halliday & Hasan 1976), such as for example more or less explicit references to entities, particularly in third person narratives (e.g., Hickmann 2003). Studies on the development of linguistic means for reference introduction and maintenance show significant age-related changes across languages (Hickmann & Hendricks 1999; Jisa 2000). Multimodal studies on narratives by Italian children (Cristilli, Capirci & Graziano 2010) and by second language learners (Yoshioka 2009) report more frequent use of representational gestures that seem to disambiguate reference and compensate for the absence of explicit anaphora or for the erroneous use of anaphora. However, studying French-speaking child and adult narratives, Reig Alamillo, Colletta and Kunene (2010) do not find increased use of representational gestures in similar disambiguating linguistic settings. The fact that French requires the marking of linguistic anaphora (contrary to Italian) could explain this result. But does the compensation hypothesis hold true for non-Romance pro-drop languages such as Zulu?

1.3 Aims of the present investigation

In this paper, we present the results of a study on the production of speech and gesture by French- and Zulu-speaking children and adults in the same narrative task. To our knowledge, this is the first study comparing both verbal and gestural production in Romance vs. Bantu languages.

In a recent study, we compared speech and co-speech gestures observed during a narrative retelling task in three different linguistic groups: French, English, and Italian (Colletta, Guidetti, Capirci, Cristilli, Demir, Kunene-Nicolas & Levine 2015). Five- and ten-year-old children were asked to narrate a short, wordless cartoon. Results showed that French-speaking children produced longer narratives while Italian-speaking children gestured more than their French- and English-speaking counterparts. However, despite other minor differences, the results showed a common developmental trend across the three language groups. On this basis, we proposed a tentative model of multimodal narrative development in which similar developmental changes occur with age despite differences across linguistic systems.

In the present study, we aim at documenting similarities and differences between speech and gesture in narratives produced in French (non-pro-drop Romance language) and Zulu (pro-drop Bantu language). Our hypotheses were as follows. From a developmental point of view, we expected narrative length in both languages to increase, and narratives to include more details and to insert more meta- and para-narrative comments with age, as well as to be accompanied by more gestures, particularly more cohesive and framing gestures, following findings in Colletta et al. (2015). From a cross-linguistic point of view, we expected to see more representational gestures in narratives produced by Zulu-speaking participants compared to French-speaking participants, for the reasons explained in the next paragraph.

As languages differ, different linguistic strategies accompany gestural reference-tracking (Gullberg 2006; Yoshioka 2009). Unlike French, Zulu is a pro-drop language (Bresnan & Mchombo 1986; Marten, Kempson & Bouzouita 2008; Zeller 2008) in which the pronominalized subject is not used unless required by context (e.g., emphasis and contrastive uses). Verbs agree with subject and object through the use of obligatory subject and object markers. Zulu, like all Bantu languages, groups nouns in 15 different classes marked by a prefix. Some noun classes are semantic (e.g., classes 1–2 for persons, 3–4 for trees, rivers and other nouns, 5–6 for parts of the body and other nouns) and others are based on grammatical categories (e.g., classes 1–10 are paired, the first member of the pair is for singular nouns, the second for plural nouns). In Zulu, the agreement prefix is the only indicator of person and class. In turn, the connective that marks a chronological relationship between clauses will take the agreement marker of the referent or head noun. Consider the following examples from a 9-year-old boy.[1]

(1)	*iqanda*	***lase***	*lagcabula*	*ulwembu*	*lawela*	*phansi*
	'the egg	**then**	broke	the spider-web	and it fell	down'

i-qanda	l-as-e	la-gcabul-a	u-lwembu
NC5-egg	5SC-do.next-SBJV	5SC PST-break-V^{suff}	NC11-spider.web

la- wel-a	phansi
5SC PST-fall-appl-V^{suff}	down

(2)	***yase***	*iyaphuma*	*eqandeni*
	'**and then it** [the bird]	came out	of the egg'

y-as-e	i-ya-phum-a	e-qand-eni
9SC-do.next-SBJV	9SC-PRS-come.out-V^{suff}	LOC.NC5-egg-LOC

The connective in Example (1) *lase* incorporates a subject marker that co-refers with the head noun, 'egg' (class 5). This egg then hatches and a baby bird comes out, the head noun then jumps to the animal class 9 (Example (2)). However, the child does not introduce the change explicitly; for instance, the child could have added a transitional clause such as 'from the egg a baby bird comes out'. Then the connective changes to *yase* which now incorporates the marker for the referent as the animal class for birds. This change may require the presence of co-speech gesture to disambiguate the referent. In order to avoid the ambiguity, adult speakers will choose the connective agreement *bese* which is a class 15 nominal or *kwase* which is a class 15 indefinite nominal, allowing the referent to change between different nominal and pronominal classes.

We therefore hypothesized a compensation link between speech and gesture in Zulu-speaking children's narrative performance, i.e., reference-tracking would be partially complemented through representational gestures that help construct and/ or express the referent throughout the narration, in particular during changes of

1. NC – noun class; SC – subject concord; SBJV – subjunctive; PST – past; V – verb; SUFF – suffix; PRS – present; LOC – locative.

chronological connectives that add coherence to the narrative. As a consequence, the proportion of those gestures should be higher in the Zulu narratives than in the French ones.

2. Method

2.1 Participants

The participants were 72 children and adults speaking French and Zulu as their mother tongue (12 adults and 24 children of approximately 6 and 10 years) in each language group; see Table 1). Gender was distributed equally in all groups. Adults were university students in Grenoble and Toulouse (France) and in Empangeni (Kwa-Zulu Natal, South Africa). Children were interviewed in their schools in the same towns. The participants were selected in collaboration with their teachers.

Table 1. Distribution of participants by language and age (years; months)

	6 yrs	**10 yrs**	**Adults**	**Total**
French subjects	12 6 girls M = 5;9 yrs Range = 5;3 – 5;9	12 6 girls M = 9;9 yrs Range = 9;4 – 10;4	12 6 girls M = 25;5 yrs Range = 21;0 – 33;0	36
Zulu subjects	12 6 girls M = 5;7 yrs Range = 5;0 – 6;0	12 6 girls M = 9;5 yrs Range = 9;2 – 9;8	12 6 girls M = 25;5 yrs Range = 19;1 – 26;4	36
Total	24	24	24	72

2.2 Procedure

All participants were asked to watch a video extract (2'47) of a wordless cartoon, taken from the series *Tom & Jerry*, and to retell the story it depicted. The cartoon starts with a mother bird leaving her egg in the nest. The egg accidentally falls out and rolls into Jerry's house. The egg hatches in Jerry's house and a baby woodpecker emerges. The baby bird then starts damaging Jerry's furniture. After a few failed attempts to calm the bird down, Jerry gets angry and decides to put the bird back into its nest. All participants' narratives were videotaped for later analysis.

2.3 Coding

For transcription and annotation purposes, we used a multi-tier coding grid in *ELAN* originally designed for the Colletta et al. (2015) cross-linguistic study and a coding manual, accessible from <http://www.lat-mpi.eu/tools/elan/>, that accompanies the annotation system. It presents transcription rules adapted from the Belgium VALIBEL system, defines the linguistic and gestural variables to be analyzed, explains how to code tier by tier, and provides examples for each variable.

2.3.1 *Speech coding*

The number of clauses or words provides a possible indication of the quantity of information in a given verbal production. However, work in the framework of Conversation Analysis demonstrates that spontaneous talk comes along with hesitations, filled pauses, vowel lengthening, restarts, repetitions, rewordings and other hints of the speaker's on-going process of enunciation (Goodwin 1981). Consequently, in order to compare the narrative performance of all participants, and as they differ greatly in their marking of the speech production process, we removed all marks of this kind from the transcripts before segmenting the participants' speech into clauses. Two examples from French and Zulu narratives are provided in the Appendices. In order to track language and age differences as stated in the previous section, we then analyzed the pragmatic contents of the narratives. Basing our analysis on Labov and Waletzky (1967) and McNeill (1992), each clause was categorized as expressing one of the four following discourse functions.

a. **Narrating:** when the clause describes an action represented in the cartoon, e.g., "*then the mummy bird looks at her watch / and stops knitting*" (two clauses in Italics coded as "narrating").
b. **Explaining:** when the clause imports a causal piece of information: the subject includes an additional explanation to the narrated event, e.g., "he takes it [the bird] back to its nest / *because it's breaking everything*" (second clause in Italics coded as "explaining").
c. **Interpreting:** when the clause presents an inference or an interpretation concerning the situation or the intentions of the characters: the subject invents some information on the basis of the event, makes a hypothesis, e.g., "then it [the mummy bird] looks at its alarm clock / *it realizes / that it is time to leave*" (last two clauses in Italics to be coded as "interpreting").
d. **Commenting:** when the clause deals with neither explicit nor implicit aspects of the course of the events but presents either a "meta-narrative comment" (McNeill 1992: 185) relating to the story, its genre, or its structure, e.g., "*I watched an extract from a Tom and Jerry cartoon*"; "*the story starts with…*",

or a "para-narrative comment" (McNeill 1992: ibid.): personal appreciation, judgement on a character or an event, comment on the action of telling the story itself, e.g., "*it is a crazy bird*"; "*I like this cartoon*".

2.3.2 *Discourse cohesive clues*

In order to study the role played by representational gesture in the backtracking of referents in Zulu as compared to French, we coded for linguistic anaphora (i.e., nominal anaphora, personal and relative pronouns) that contribute to reference maintenance in French, and for chronological connectives which mark inter-clause relationships in narratives such as AND, THEN, BEFORE, AFTERWARDS (e.g., Zulu *lase, wase, yase, bese, kwase* 'and then she/he/it'; French *puis, et puis* 'then', 'and then'). Chronological connectives were coded because of their anaphoric properties in the Zulu language. Note that a few other chronological markers were produced by both children and adult Zulu speakers, but for this article, we selected the five most frequent markers in the corpus.

2.3.3 *Gesture coding*

For the coding of co-speech gesture, we defined ways to identify and then code gestures and their relationship to speech on several dimensions. To identify gestures, each coder took into account the following three criteria (based on proposals in Kendon 2004):

a. If the movement was easy to perceive, of good amplitude or marked well by its speed.
b. If location was in the speaker-interlocutor's shared frontal space rather than in a less salient location.
c. If there was a precise hand shape or a well-marked trajectory.

These were all rated on a scale of 0 to 2, 2 being the strongest value.

Once a gesture had been identified (total score > 3), the coder annotated its phases (e.g., preparation, stroke, hold, retraction) and attributed a function to each gesture stroke. The coders had to choose between the following types:[2]

a. **Representational**: hand or facial gesture, associated or not with other parts of the body, which represents an object or a property of this object, a place, a trajectory, an action, a character or an attitude (e.g., two hands drawing the form of the referent; hand or head gesture pointing to a spot that locates a virtual character or object in the frontal space; hand or head moving in some direction

2. Deictic pointing was coded but was not taken into consideration in this study, as the monologue task did not favor their use.

to represent the trajectory of the referent; two hands or body mimicking an action), or which symbolizes, by metaphor or metonymy, an abstract idea (e.g., hand or head movement towards the left or the right to symbolize the past or the future; gesture metaphors for abstract concepts).

b. **Discursive**: cohesive gesture which aids in structuring speech and discourse by accentuating or highlighting certain linguistic units (e.g., beat gesture accompanying certain words; repeated beats accompanying stressed syllables), or marking discourse cohesion by linking clauses or discourse units (e.g., brief hand gesture or beat accompanying a connective).
c. **Framing**: gesture which expresses an emotional or mental state of the narrator (e.g., face showing amusement to express the comical side of an event; shoulder shrug or facial expression of doubt to express uncertainty about what is being asserted).
d. **Performative**: gesture realizing a speech act (e.g., head nod as a "yes" answer, head shake as a "no" answer), or co-expressing, together with the verbal utterance, the illocutionary value of a speech act (e.g., head nod accompanying a "yes" answer, head shake accompanying a "no" answer).
e. **Interactive**: gesture accompanied by gaze towards the interlocutor expressing that the speaker requires or verifies his/her attention, or shows that s/he has reached the end of his/her speech turn or his/her narrative, or towards the speaker to show his/her own attention (e.g., nodding head while interlocutor speaks).
f. **Word Searching**: hand gesture or facial expression indicating that the speaker is searching for a word or expression in contexts of incomplete utterances (e.g., frowning, staring above, tapping fingers while searching for words).

2.3.4 *Rates per clause*

In order to ensure comparability across groups, we divided the total number of gestures and gesture types by the number of clauses. These rates allowed us to account for individual and age group differences, as well as to compare the proportions of gestural components in the different groups.

2.3.5 *Reliability*

In order to establish reliability in gesture coding, two separate coders identified the gesture units and attributed a function to each stroke. A third coder validated their annotations and settled any disagreements. Agreement on the identification of gesture units was 87%, and agreement on the function attributed to each stroke was 85%.

3. Results

All of the data were processed using two-way ANOVAs with language groups (2: French, Zulu) and age groups (3: age 6, age 10, adults) as between-subject factors. This section presents data concerning these two factors, language and age, first in relation to the linguistic measures, then in relation to the gestural measures.

3.1 Effects of language and age on linguistic measures

We first examined narrative length in terms of the number of clauses that were used by the participants in each age group. Table 2 presents the results for clauses as well as the pragmatic type of clauses for both language groups and for the three age groups. Our results showed that overall, collapsing age groups, Zulu speakers produced slightly longer narratives ($M = 42.06$, $SD = 16.71$) than the French speakers ($M = 35.64$, $SD = 16.12$), but this difference did not reach statistical significance. However, the length of narratives showed an overall effect of age ($F(2,71) = 7.69$, $p < .001$). In particular, adults produced longer narratives than six-year-old children. In French the post-hoc Bonferroni test showed that the six-year-olds' narratives were significantly shorter than those of the ten-year olds ($p < .03$) but did not differ significantly from the adults. Length also did not differ significantly between ten-year-olds and adults. In Zulu there was a significant difference between six-year-olds and adults ($p < .02$) but this sample showed no significant difference between six-year-olds and ten-year-olds. However, as in French, length differences between ten-year-olds and adults did not reach statistical significance.

Table 2. Means (SD) of clauses and pragmatic type of clause per language and age group

Language	Age group	Clauses (SD)	Narration clause (SD)	Commentary clause (SD)	Interpretation clause (SD)	Explanatory clause (SD)
French	6	26.67 (13.59)	23.50 (11.80)	0.50 (0.67)	1.42 (1.51)	1.00 (1.48)
	10	44.00 (19.31)	38.92 (17.86)	1.33 (1.15)	1.50 (1.68)	2.33 (1.44)
	Adults	36.25 (12.91)	24.58 (8.99)	6.33 (2.96)	1.83 (2.17)	5.42 (4.14)
Zulu	6	31.5 (7.20)	28.58 (6.57)	0.58 (1.00)	0.08 (0.29)	0.83 (1.27)
	10	45.75 (16.32)	41.42 (15.40)	0.50 (1.00)	0.58 (0.79)	2.17 (3.04)
	Adults	48.97 (17.92)	39.75 (14.01)	2.58 (2.61)	4.75 (4.16)	0.92 (1.51)

Second, we analyzed the pragmatic content of all clauses extracted from the data. We calculated the mean number of narrative, commentary, explanatory, and interpretative clauses produced by the participants (see Table 2). Our results showed that the most frequent type of clause was the narrative clause, which is consistent with the type of language task proposed to the participants. ANOVAs revealed an effect of age ($F(2,71) = 7.11$, $p < .002$) as well as an effect of language ($F(1,71) = 6.12$, $p < .02$) but there was no interaction between the two factors. Collapsing across language groups, Post-hoc Bonferroni tests showed that the age effect for the narrative clauses only concerned the difference between the six-year-olds and the ten-year-olds ($p < .001$), showing that the youngest children produced fewer narrative clauses than the older children.

A closer look at each language group showed distinct patterns with regards to the use of narrative clauses. In French, the Post-hoc Bonferroni tests showed that ten-year-olds produced significantly more narrative clauses than the adults ($p < .04$). The adults did not differ from the younger children in terms of the quantity of clauses produced. However, French-speaking adults tended to give summarized accounts of the story, sticking to the story plot and the main events, whereas older children tended to give more of an event-by-event account. In contrast, in Zulu the Post-hoc Bonferroni tests showed that the number of narrative clauses did not differ significantly between ten-year-olds and adults. Unlike French-speaking adults and more like older children from the same language group, Zulu-speaking adults tended to give elaborate details of the narrative.

Clauses providing commentaries, explanations, and interpretations were less frequent but their distribution over the two languages was different: French speakers produced more non-narrative clauses (20% out of the total number of clauses) in comparison to Zulu speakers (10%). Because of the scarce production of each of the three types of non-narrative clause, we grouped them together for statistical analysis. Non-narrative clauses were more frequent in the adults' productions than in the children's. We found a significant effect of language ($F(1,71) = 16.07$, $p < .001$) and age ($F(2,71) = 37.54$, $p < .001$) as well as an interaction between the two factors ($F(2,71) = 6.29$, $p < .003$).

The fact that there is an interaction between language and age suggests that changes in performance with age differed in French and Zulu (see Table 2). On the one hand, non-narrative clauses in French-speaking adults' narratives represent 38.5% of the total number of clauses. On the other hand, non-narrative clauses in the Zulu-speaking adults' narratives represent 16.5% of all clauses.

To sum up, French-speaking adults not only insert substantially more information that expands the retelling of the events than Zulu-speaking adults, but they also include more meta-narrative and para-narrative comments as well as causal explanations. Unlike their French-speaking counterparts, Zulu-speaking adults tend to narrate in greater detail and insert less information that expands the retelling of the events. When they do so, they favor interpretations of the events rather than commentaries or explanations.

3.2 Effects of language and age on gestural measures

As Zulu speakers produce more clauses and presumably more detailed narratives than their French counterparts, we would expect the Zulu participants to produce more co-speech gestures. However, although Zulu speakers produced more co-speech gestures than the French speakers (see Table 3), the ANOVA on gesture rate did not show any significant effect of language.

As co-speech production is sensitive to age, older children and adults were expected to gesture more than young children. Indeed, as indicated in Table 3, the ANOVA showed an effect of age ($F(2,71) = 38.80$, $p < .001$). As confirmed in Post-hoc Bonferroni tests, French-speaking adults gestured significantly more than six-year olds ($p < .003$). However, the frequency of gesture did not significantly differ between ten-year-olds and adults. On the other hand, Zulu adult speakers produced significantly more gestures than both six- and ten-year-old children ($p < .001$ in both cases). There was also an interaction between language and age ($F(2,71) = 3.54$, $p < .04$) suggesting that narrative performance differed between the two language groups, as discussed in more detail below.

Table 3. Means (SD) of gestures and gesture types (rate per clause) per language and age group

Language	Age group	Gesture rate (SD)	Representational gesture rate (SD)	Discursive gesture rate (SD)	Framing gesture rate (SD)
French	6	0.27 (.20)	0.13 (0.17)	0.01 (0.02)	0.03 (0.04)
	10	0.56 (.31)	0.31 (0.29)	0.09 (0.06)	0.09 (0.11)
	Adults	0.86 (.42)	0.34 (0.22)	0.26 (0.23)	0.20 (0.14)
Zulu	6	0.25 (.26)	0.20 (0.21)	0.01 (0.01)	0.01 (0.02)
	10	0.52 (.32)	0.41 (0.29)	0.03 (0.02)	0.03 (0.03)
	Adults	1.26 (.34)	0.85 (0.33)	0.17 (0.12)	0.07 (0.05)

Further analyses examined the types of gestures produced as a function of age and language. For these analyses we removed the interactive, performative, and word-searching gestures from the data, given their infrequent use as well as their functions – which do not directly relate to the narrative, meta-narrative and para-narrative aspects of monologue narration. Our analyses on gesture type were thus conducted on the three main categories of representational, framing, and discursive gestures.

As predicted, we noted that the type of gesture most used by all participants was representational (see Table 3). Almost all occurrences represent characters (e.g., mother bird, egg/baby bird, mouse) as well as their actions and displacements in the story. We also noted that representational gestures were more frequent in the Zulu data (83% of all three types of gestures against 56.5% in the French data) whereas non-representational gestures (i.e., framing and discursive gestures) were more frequent in the French data (23.5% of all three types of gestures for discursive gestures against 11% in the Zulu data; 20% for framing gestures against 6% in the Zulu data). This result is consistent with our earlier observation about the pragmatics of narratives, which suggests that Zulu speakers place more emphasis on narrative than non-narrative clause types.

We proceeded with an analysis of the rates per clause of the three types of gestures. We found an age effect ($F(2,71) = 16.73$, $p < .001$) for both language groups and a language effect ($F(1,71) = 13.67$, $p < .001$) as well as an interaction between these two factors ($F(2,71) = 5.35$, $p < .007$) for representational gestures. Post-hoc Bonferroni tests confirmed that the adults produced significantly more representational gestures than the six- and ten-year-old groups ($p < .001$ and $p < .007$, respectively). There was also a significant difference between the children's groups, with the ten-year-olds producing significantly more representational gestures ($p < .03$) than the six-year olds. However, the French data did not reveal any effect of age ($F(2,35) = 2.81$, $p < .075$). The Post-hoc Bonferroni tests showed that children and adults did not differ significantly in their production of representational gestures. In contrast, the Zulu data showed a significant effect of age ($F(2,35) = 16.59$, $p < .001$), and Post-hoc Bonferroni tests showed that the adults produced significantly more representational gestures than the six- and ten-year-old children ($p < .001$; $p < .002$).

As for non-representational gestures (framing and discursive), Table 3 shows that French-speaking adults produced more of both types of gestures than their Zulu-speaking counterparts. Grouping the rates per clause for framing and discursive gestures gives us a clearer picture of how these gestures were distributed across languages and age groups. The ANOVA revealed an age effect ($F(2,71) = 30.82$, $p < .001$), a language effect ($F(1,71) = 7.34$, $p < .001$), and an interaction between these two factors ($F(2,71) = 6.29$, $p < .003$). Post-hoc Bonferroni tests showed that the French-speaking adults produced significantly more non-representational gestures than the six- and ten-year-old children ($p < .001$ in both cases), but the difference between the children's groups failed to reach significance. In line with the higher number of non-narrative clauses produced by the French speakers, non-representational gesture production is higher showing that speakers produced more gestures to accentuate, emphasize, and explain events. Zulu speakers, on the other hand, produced fewer non-representational gestures: their gestures mostly remained on the narrative level and involved fewer commentaries and explanations.

3.3 The role of gesture in tracking referents in Zulu narratives

In order to study the role of representational gesture in the backtracking of referents in Zulu and French, we selected the gestures that represented main characters, actions and displacements, and that occurred with linguistic anaphora. In the French data, such gestures were produced with nominal and pronominal anaphora, as demonstrated earlier on a larger set of data by Reig Alamillo, Colletta and Kunene (2010). Only a small proportion of personal pronouns (73 out of 881 occurrences) were found to be underspecified, and only relatively few occurrences of the last category were accompanied by a gesture that helped disambiguate reference. In Zulu, an interesting result concerned gestures that occurred with chronological markers. For the introduction of referents, Zulu speakers used nouns and pronouns, but to track referents throughout the narrative they used chronological connectives (e.g., '*lase*', '*yase*', '*wase*', '*bese*', '*kwase*') as described in our introduction (see Table 4).

Table 4. Number of chronological markers and co-occurring representational gestures per age group in the Zulu data

	lase	*wase*	*yase*	*kwase*	*bese*	Total	Average
6 yrs speech occurrences	19	31	10	10	5	75	15
6 yrs representational gestures occurrences	5	5	0	0	0	10	2
10 yrs speech occurrences	25	17	14	3	54	113	22.6
10 yrs representational gesture occurences	6	6	5	0	5	22	4.4
Adult speech occurrences	12	13	7	3	25	60	12
Adult representational gesture occurrences	8	11	4	4	4	31	6.2

Out of a total of 248 occurrences of these types of chronological markers, only 63 (25%) were accompanied by a representational gesture. This result was contrary to our prediction as only a small proportion of the gestures that occurred with connectives were used to disambiguate referents. With the exception of a few children among the six-year-olds, all speakers introduced referents each time they changed their denotation (e.g., 'the egg' to 'the baby bird') and used the correct subject agreement. The gesture would then serve to integrate the information on the referent or render it more precise. So if a speaker referred to the egg as both an egg and a baby bird, the gesture would take the form of the egg or the baby bird, in line with what had been expressed in speech.

Table 5. Means (SD) of chronological markers and co-occurring representational gestures (rate per clause) per age group in the Zulu data

	Chronological markers rate per clause (SD)	Co-occurring representational gestures rate per clause (SD)
6 years	0.48 (.49)	0.06 (.13)
10 years	0.49 (.76)	0.10 (.19)
Adults	0.25 (.47)	0.13 (.38)

In terms of development, adults also used other chronological markers that were infrequent in the children's groups, so they did not rely too much on *lase*, *yase*, *wase*, *kwase*, and *bese* which explains their low production of 0.25 per clause (see Table 5). Adults, however, produced a higher rate per clause of representational gestures occurring with such connectives. For instance if the 'mouse' was on their right, the connective occurred with a gesture to refer to the imaginary spatial position where the 'mouse' was. A qualitative investigation shows that most of the adult gestures occurred with the onset of a chain of representational gestures that followed the connective.

To sum up, the quantity of gesture produced in our narrative task shows an increase with age in both languages. Yet developmental change differs qualitatively across language groups. French-speaking adults gesture significantly more than six-year-old children while Zulu-speaking adults produce significantly more gestures than six- and ten-year-old children. Zulu-speaking narrators tend to favor the use of representational gestures, especially adults, whereas French-speaking narrators use more non-representational gestures than their Zulu-speaking counterparts in all three age groups. As for reference maintenance, Zulu-speaking narrators use gestures to help track the main characters of the story, to add emphasis or to reinforce linguistic anaphora when using chronological connectives. French-speaking narrators also produce representational gestures along with linguistic anaphora. In both languages, gesture is rarely used by young children to resolve linguistic ambiguity.

4. Discussion

4.1 Effects of language on narratives

Considering first the verbal content of the narratives, Zulu-speaking adults favored an 'event-by-event' account, whereas French-speaking adults produced more non-narrative clauses and favored more synthetic accounts or summaries in their storytelling. We think cultural specificities in conceptions of literacy can help explain these unexpected differences. Zulu is a Bantu language with a long tradition of *orature*. For centuries, information, culture, and education were transmitted through oral narratives alone (Groenewald 2004; Ramaila 2005). Despite possible changes linked to the introduction of television into households, or due to the mixing of population in urban settings, traces of the oral past of Zulu are vividly present today in South Africa. Storytelling in traditional oral folklore requires a participative audience and the storyteller mimics roles to allow the tale to be as imagistic and realistic as possible. French, on the other hand, has a long written history that dates back to the 15th century. Storytelling practice relies on reading books rather than on oral performance. For example, when French children go to bed at night, their caregivers will read them a story from a book. This shared reading practice is also favored at school. Interestingly, teachers who read stories to pupils concentrate both on reading as well as on showing and commenting on the pictures in the book (Grossmann 1996). In Zulu, telling a story entails telling all events as they occurred enriched with depictions of characters and situations. Conversely, in French, narrators do not conceive of oral storytelling as necessarily requiring an event-by-event account, and they rather navigate through different narrative levels including meta- and para-narrative comments.

4.2 Effects of language on gestures

The Zulu-speaking participants produced a higher number of co-speech gestures than the French-speaking participants. As expected they produced comparatively more representational gestures than their French-speaking counterparts. In order to test our hypothesis on the distinctive role played by gesture in reference maintenance in the two languages, we focused on gestures that represent the characters, their actions and displacements. Although we could not run statistical analysis on so few data, the results show differences in the way representational gesture participates in the marking of reference throughout the telling.

In the French data, the gestural representation of characters coincides with linguistic anaphora (nouns and pronouns). The third person personal pronoun paradigm in oral French is limited to a dual opposition within gender (/il/ *vs* /ɛl/) and number (/il/ *vs* /ilz/, /ɛl/ vs /ɛlz/ in the context of a liaison). The paradigm and its use in the context of the narrative is mastered by the age of ten years, as shown in our data by the small percentage of underspecified pronouns in the older group of children and in the adult group (7% and 3%, respectively). As a consequence, there is virtually no need for representational gesture to disambiguate speech except for very few occurrences in the younger group's narratives.

In contrast to French, the linguistic marking of reference maintenance in Zulu is supported by chronological connectives rather than by pronouns. Connectives that mark a succession of events incorporate an agreement prefix (subject marker or object marker) that indicates the referent's person and class. In our study, the narrator has to select up to 15 types of marking when using a connective to relate a certain episode within the story involving one character or another character. The chances of error are potentially higher than in French. Yet, except for a few children in the younger age group, the Zulu-speaking narrators use the correct subject agreement. According to several studies (see Demuth 2000 for a synthesis), children exposed to Bantu languages acquire the phonology of Bantu noun prefixes much earlier than its semantics. In our study, young Zulu-speaking children who do not use the correct noun prefix could be in the semantics stage of acquisition that starts around age 4–5 years for the distinction between 'human' and 'animacy' features (Demuth 2000). However, in line with the above finding, only a few occurrences of the concomitant representational gestures help disambiguate linguistic anaphora. In other words, the current investigation does not provide any evidence showing that Zulu-speaking children use gesture to disambiguate linguistic anaphora.

What would account for the profusion of representational gestures in the Zulu performance? Since the compensation hypothesis cannot explain this result, an alternative explanation could lie in the cultural specificities of literacy norms as described in the last section. As illustrated by narrative performance in our study, telling a story in the Zulu language entails denoting all events as they occur in the story plot, enriched with depictions of characters, situations and events. In effect, olderZulu-speaking children and adults used a lot more representational gestures throughout their narrative. They rarely interrupted the retelling of the event frame to insert a comment, thus producing far fewer non-narrative gestures than the French-speaking narrators. Conversely, for the French speakers, their gestures were comparatively more pragmatic (discursive gestures that mark structure and cohesion; framing gestures that help reinforce, connote, or supplement a verbal utterance) than representational.

In order to test the effect of literacy norms on the speech-gesture system, we need to further examine the effective practice of storytelling in Zulu culture as compared to French, as well as experiments comparing a non-narrative monologue type task (e.g., depiction, explanation) and a narrative task. A follow up study on the formal aspects of gesture (i.e., locating a character in space in front of the narrator, tracing its displacement, representing the character on the basis of one of its features) would also be of interest to get a more precise view of the import of gestural to verbal information in both languages.

4.3 Effects of age on narratives

Similar differences occurred in both language groups between younger children, older children and adults. Interestingly, these differences appeared in the gestural aspects of narrative performance as well as in the length and the pragmatics of the narratives. Adults and older children produced longer narratives with more narrative and non-narrative clauses than younger children in both languages. Previous studies have shown that children do not fully master the ability to summarize stories before age 9 (Fayol 1997). Interestingly, this summarizing behavior appeared in the French-speaking adults, but not in the Zulu-speaking adults.

4.4 Effects of age on gesture

Within each language group, adults produced more gestures than both groups of children, and older children produced more gestures than younger children. However, speakers across language groups differed in the types of gestures they used. The ten-year-old Zulu-speaking children produced significantly fewer gestures than the adults. Yet the type of gestures they produced was more representational, which showed that Zulu-speaking children are developing their ability to make their interlocutor visualize what is said during the narrative. The ten-year-old French-speaking children also produced significantly fewer gestures than adults, yet they produced more pragmatic gestures than younger children, while adults produced significantly more non-representational gestures than both groups of children. For each age and language, the consistency we found between tendencies observed in the pragmatics of the verbal narrative (narrating *vs.* commenting on and adding to the narrative) and those observed in co-speech gesture production (representing characters and events *vs.* framing and marking discourse structure and cohesion) directly supports McNeill's co-expressivity framework according to which gesture and speech are one system (McNeill 1992, 2014). Our findings are in line with results from cross-linguistic developmental studies that focus on depiction of motion events (Hickmann, Hendriks & Gullberg 2011; Özyürek, Kita, Allen, Brown, Furman & Ishizuka 2008), disregarding task and language specificities, speakers' gestures seem to match the content of their speech.

Moreover, despite the language differences reported here, our findings also support the model of multimodal narrative development outlined in Colletta et al. (2015). Whatever the language, the co-speech gesture system evolves in later language acquisition in order to fulfill new specific functions or new communicative aims such as, in our case, narrating fictitious events. In other words, language and gesture development are tightly related during childhood. Young children in the first year of primary school, who are typically more at ease with dialogue and interactive language formats, find that the production of a story is a difficult task and produce short narratives with not much detail. When they do gesture, they try to represent characters and events. Older children on the way to secondary school have developed narrative abilities that can be seen in the length of their linguistic production as well as in their linguistic and gesture content. They perform the task from beginning to end, concentrate on the narrative, and deliver longer and more detailed accounts. This greater complexity in linguistic information goes along with an increasing use of co-speech gestures to represent and track the characters from the story and to enliven the events. Their gesture repertoire includes discursive gestures that mark discourse progression and framing gestures that express personal feelings towards the story and connote the content of speech. But as this study shows, the narratives of older children introduce orientations that seem to reflect – in terms of both gesture and speech – specificities of literacy which are embedded in social practice and representations of storytelling. Their narrative performance, although not yet adult-like, seems to be in line with the usual narrative performance displayed by adults who belong to the same language/culture group.

In conclusion, our findings provide further evidence for the strong relationship between speech and gesture within a given language. As regards representational gesture production in both languages, the results do not support the idea that gesture is an expressive device that is used to compensate for speech in reference maintenance. Rather, the results suggest an effect of cultural practices and conceptions of literacy on the language-gesture performance and the way it evolves with age. Future data collection and analyses should especially include other Bantu and Romance, pro-drop or non-pro-drop languages, in order to disentangle potentially confounded variables (linguistic *vs.* cultural factors).

Acknowledgements

French data collection was financed by the French National Research Agency (project ANR-05-BLANC-0178-01 and -02). We thank Dr. Andrew Van der der Spuy, Senior Lecturer of Linguistics at the University of the Witwatersrand, Johannesburg, for input on the isiZulu language, Asela Reig Alamillo for helping us with coding and analyses of the data, and the children from Grenoble (Toulouse, France) and Empangeni (Kwa-Zulu Natal, South Africa) who took part in this study.

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Appendices

Examples of a French narrative and a Zulu narrative

The two extracts below correspond to the telling of the first, second and third episodes in the story. The extracts are segmented into clauses.

French boy participant – aged 9;11

En premier c'était la maman • elle tricotait • et puis après elle est partie • et puis l'œuf il bougeait • et puis après il est tombé • il est arrivé dans la maison de la petite souris • et puis la petite souris elle s'est réveillée • et elle s'est réveillée • et puis elle était assise dessus l'œuf • et puis après elle est partie • parce qu'elle avait un peu peur […]

English translation:

First it was the mommy • she was knitting • and then she left • and then the egg it moved • and then it fell down • it ended up in the little mouse's house • and then the little mouse it[she] woke up • and it[she] woke up • and then it[she] was sitting on top of the egg • and then it[she] left • because it[she] was a bit scared […]

Zulu Boy Participant – aged 9;08

Ngibone ipopayi beligibele esidlekeni • kuneqanda lapha phakathi • yase ipopayi ya.. yathatha lela thawula ya yavala iqanda ngayo • laphuma lelipopayi lahamba • bese leqanda langena kuleyanto • labampa so lawela eblomini • lagibela iblom' // layiwisa bese lase laphuma laya endlini • langena ekameleni bese // la… kanti lo ulele, bese langena • lona aphakame aphakamise i'ingubo ahlele phezukwalo lomama • kanti iphethe iqanda lomama lo • A:: …athatha athatha leqanda alisusa phezu kwombede […]

English Translation

I saw a cartoon character • who had climbed up, in the nest • There is an egg inside • and then the popayi took a towel • it[she] covered the egg with it • and then this popayi left • and then egg got into that thing • it jumped like this • it fell into a flower • it climbed into the flower • which dropped it • and then it came out • it went into the house • it went into the room and • yet this one is sleeping, • this one gets up • lifts the blanket it[she] is sitting on, this mother • and yet it had an egg on it so this mother • took the egg, • it[she]she removed it from the bed […]

PART II

Variation in input and contexts during acquisition

CHAPTER 8

Conversational partners and common ground

Variation contributes to language acquisition

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Children's early exposure to and experience with language varies. They differ in how much conversational interaction they have with more expert adult speakers, which affects both speed of processing and early vocabulary acquisition. Another source of variation is how many interlocutors children interact with. Interlocutors are male or female, use different dialects, and know differing amounts about the child's daily routines. Here, how much practice children have with interlocutors inside and outside the family affects how well children can establish and make use of common ground. Children also differ in how much practice they have, early on, in making themselves understood to others, and this affects how readily they can establish and then add to common ground with each new interlocutor.

Keywords: variation, interaction, common ground, practice, feedback

Children are exposed to variation in language in many forms from the very first. They hear variations in specific sounds within words (e.g., Seidl et al. 2014), and they must learn which of these variations count as 'the same' (e.g., the varieties of /k/ in such English words as *cup* vs. *cap* vs. *pick* vs. *sock*) within and across speakers. They are also exposed to variations in the forms of words, as in contracted *didn't* or *gonna* vs. full, uncontracted *did not* or *going to,* where the uncontracted forms are more characteristic of somewhat formal or careful speech. (This is distinct from the variations in word form that result from choices of case-marking or number on nouns, say, or choices of person, number, aspect, and tense on verbs.) They are also exposed to variation in constructions, as in the various forms of polar *yes/no* questions in English where speakers use a simple *Coming?, You coming?*, or the canonical *Are you coming?* (Estigarribia 2010), or, as in choice of active and passive constructions that speakers use to mark different perspectives on an event (Clark 1997). And, they are exposed to differences in dialect within a language, for instance

DOI 10.1075/tilar.22.09cla

when parents and caregivers come from different geographic regions or different social classes (Floccia et al. 2012). In this case, children may hear the same word pronounced by two different speakers, with different vowels, as in *bath*, pronounced with /a/ in US English, compared to /ɑ/ in UK English, either on a daily basis, or upon first encountering someone with a different accent.

In this chapter, I take up a rather different aspect of variation in children's exposure to language, namely variation in the amount of common ground children have with different interlocutors. I will argue that this source of variation is particularly important because different interlocutors may know a lot or only very little about the child, for example about daily routines and activities, or about recent history within the family. As a result, children cannot rely on familial common ground, and may have to work hard both to make themselves understood, and to understand new interlocutors. My focus is therefore on *variations in usage* within communicative exchanges, and how different conversational partners play a role in extending children's linguistic skills in the course of acquisition. In effect, children have to learn how to make use of common ground in conversation. On many occasions, they can rely on common ground already established with a familiar interlocutor, and make that their starting point. On other occasions, they must first establish some common ground with the new interlocutor, and then proceed to add to that in the course of any ensuing exchange. Common ground between speakers, I suggest, is important for children's emerging skills in *using* language.

I will start, however, by considering just how much language children are exposed to in their first few years. This is because the amount of interactive exposure early on makes a difference to how readily young children recognize familiar words, an important factor in dealing with unfamiliar speakers. That is, the amount of language children hear in interaction in the first three to four years lays the groundwork for both word recognition and the acquisition of new vocabulary. I will then turn to the general role of common ground in interaction, and review some of the strategies adults and children rely on as they establish and add to common ground, before going on to consider how children manage common ground as they learn to speak with a range of different interlocutors.

How much interactive language are children exposed to early on?

Children differ in how much language they are exposed during their first three or four years. Their exposure depends on the amount of language they hear and produce in interaction with parents, caretakers, and older siblings. (It does not include language they overhear at this age.) The amount of language children are exposed in direct interactions with an adult varies considerably by social class (Hart & Risley 1995), as shown in Table 1. Children in upper-middle class professional families interact with their adult caretakers much more often in a day than children in welfare families. One measure of this is the mean number of words the children hear in interactions with their parents in an hour, in a week, in a year, and extrapolated over the course of three years. Overall, high SES children hear nearly twice as many words before age four as working class children, and nearly four times as many words as children in welfare families. Hart and Risley found that the *amount of interaction* was what mattered for the children, not the number of adults present in the family setting. The amount of speech children hear and respond to in interaction also varies somewhat within social classes, so some children participate in a larger number of adult-child interactions than others (see, e.g., Weisleder & Fernald 2013).

Table 1. Amount of adult-child interaction measured in words/hour by social class [based on Hart & Risley 1995]

SES	Words x hour	Words x week (100 hrs)	Words x year	Words x 3 years
Welfare	620	62000	3 million	9 million
Middle-Working	1250	125000	6 million	18 million
Professional	2150	215000	11 million	33 million

Other researchers have measured the amount of interaction children participate in, not only in terms of the number of words adults use, but also in terms of the number of turns children take in conversation with adults. Both are strongly predictive of scores on standard measures of language development before age three (Zimmerman et al. 2009). In some other studies of early bilinguals, Hoff and her colleagues found that the more English speaking young children interact with others, the greater the children's early proficiency in English (e.g., Hoff 2006; Place & Hoff 2011).

Consequences of differences in amount of interaction

The amount of speech addressed directly to children as they talk with their parents and caretakers in their first three years is highly correlated with their vocabulary size (Weisleder & Fernald 2013). That is, the more young children interact with the adults talking with them, the larger their vocabularies by age three, and in general, the further ahead they are on measures of language development. Fernald and her colleagues found that between 15 and 24 months, for example, young children become better at recognizing familiar words and identifying the intended referent when shown two pictures to choose from, as shown in Figure 1. At the same time, they also get steadily faster at recognizing familiar words as they get older, as shown in Figure 2 (see Fernald, Perfors & Marchman 2006; Fernald & Marchman 2012).

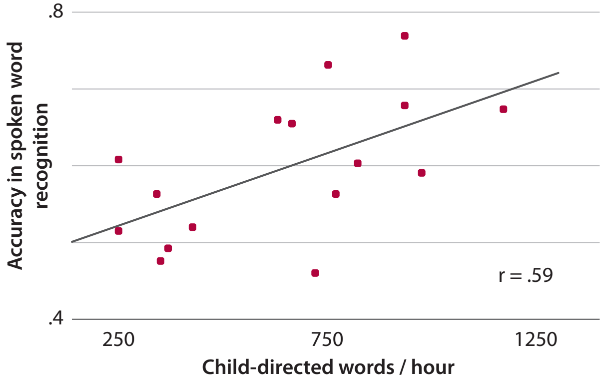

Figure 1. Accuracy in words recognition correlates with amount of child-addressed speech (based on Fernald et al. 2006)

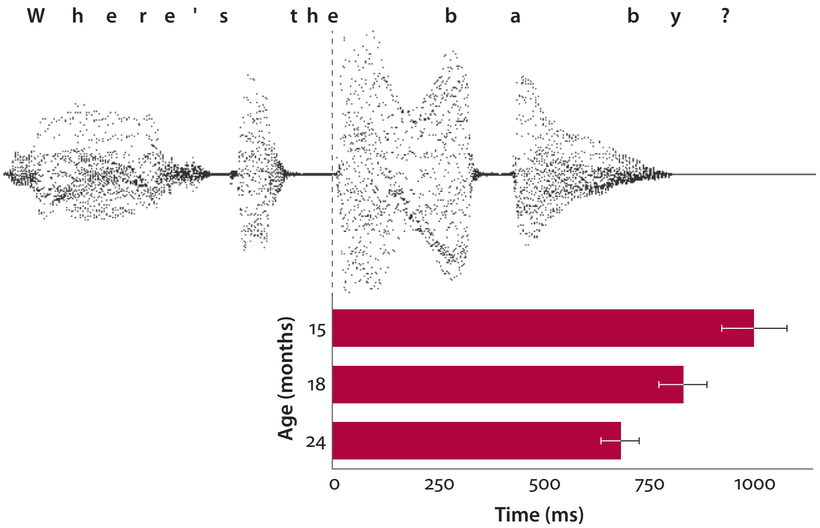

Figure 2. Children become faster with age in word recognition from 15 to 24 months (based on Fernald et al. 2006)

The extent to which young children speed up in their recognition of familiar words as they get older can be seen in the horizontal bars that show how long on average they take to recognize familiar words at 15, 18, and 24 months, as shown in Figure 2.

In summary, very young children who interact more often with adults both hear and *use* more language. I will argue that those children who interact with a number of different adults gain more experience early on in recognizing familiar words from different speakers, are exposed to a certain amount of unfamiliar vocabulary by those adults who do not know them, and so have added exposure to unfamiliar words. In talking to different adults, children necessarily become aware of many of the variations in form that they need to master in order to be able to deal readily with an increasing range of interlocutors. Indeed, this exposure is important not only for the range of linguistic variants they hear, but also for the experience they accumulate on how to talk to both familiar and unfamiliar interlocutors.

Common ground

When children talk with family members, they are usually able to assume that those interlocutors know what the children are talking about when they bring up topics. The adults are aware of the relevant events, daily routines, and current events in the children's lives. In short, within the family, adults and children share quite extensive common ground.

Common ground comprises the information shared by speakers in previous interactions as well as in the current interaction. In a communicative exchange, speakers accumulate common ground over the course of their interaction, with each participant in the conversation ideally adding to it with each turn (see H. Clark 1996; E. Clark 2015). That is, speakers typically acknowledge information offered by the other (at that time 'new' information) and so treat it from then on as 'given' information, now known to both participants. This local accumulation of common ground is accomplished by each speaker contributing in turn, while the other takes up the new information, placing it into common ground, and so transforming it into given information.

Conversational partners

What do the speakers in a conversational exchange know (and know that they know) in common? How do they establish a starting point for their interaction? If two people know that they both enjoy sailing, or that they both bicycle to work, they already have some common ground. If they attend the same school, live in the same village, or work in the same hospital, these too can provide some starting common ground.

Common ground can be viewed from several perspectives. First, take *cultural common ground*: Do we speak the same language? Do we live in the same country, city, district? Did we go to the same schools? To the same university? Do we have friends in common? Second, *local common ground*: When we speak to neighbors, we can assume shared knowledge of who lives in the street, where the local school and shops are to be found, where the closest bus stop is, who owns the red car, and so on, even though we may each have different amounts of knowledge about, and so different degrees of common ground with, specific neighbours. Third, *immediate common ground*: When we speak to a particular individual, how much common ground we share depends in part on whether we have ever spoken before, and if so, how often and under what circumstances. We initially establish common ground in any exchange by agreeing to the topic chosen by the first speaker, and then continue from there, accumulating immediate common ground over the course of the exchange (see further H. Clark 1996).

How does one add information to common ground? Language offers speakers several resources here, primarily through the use of elements that identify the information the current speaker is treating as *given* versus *new*. Speakers typically present given information before any new information in an utterance, and they can signal this in English (and many other languages) with the use of definite articles, where use of the definite *the* marks that information as 'already known' to both speaker and addressee. Speakers mark new information, in contrast, by presenting it at the end of the utterance, with sentential stress, and often introduced with an indefinite article, *a* (see Haviland & Clark 1974; Fisher & Tokura 1995; Clark & Bernicot 2008). Once some information has been placed in common ground, the next speaker can add to that, with a further piece of new information. In this way, speakers can accumulate common ground within their current exchange. At their next encounter, speakers can draw on any previously accumulated common ground.

Common ground for adult and child

What the adult already knows about the child, about the child's recent history, and about the child's everyday routines, all allow the adult to 'scaffold' the very young child's utterances. Children know what their daily routines are, and are aware of departures from those routines – events that are out of the ordinary and so memorable. So when an adult prompts a one-and-a-half year old to 'tell a story', the adult often supplies framing or scaffolding that makes the young child's contributions both possible and timely. Both the framing and the child's contributions in the exchange depend on their common ground. Consider the exchange in (1) (Clark, unpublished diary):

(1) Mo: Did you see Philip's bird? Can you tell Herb?
D (1;6.11): *Head, head, head*. <touches his head>
Mo: What landed on your head?
D: *Bird.*

Here the adult framing of the narrative, based on what the mother and D both knew about the episode in question, presented D with turns where he could supply, with single word utterances (*head*, *bird*) the new information relevant to the story, for the benefit of the child's father (Herb) who had not been present at the original event.

Compare (1) to an initial failure, followed by success, with a similar story-telling episode at much the same age, with Meredith (1;6) and two different interlocutors (Snow 1978), in (2a) and (2b):

(2a) Meredith (1;6, talking to an unfamiliar adult): *Band-aid.*
Observer: Where's your band-aid?
Meredith: *Band-aid.*
Observer: Do you have a band-aid?
Meredith: *Band-aid.*
Observer: Did you fall down and hurt yourself?

Here the adult observer was unaware of the event Meredith wanted to talk about, and so unable to follow up on Meredith's uses of *band-aid*. But when her mother returned to the room, Meredith returned to her topic and immediately received the necessary framing based on the mother's and child's common ground:

(2b) Meredith (1;6): *Band-aid.*
Mother: Who gave you the band-aid?
Meredith: *Nurse.*
Mother: Where did she put it?
Meredith: *Arm.*

What is critical in these exchanges is what the adult knows and can therefore scaffold for the young child – namely the common ground they have already established together. In Meredith's case, the framing offered by her mother works because her mother knew about the episode with the nurse (and had presumably been there with Meredith), but the observer-adult did not know the history here, and so was unable to provide appropriate supporting talk (Bruner 1983).

In the early stages of language acquisition, when children produce only one word at a time, telling of a story with minimal contributions, as in (1) and (2b), is no simple matter. The adult's framing provides an essential scaffold for when to offer those critical single word utterances. Without that framing, young children may well be at a loss for how to go on, and so simply re-iterate their starting point utterance, as Meredith did with her repeated utterances of *band-aid*.

Adding conversational partners

At a certain point, children begin to interact with adults outside their immediate families, adults who do not know them, their daily routines, or their history. One setting in which one can examine some of the effects of learning to talk to different interlocutors is in different daycare settings. The critical issue here is how learning to talk to interlocutors outside the family affects children's language skills. I argue that learning to deal with a variety of different interlocutors is critical in extending children's conversational skills, and in particular their learning how to establish and make use of common ground in relation to each new conversational partner.

Consider the daycare options in France: young children may spend their days at home, or they may go to a *crèche* (a daycare centre) where there are a number of other children and a high ratio of adults who care for them, or to an *assistante maternelle* (a licensed day-care provider) who takes care of three or four children in her home. In a comparison of how children fare developmentally in these three settings, Marcos and her colleagues (2004) compared children on a variety of measures of language development. They found that those children who spent part of the day away from home, at a *crèche* or with an *assistante maternelle*, scored consistently higher on measures of vocabulary size, utterance length, and conversational skill, than children who stayed at home all day.

Why do children who spend part of their day outside the home score higher? Because they are exposed to greater variation in the people they talk with. They interact daily with other adults and children during their time away from home. They learn to understand a range of different interlocutors, and how to manage talk with interlocutors who initially know little or nothing about the children, such as their routines, family settings, or preferences in play and other activities. In doing that, children often have to fill in information that the adult does not know, as well as respond to requests for clarification (e.g., Corsaro 1977; Tomasello, Farrar & Dines 1984). In this way, children learn when to supply relevant information to an adult interlocutor in order to establish some common ground. Thus, exposure to and experience with new interlocutors helps children to extend their conversational skills and supply appropriate information in order to establish common ground.

Then, when these children return home each day, their parents ask them about what they did, who they played with, what they had for lunch, and so on. Answering these parental questions requires that here too children take into account what their parents do and do not know, what is and what is not common ground. In this, they cannot rely on their parents having the necessary knowledge to help them, for example, by scaffolding the telling of specific episodes or the reporting of new activities and events. So, children who spend time outside the home on a regular basis have to assess what even familiar adults do and do not know, and then supply any relevant information needed on each occasion.

In short, exposure to a growing range of interlocutors extends children's skill in learning how to talk to people with varying degrees of knowledge about the children, hence varying degrees of common ground. Children cannot simply count on *all* adults already knowing the relevant background for talk about specific episodes and activities, even if these involve everyday routines. Instead, they have to keep track of what each interlocutor does and does not know. Learning how to do this takes attention and practice. Although young children may not be very skilled at assessing when a particular adult does or does not share the relevant knowledge, they get ongoing practice in this as they talk with caregivers on the one hand, and with their parents on the other. In all their exchanges, they have to choose and then produce linguistic forms appropriate to what they intend to convey to each addressee. In talking to adults other than their parents, as well as to their parents when the latter are unfamiliar with their children's recent activities at daycare, young children gain experience in both establishing and accumulating common ground.

How do speakers establish a starting point?

Two speakers establish common ground in an exchange when Speaker 1 offers a piece of information that the other, Speaker 2, first **ratifies** and can then **add to** by offering some further piece of (relevant) information. But Speaker 2 must first recognize what the starting point is, and identifying this may be difficult when speaking with a young child. Consider the exchange in (4) (from Scollon 1976) where Brenda first attracts her mother's attention (*mama, mama, mama*), and then attempts the word *shoe*, with seven iterations before her mother recognizes the target word, at which point Brenda repeats the word she had been aiming for without adding anything new:

(4) Brenda (1;7.2, holding up her mother's shoe): [mama], [mama], [mama],
[ʃ], [ʃɪ], [ʃ]. [ʃɪʃ], [ʃu], [ʃuʔ], [ʃuʃ]
Mother: Shoes! (RATIFIES B's TOPIC)
Brenda: [ʃi] [ʃi] [ʃuʔ] (REPEATS TOPIC)

But a month later, even though Brenda again had some difficulty getting her mother to recognize the target word (*fan*), she manages to add some new information in the third turn instead, as shown in (5), and her mother then ratified this too.

(5) Brenda (1;8), looking at the electric fan: [fẽĩ] [fæ̃]
Mother: Hm?
Brenda: [fæ̃]
Mother: Bathroom?
Brenda: [fanɪ] [faĩ]
Mother: Fan! Yeah. (RATIFIES B's TOPIC)
Brenda: [k^{h}u] (ADDS NEW INFORMATION)
Mother: Cool, yeah. Fan makes you cool. (RATIFIES NEW INFORMATION)

How do speakers add new information to existing common ground?

Speakers can add information to common ground in several ways, including a verbal acknowledgement in the form of (a) a repeat of the new information, (b) use of deictic *that,* or (c) use of a pro-form of some kind. Or they may rely on non-verbal acknowledgements and proffer a gestural acknowledgement in the form of a head-nod, a glance at the entity or activity referred to, or a pointing gesture, also towards the referent.

Children commonly use *repeats* to ratify adult offers of new words (Clark 2007, 2010), as in Examples (6)–(8), where **bold face** marks the element ratified (new from the previous speaker) and the <u>underline</u> marks new information in the utterance.

(6) D (1;8.2) points at some ants on the floor: *Ant. Ant.*
Father (indicating a small beetle): <u>And that's a bug.</u>
D: ***Bug.*** (RATIFIES NEW INFORMATION)

(7) Hal (1;10.26): *What's this?*
Mother: It's <u>a beaver</u>.
Hal: ***Beaver***. (RATIFIES NEW INFORMATION)

In (6) and (7), both D and Hal repeat the words offered by their parents and so ratify them as words for the referents in joint attention at that moment. In (8), Hal goes further, incorporating the new phrase into his third-turn utterance and adding some new information as well, so he both ratifies the earlier (new) information from the adult speaker, placing it in common ground, and adds new information of his own.

(8) Hal (2;0.20, pointing in book): *What's that?*
Mother: <u>Bag of wool</u>.
Hal: *<u>Man</u> got a big* ***bag of wool.*** (ADDS NEW INFORMATION; RATIFIES)

While children favor repeats for ratification, adults ratify what children say in several ways: (a) They too repeat single words; (b) they frequently check up on what the child intended; and (c) they follow up, expanding on what the child said. Take the exchange in (9) (from the Léveillé/Suppes corpus, CHILDES):

(9) Philippe (2;1.6, hiding his truck behind a piece of paper)
Philippe: *il se cace le camion*. [= the truck is breaking (means 'hiding')]
Father: pas cace, cache. [= not 'break', 'hide']
Philippe: ***cass***. <tries to correct pronunciation>
Father: cache. très bien. [= hide. very good]

Here the father offers feedback on the pronunciation of *cacher* 'hide', which Philippe tries to emulate, though not entirely successfully. Naomi's father also offers feedback, here on the preposition to use, in (10) (Sachs corpus, CHILDES):

(10) Naomi (2;7.16), looking at a book:
Naomi: *one fell down on a tree*.
Father: He fell down from a tree?
Naomi: *he fell down* ***from*** *a tree*.

Adults reformulate erroneous child utterances for between 40% and 65% of the errors produced by children under 3;6 to 4;0 (Clark & Chouinard, 2000; Chouinard & Clark 2003). They reformulate in two ways, with side sequences (70%) and with embedded corrections (30%). Such reformulations (a) check up on children's intended meanings, (b) provide feedback on errors, and (c) place the child's contribution in common ground. This can be seen, for example, in the exchanges in (11)–(13) (from Veneziano 1988):

(11) Mother and child reading a 'texture' book:
Camille (1;5.23): /pik/ [= pricks]
Mother: oui ça pique <u>comme la barbe de papa</u> (RATIFIES; ADDS NEW)
[= yes, that pricks, like papa's beard]
Camille: ***papa***. (RATIFIES)

While Camille's mother ratifies the topic Camille had introduced and adds some new information, Camille herself simply ratifies that new information in her next turn. As she gets older, she sometimes adds new information herself, as in (12), but this is typically only in answer to a question – where even very young children are able to add new information.

(12) Child places a doll in a toy-cradle,
Camille (1;6.28): *dodo dodo* [= sleep, sleep]
Mother: qui c'est qui va <u>faire dodo</u>? [= who's going to go to sleep]
Camille: *bébé* [= baby] (ADDS NEW INFORMATION)

In the next exchange, in (13), Camille adds new information first with the topic she initiates (*chien*) and then by commenting on what the dog is doing (*court* = 'is running'):

(13) Mother and child looking at a book:
Camille (1;7.18): /eʃɛ̃/ [≈ the dog] (INTRODUCES NEW TOPIC)
Mother: *le chien*. [= the dog] (RATIFIES)
Camille: /kur/ [= runs] (ADDS NEW INFORMATION)
Mother: *oui il court le chien* [yes, the dog is running] (RATIFIES)

Schematically, speakers accumulate common ground by each ratifying what the other has just added and then adding in turn to common ground. The ratification of the other's contribution places information in common ground, as shown in (14), and then that speaker in turn can also add something new to the current utterance. This accumulation means, in the ideal, that each speaker ratifies and so adds to common ground whatever new information the preceding speaker has offered. That speaker in turn then adds some new information.

(14) Sp-A: /Given-a/ + New-a
→ Sp-B: /New-a = Given-b / + New-b
→ Sp-A: /New-b = Given-c/ + New-c
[and so on.]

By ratifying what the previous speaker has just said, children acknowledge it and thereby place it in common ground. They achieve this step at a very young age. Ratification is easier than the next step, the adding of new information, because in ratifying children can simply repeat part or all of the preceding speaker's utterance. While early ratifications are usually explicit, made with a repeat or a pro-form of some kind (but mainly with repeats), they can also be implicit, made with a semantically appropriate move-on in the next turn. Consider the following ratifications, using repeats, in (15–17) (from Clark & Bernicot 2008).

(15) Mother: Y'a <u>du riz dedans</u> / hof / j'en mis / un morceau par terre/
[= there's rice in there / oops / I dropped some on the floor]
Elodie B (2;3): ***Du lli dedans***/ [= rice in there]

(16) Mother: Oui on ira au manège mais <u>demain</u> / on ira au manège/
[= yes we'll go to the stables tomorrow/ we'll go to the stables]
Estelle (2;3): ***domain***. [demain, = tomorrow]]

(17) Mother: Hum / C'est trop sucré. [= hm, it's too sweet]
Elodie A (2;3): ***uké*** / [sucré, = sweet]]

Even very young children can add new information with the aid of scaffolding or in well-rehearsed 'proto-conversations'. These tend to consist of exchanges that recur in specific contexts, when the child is reminded of some episode or when looking at particular pages in a book, with the child producing the same sequence of utterances each time, either with or without scaffolding. Compare (18) and (19) (both from Clark, diary):

(18) The 'bird' conversation repeated:
Mother: Did you see Philip's bird? Can you tell Herb?
D (1;6.11) *Head, head, head.* [touches own head]
Mo: What landed on your head?
D: *Bird.*

Compare this to the 'swimming pool conversation' in (19) which first occurred when his parents took D (1;7.1) to the local swimming pool. Over the course of the next week, D made many attempts to talk about the pool and what he had seen there. These 'practice-conversations' at 1;7 all consisted of one or more of the sequences listed in (19):

(19) Swimming pool conversations (D 1;7):
a. swimming / man / Eve [mother] / people /
b. in water / swimming / in water swimming
c. people water / hair water / hair shower / people water / swimming / people water /
d. people water / hair wet / swimming /
e. swimming / water wet / hair wet /
f. people water duck / water duck / go swimming /

As children get older, they become better able to both ratify and add new information without scaffolding, as in (20) and (21) (from Clark & Bernicot 2008):

(20) Mother: Après t'as le printemps.
[= afterwards you have Spring] (ADDS NEW)
Zoë (3;2): ***'temps*** *et* <u>*après l'été*</u>!
[Spring and then Summer] (RATIFIES; ADDS NEW)

(21) Mo: Il est un p'tit peu plus blanc parc'que je ne l'ai pas acheté <u>à la même boulangerie</u> [= it's a little whiter because I didn't buy it at the same bakery] (ADDS NEW)
Daphnée (3;9): <u>*C'était où*</u> ***cette boulanzerie***?
[= it's where, this bakery?] (ADDS NEW; RATIFIES)

Children readily ratify new information introduced by the other speaker, typically by repeating some or all of the preceding adult turn, as we have seen. But in order to add new information themselves, they must assess what the other person (already) knows. They begin to do this as young as age two.

Assessing what the other knows

By age two, and sometimes even younger, children seem able to assess, to some extent, what their interlocutors know or do not know in particular contexts. For example, in a setting where the interlocutor either could see or could not see what had just happened, children aged 2;7 consistently offered more information when the interlocutor did not see, or had less or no knowledge, than when the interlocutor was as knowledgeable as the child (O'Neill 1996), as shown in Table 2.

Table 2. Percentage of labels for objects or places, and gestures to places, offered to parents who knew (present) vs. did not know (outside, eyes shut) by 2;7-year-olds (O'Neill 1996)

Parent:	Name toy	Name place	Gesture to place
Present	56	13	56
Outside	***75***	***44***	***94***
Present	50	13	44
Eyes/ears shut	***73***	***33***	***80***

Even younger children, aged 2;3, in a similar task, consistently pointed more often to the location of an object placed on a shelf by the Experimenter when their parents had had their eyes shut during the placements, than when they had had their eyes open, as shown in Table 3. That is, they took account of what their parents knew in each condition.

Table 3. Percentage of pointing gestures to location by 2;3-year-olds after parents had had their eyes open vs. shut during E's placements of objects on a shelf (O'Neill 1996)

	Child: pointing gestures to location	
Trial	**Parent eyes open**	**Parent eyes shut**
1	44	**75**
2	50	**63**
3	40	**80**

At an even younger age, infants appear able to keep track of which of two adults had played with a toy with them earlier on, and make use of that information when invited to help put the toys away by the adult who had played with a specific toy (shared) or not (unshared), as shown in Figure 3.

In a study of spontaneous helpfulness in one-year-olds, Liszkowski and his colleagues (2008) found that 12-month-olds were much more likely to point at an object that had fallen off a desk if the adult at the desk appeared not to know where it had gone, than if that adult showed signs of knowing whether it had fallen, as shown in Figure 4.

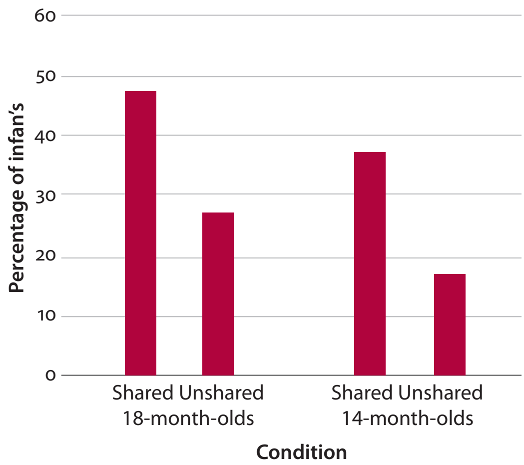

Figure 3. Infants keep track of shared experience in play at 1;2 and 1;6 (Liebal et al. 2009)

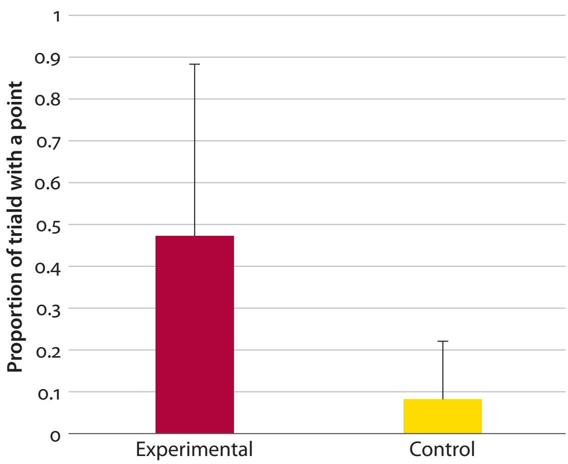

Figure 4. Number of pointing gestures by 12-month-olds for adults who knew (+) or did not know (–) the location of a fallen object (Liszkowski et al. 2008)

These findings show that young children begin to keep track of what their interlocutor knows in certain settings as young as 12–14 months – whether an adult saw *where* an object fell down, and so might, or might not, need information in order to locate it; or which toy the child played with, with a specific adult (the toy picked up when the child was asked to put <u>*the*</u> toy away); or whether the parent saw where a sticker was placed or not. What children this age do not yet know are the linguistic devices that serve to identify verbal information as 'given' versus 'new'.

Linguistic devices for signaling *given* and *new*

Speakers can signal that information is 'given' in several ways. They typically place that information first in their utterances, and so background it compared to any new information. They mark noun phrases as given by making them definite, or they use a deictic like *that* to refer to an event that has already been mentioned, and a pronoun to refer to a person who has already been mentioned. These devices have other functions too, and children take quite a long time to learn, for instance, how to use indefinite and definite articles to signal whether some information is new (indefinite) or given (definite). Younger children often overuse (and so misuse) the definite article, as in (22) and (23) (from Brown 1973):

(22) Sarah: *the cat's dead.*
Mother: What cat?

(23) Adam: *Put it up, the man says.*
Mother: Who's the man?

But by age six or seven, children do much better, as in (24) (from Bowerman, diary data).

(24) Christy (7;0.21, listening as her younger sister Eva tells their mother about a TV program, without any previous mention of "the island")
Eva: .... the island.
Christy: You're saying "the"! … She doesn't know!

By age four to five, children produce *a* and *the* regularly in English noun phrases, but are not yet able to assign their articles in relation to the interlocutor's perspective with respect to what is known already and therefore given, compared to what is new. As a result, they often appear to misjudge what their interlocutors already know, over-using the definite article, up to age eight or nine (see Maratsos 1974; Warden 1976; Bresson 1977).

Young children often introduce new information in the form of new topics for the interlocutor to follow up – but these introductions by very young children, as we have seen, are not always successful, as in (25) (from Scollon 1976).

(25) Brenda (1;8), as a car passes on the street; not heard by the adult
Brenda: [k^{h}a] [k^{h}a] [k^{h}a] [k^{h}a]
Adult: What?
Brenda: [gɔo] [go]
[bəɪʃ] [bəɪʃ] [bəɪʃ] [bəɪʃ] [bəɪʃ] [bəɪʃ] [bəɪʃ] [bəɪʃ] [bəɪʃ]
Adult: What? Oh, bicycle? Is that what you said?
Brenda: [naʔ]

Adult: No?
Brenda: [naʔ]
Adult: No – I got it wrong. <laughs>

In this particular instance, when transcribing the tape later, the adult observer noticed the sound of a bus in the background and only then realized what Brenda had been trying to say.

When young children's bids to introduce new topics are recognized and then, in the next turn, ratified by the adult interlocutor, the children must then add a further piece of new information, in a third turn. That is, they need to go beyond simply ratifying new information introduced by the other (adult) speaker, and add new information themselves, so as to advance the conversational exchange. Children become better at doing this as they get older, and by 3;6 are beginning to become quite adept at adding new information, as shown in Table 4.

Table 4. Third-turn responses at 2;3 and 3;6 (Clark & Bernicot 2008)

Age	Acknowledge (*mh, ouais*)	Repeat alone*	Repeat +New*	Semantic move-on
2;3	6.33	**3.79**	0.67	0.87
3;6	6.06	0.56	**2.26**	1.51

But two-year-olds typically use third turns only to ratify new information contributed by the adult, as in (26), compared to (27) where the three-year-old also adds new information. Note, however, that this was in response to a question.

(26) Child (2;3): *Ze mets à bouche.* [= I put in mouth]
Adult: Tu le mets à la bouche ? [= you put it in the (your) mouth]
Child: ***oui ze mets à la bouche***. (REPEATS GIVEN INFORMATION)
[= yes, I put in the mouth]

(27) Child (3;5): *là – dans la machine* [= there – in the machine]
Adult: dans quelle machine? [= in what machine?]
Child: <u>*dans l'ordinateur*</u>. [= in the computer] (ADDS NEW INFORMATION)

Exchanges with a variety of conversational partners expose children to interlocutors who often know little about the children they are talking to – their routines, favorite toys, games, interests, or daily activities – and therefore challenge children to make their intentions clear in any interaction. This places added demands on children, compared to talking with their parents, say, about daily routines that both parties are familiar with. Sometimes, they need to fill in missing information, of course, in response to a request for clarification (e.g., Corsaro 1977), they need to speak clearly, and they have to repair any misunderstandings. The entire process depends on children assessing what their adult interlocutors do and do not know.

Conclusions

Gaining more practice in all this with a variety of different interlocutors helps children become more skilled at using language, and, therefore, at establishing common ground as well as accumulating it throughout an exchange. They also get practice in introducing new topics; indeed, by 2;6, young children initiate nearly two-thirds of exchanges and so get a great deal of practice in introducing topics (see Bloom et al. 1996). Having introduced a topic, they must work out how to maintain it over several turns. They also learn to repair what they are saying, either spontaneously with self-repairs to pronunciation, for example, or in response to requests for repair (see, e.g., Käsermann & Foppa 1981; Corrin 2010; Tarplee 2011). Finally, they learn how to accumulate common ground and make use of different kinds of common ground as they learn more about their immediate surroundings and the culture in which they are growing up (Clark 2015). The essential here is that exposure to a range of conversational partners gives children experience in assessing initial common ground and in learning how to add to common ground throughout an exchange. These variations in interaction nurture children's communicative skills, offering them many opportunities to clarify what they mean, leading them to attend to common ground, and thus allowing them to practice assessing what each interlocutor knows and does not know.

To conclude, the amount of interaction children participate in and the number of different interlocutors they interact with jointly play an important role in children's acquisition of both language and communicative skills. This initial skill-building is then extended by their interactions with a growing range of interlocutors. Variation in what they hear and what they can assume with different interlocutors further extends children's linguistic and communicative skills, by giving them practice in talking about their days when they return from childcare, not only to their parents, but also to caretakers outside the home.

Acknowledgements

Preparation of this chapter was supported in part by the Freiburg Institute for Advanced Study, Albert-Ludwigs-Universität, Freiburg im Breisgau, Germany, while I was a Senior External Fellow in the autumn of 2012, and in part by the Max-Planck-Institute for Psycholinguistics, Nijmegen, Netherlands.

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CHAPTER 9

Invariance in variation

Frequency and neighbourhood density as predictors of vocabulary size

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This article examines the influence of word frequency (WF) and neighbourhood density (ND) in vocabulary acquisition of French-speaking children. Data were collected through the French version of the MacArthur-Bates Communicative Development Inventory. A regression analysis based on 462 children aged between 16 and 30 months who have acquired at least 5 words revealed that ND and WF together predicted 45% of the variance in vocabulary size, with ND and WF uniquely accounting for 32.2% and 12.8% of that variance respectively. The same analysis was done with nouns and predicates only. For nouns, the model predicted 64.6% of the variance whereas for predicates, the size of predicate vocabulary was not correlated with either of the two variables.

Keywords: lexicon, development, word frequency, neighbourhood density, French

1. Introduction

The child early productive lexicon is quantitatively and qualitatively very different from adult language (Fenson, Dale, Reznick, Bates, Hartung, Pethick & Reilly 1993). Several factors play a role in the quantitative and qualitative development of first word production. Among them, two factors have frequently been taken into consideration: phonetic/phonological development (Vihman 1996) and input characteristics (Lieven 2010). In this chapter, we will examine more deeply the influence of input, and in particular the influence of frequency and neighbourhood density (ND) on children's early lexical development. Facilitative effects of high

DOI 10.1075/tilar.22.10ker

density and frequency were demonstrated on language processing, on speech recognition, as well as on speech production across the lifespan (Ellis 2002; Vitevitch 2002; Vitevitch & Sommers 2003). The questions we will answer are the following: does frequency and/or ND play a role in lexical development? And do they have the same role as the function of grammatical categories?

2. Theoretical background

Within a function-based perspective, the role of input is considered important to early language learning (*e.g.*, Cameron-Faulkner, Lieven & Tomasello 2003; Gallaway & Richards 1994; Snow 1977). Even if most of the research conducted to date provides only indirect forms of evidence for the evaluation of the effect of input on vocabulary acquisition, there also appears to be a general theoretical consensus on the positive effect of input on word learning. There are many ways to characterise language input: in a qualitative manner, following typological descriptions, or in a quantitative manner, looking at the frequency of different units, or even by combining both ways. In this chapter, we will focus on two characteristics of words: frequency of occurrence in the input and ND.

2.1 Frequency and lexical acquisition

Many studies agree on the role of word frequency (WF) on lexical development in children acquiring their mother tongue. Important correlations between the lexicon size of children and the amount of heard input were observed (Hart & Risley 1995; Weizman & Snow 2001). Furthermore, typically developing children as well as children with specific language impairment (SLI) more easily acquire words they have been frequently exposed to (Rice, Oetting, Marquis, Bode & Pae 1994). In addition, frequency of exposure to a specific grammatical category seems to help the learning of this specific category (Gopnik & Choi 1990, 1995). Goodman, Dale & Li (2008) came to the conclusion that even if it is true that frequency of exposure to a word plays an important role in the acquisition of the word, this is only a part of the truth. The authors have correlated the age of acquisition evaluated through the use of the MacArthur-Bates Communicative Development Inventories (Fenson et al. 1993) of 562 words in English-learning children aged 8 to 30 months with the frequency of these words in 28 corpora of child-directed speech available on the Childes website (http://childes.psy.cmu.edu). Interestingly, they showed on the one hand, that if all words were considered, there was a positive correlation between age of acquisition and frequency: frequent words were acquired later than less frequent ones. They explained this result by a late acquisition by children of closed class items. On the other hand, inside the lexical categories of verbs and nouns, high frequency was associated with early acquisition. Furthermore, frequency played a more important role in the productive vocabulary than in the receptive one: in comprehension, parental frequency was correlated with language acquisition only for common nouns.

According to all the studies presented, a link between frequency of exposure and language development exists. However, given the limited number of studies and the disparities in the findings and in the measurements of WF, it is difficult to make a clear statement regarding the role of WF and measures of production. In addition, to our knowledge, no one except Goodman et al. (2008) has so far been able to explain why particular words were acquired before others within one specific grammatical category.

2.2 Neighbourhood density and lexical acquisition

The second variable we are going to take into consideration for vocabulary learning is ND, that is to say the link between word acquisition order and how many phonological neighbours each word has. Two words are considered phonological neighbours when they are composed of the same phonemes with the exception of one (Charles-Luce & Luce 1990). The difference between a word and its phonological neighbours can be due to phoneme substitution, or the addition or deletion of a phoneme. In a specific language, the number of phonological neighbours for every word differs. For example, the word *balle* ('ball') [bal] has 42 neighbours whereas the word *fenêtre* ('window') [fənƐtʁ] has only one. Words with many phonological neighbours belong to a dense neighbourhood, whereas words with few neighbours belong to a sparse neighbourhood.

Several studies have investigated the role of ND on lexical development in young children. Charles-Luce and Luce (1990, 1995) as well as Logan (1992) demonstrated that children's words have fewer neighbours than the same words in the adult lexicon. By considering absolute numbers of neighbourhoods, they also showed a trend toward denser neighbourhoods with age. However, these studies were limited to either children's expressive or receptive vocabularies, have underestimated the size of children's vocabularies, and more importantly, have not normalized neighbourhoods by the sizes of the vocabularies considered.

Coady and Aslin (2003) conducted three more comprehensive analyses of phonological neighbourhoods, trying to take these limitations into account. Phonological neighbourhoods were calculated for all monosyllabic words produced by two English-speaking children from the age of 2;3 until the age of 3;6 and their mothers. In addition, ND was calculated for an adult lexicon. The results support previous findings, with denser ND in the adult lexicon than in the developing lexicon for the same words. Data also suggest that children are acquiring words from denser than average neighbourhoods: for words that appear in children's lexicons, the average number of phonological neighbours in the adult lexicon is higher than the average for all words in the adult lexicon. Lastly, the data show that words in developing lexicons had roughly twice as many neighbours as shown in previous analyses (6.5 neighbours *vs.* 2.25–3.32 neighbours). This difference in the number of neighbours could be due to length differences, as previous studies considered all word lengths. The second study presented in the same article seems to confirm this idea. In this study, Coady and Aslin dealt with the relationship between vocabulary sizes, word length and ND. They were able to show that ND decreases as word length increases. But they also showed that children's lexicons contained many shorter words, with progressively fewer neighbours as word length increased. So, because children have a significant proportion of shorter words that reside in denser phonological neighbourhoods, ND should decrease over development as children acquire longer words with sparser phonological neighbourhoods. In a final analysis, Coady and Aslin tried to evaluate the relationship between ND and vocabulary size by calculating the ND relative to vocabulary size in monosyllabic words only. The calculated ratios showed that in proportion to vocabulary size, ND decreased between the age of 3;6 and adulthood.

2.3 Frequency and neighbourhood density

Although ND is positively correlated with WF (Landauer & Steeter 1973), and negatively correlated with word length (Pisoni, Nusbaum, Luce & Slowiaczek 1985), only a few studies have considered their influence on early lexicon acquisition at the same time. Storkel (2004a and 2009) studied the relationship between ND, WF, word length and age of acquisition by looking at nouns produced by American English-speaking children, from 8 to 30 months of age. Data were available from a cross-sectional sample of 1800 American children. The database consists of the percentage of children from the norming sample who were reported to know each of the MCDI words at 1-month age intervals between 8 to 30 months. The results mirrored those of previously reported studies: high density words are acquired earlier than low density words. But new observations also emerged: the effect of ND was only evident for low frequency words, not for high frequency words. In addition, ND predicted age of acquisition for short words but not for long words. This finding suggests that ND may play a lesser role when learning high frequency or long words. Concerning the effect of WF, early acquired words were higher in frequency than later acquired words, and this effect was more robust for short words than for long words. Finally, early acquired words were shorter than later acquired words, but this effect was present only for high frequency words.

According to Storkel (2009), WF is a composite variable possibly playing a role in three different linguistic domains: phonology, lexicon, and semantics. Consequently, in her model for predicting the age of word acquisition, she used two phonological predictors (for each word, she calculated mean frequency of segments and diphones according to their position in the word) and two lexical predictors (ND and word length). She found that there was an influence of both phonological variables from 16 to 30 months, and an influence of both lexical predictors from 16 to 20 months only.

Maekawa and Storkel (2006) also attempted to differentiate effects of ND, WF and word length on expressive vocabulary development in three children between the ages of 1;4 and 3;1, native speakers of American English with typical language development. Naturalistic conversational samples were obtained from CHILDES. As high phonotactic probability seems to facilitate both expressive and receptive lexical acquisition, especially in children with smaller vocabularies (Edwards, Beckman & Munson 2004; Storkel & Rogers 2000), they added phonotactic probability to their analysis. They also kept in mind the positive correlation between phonotactic probability and ND (Storkel 2004b). The study identified length as a predictor of expressive vocabulary development across three subjects whereas the other three factors affected only one child each. This inter-child variability could be explained by differences in the words sampled across children but also by developmental differences across children, suggesting that the role of the factors changes across development. According to the authors, children are first constrained by word length in their lexical acquisition, before being able to use phonotactic probabilities. In a third step, they are supposed to lean on frequency of items and, in the last steps, use ND to develop their expressive lexicon.

In 2010, Stokes studied the influence of frequency and ND in the lexical development of 222 British English-learning children (mean age 27 months). In line with previous studies, only monosyllabic content words were included (160 nouns, 88 verbs and 31 adjectives). Due to lack of consensus surrounding the issue of the relation of ND and WF, both factors were investigated as separate variables before co-linearity of the two was examined in a regression analysis. Data were collected through the British version of the MacArthur-Bates Communicative Development Inventory developed by Klee & Harrison (2001). Stokes came to the conclusion that ND and WF were responsible for 61% of the lexicon size variance, accounting for 47% and 14% of the variance respectively. ND was inversely related to vocabulary size: as vocabulary size increased, more words from sparse neighbourhoods were added. WF was positively related to vocabulary size, with more frequent words in larger vocabularies. Moreover, Stokes pointed out the fact that low-vocabulary children scored significantly higher on ND and significantly lower on WF than did high-vocabulary children, but there was more variability in ND and WF for children at the lowest points of the vocabulary continuum. To explore the cross-linguistic validity of these conclusions, the same analyses were conducted on French-speaking and Danish-speaking populations. The expressive lexicons of 208 French-speaking two-year-old children were coded for ND and WF (Stokes, Kern & dos Santos 2012). Regression revealed that ND and WF together predicted 62% of the variance in vocabulary size, with ND and WF uniquely accounting for 53% and 9% of that variance respectively. The research by Stokes, Bleses, Basbøll and Lambertsen (2012) explored the impact of ND, WF and word length (WL) on the vocabulary size of 894 Danish-speaking two-year-old children. Regression revealed that ND, WF, word length and age together predicted 47% of the variance in vocabulary size, with ND, WF, WL and age uniquely accounting for 39%, 3.2%, 2.2% and 2.8% of that variance respectively. Children with small vocabularies learned words that were denser, more frequent in the ambient language and shorter than the words of children with larger vocabularies. The strong role for ND in emerging languages found in other languages was replicated for Danish, but the role of WF was much smaller than in English and French. This less important role has been explained by a different distribution of word classes on the parental checklist.

All these studies have highlighted an important role of ND and more mixed conclusions concerning the role of WF on age of acquisition. A very restricted set of languages has been considered and one could expect different results for ND due to structural differences as ND varies as a function of language (Vitevitch & Stamer 2006). This point will be discussed in the concluding section. Furthermore, very few studies were developmental studies on a longer time span which could be of interest to show the precise influence of ND and WF according to age and/or lexical size. Finally, the majority of the above described studies focused on the productive lexicon and more specifically on monosyllabic content words.

In our chapter, we explore the role of ND and WF on lexical acquisition in French-learning children from 16 to 30 months of age. We concentrate our analyses on nouns and predicates produced between 16 and 30 months. In a following paper we intend to consider the receptive lexicon as well as words longer than one syllable.

3. Method

3.1 Subjects

A total of 522 monolingual French-speaking children between 16 and 30 months participated in the study. For the analysis, only the 462 children who were able to produce at least five words were included (see Section 4. Results)

Table 1. Children producing at least five words

FCDI	**Words and sentences**														
Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Number	11	10	0	10	28	49	39	35	88	40	30	24	34	35	29
Total	**462**														

3.2 Data collection

To evaluate the lexical level of children, a parental report was adapted and normed to French: IFDC (Kern & Gayraud 2010), *Inventaire Français du Développement Communicatif Mots et Phrases*, was documented by subjects' mothers. This parental report is the French version of the MacArthur-Bates Communicative Development Inventory created by Elisabeth Bates and normed by Fenson et al. (1993).

This version, aimed for children between 16 and 30 months of age, is composed of two main parts. The first evaluates the productive lexicon: 690 words distributed in 22 semantic categories and four grammatical ones. The second part evaluates the morpho-syntactic level of children.

3.3 Data processing and coding

Data reduction

Following the method used in Stokes (2010) and Stokes, Kern & dos Santos (2012), we restricted our analysis to monosyllabic content words (nouns, verbs, adjectives and adverbs). The selected words were at minimum composed of one vowel and one or more consonants. Words with two vowels among which one was a schwa in a non-accentuated syllable and only preceded by one single consonant were considered monosyllabic words. For example, the word 'cheveux' (hair) [ʃəvø], which contains a schwa in a non-accentuated syllable, was considered monosyllabic as it is frequently produced [ʃvø] in colloquial French. Finally, concerning verbs, among several possible monosyllabic forms, the one with the highest frequency has been chosen (for example, for the verb ‘dire’ (to say), the more frequent monosyllabic form is [di]). Eventually, a list of 220 words consisting of 131 nouns, 56 verbs, 30 adjectives and 3 adverbs was included in the analysis.

Frequency
Token frequency of each word was determined through the Lexique3 database (New, Brysbaert, Veronis & Pallier 2007). Lexique3 contains more than 50 million French words. Oral frequency (from film subtitles) of each word is given according to its grammatical nature.

Neighbourhood density
ND of each word was calculated on the basis of the most frequent monosyllabic phonological form from the same grammatical category. For example, ND of the verb *chanter* (‘to sing’) was calculated on the basis of the monosyllabic phonological form (/ʃɑ̃t/ (‘sing’) only, which is the most frequent monosyllabic phonological form of this verb. Then, the phonological form /ʃɑ̃t/ has 30 neighbours (*ND* = 30; /pɑ̃t/ *pente* (‘slope’), /sɑ̃t/ *sente* (‘footpath’), /ʃɑ̃s/ *chance* (‘luck’)).

4. Results

Instead of computing a mean value for WF and ND for each child as was the case in Stokes, Kern and dos Santos (2012), we decided to compute the median value for WF and ND for each child. This choice was made in order to neutralise the effect of extreme values, specifically for WF data. Half of the words have a WF of 47.31 or less, but the mean of the whole set of words is 251.75 with the maximum being the verb ‘avoir’ (to have) with a WF of 15267.71. Moreover, we log transformed the frequency data (see Appendix for a dataset summary).

In order to have a better image of each vocabulary set, and to have enough children by age group, we decided to only select the children who were able to produce at least 5 words out of the 220 words selected for this study. Then, the medians for WF and ND for each child were standardised by age group to neutralise the effect of age. A within age-group z-score was computed for all variables.

4.1 ND and WF as predictors of total vocabulary size

Our first question about the influence of WF and ND on vocabulary size concerns the vocabulary size of each child for all 220 monosyllabic words (cf. above). A first analysis of correlations among variables shows that vocabulary size is moderately and negatively correlated with WF ($r(462) = -0.49$, $p < 0.01$) and ND ($r(462) = -0.57$,

$p < 0.01$). From these correlations, we can say that smaller vocabularies consist of more frequent words than do larger ones, as well as words with a higher ND (WF and ND are weakly and positively correlated ($r(462) = 0.25$, $p < 0.01$).

A multiple regression analysis was conducted. The variable to predict was vocabulary size. WF and ND were the predictors. The model is significant ($F(2, 459) = 189.31$, $p < 0.01$). WF and ND account for 45% of the variance in vocabulary size. ND is the strongest predictor according to the t values (Table 2). A hierarchical multiple regression showed that ND accounts for 32.2% of the variance in vocabulary size ($F(1, 460) = 176.59$, $p < 0.01$) and WF for 12.8% ($F(1, 459) = 107.68$, $p < 0.01$).

Children who present a small vocabulary size tend to produce words with high ND and high WF. Larger vocabularies tend to be composed of more words from sparse neighbourhoods and low frequency.

Table 2. Coefficients for the multiple regression predicting total vocabulary size

	Standardised coefficients			
	β	t	p	**Confidence interval (95%)**
(Constant)		0.00	1.00	
ND	−0.48	−13.29	0.00	−0.55 to −0.40
WF	−0.37	−10.38	0.00	−0.44 to −0.30

Following Goodman et al. (2008), the effect of frequency on vocabulary acquisition is taken to interact with semantic – syntactic categories. We therefore divided the 220 monosyllabic CDI words of this study into two groups. The first group contains 131 words from the category of nouns and the second group contains 89 words from the category of predicates. The predicate category is composed of verbs, adjectives and adverbs, as they all emerge after nouns in children's lexicon. As before, we selected only children who produced at least five words in the category examined. For nouns, it included 456 children and for predicates 382 children. The intention was to find out whether ND and WF have a different impact on vocabulary size in these two categories, as Goodman et al. (2008) suggest for frequency.

4.2 ND and WF as predictors of noun vocabulary size

In order to answer the question on the influence of ND and WF on noun vocabulary size, the first step involved the examination of correlation among variables. Noun vocabulary size is negatively correlated with ND, close to strong correlation level ($r(456) = -0.68$; $p < 0.01$). Noun vocabulary size is also negatively correlated with WF but strongly correlated ($r(456) = -0.70$; $p < 0.01$). Then, when noun vocabulary size increases, ND and WF decrease (ND and WF are positively and moderately correlated ($r(456) = 0.50$; $p < 0.01$).

The size of this correlation is the same as previously found for total vocabulary size, but the magnitude of correlation is stronger with noun vocabulary size.

Plots of these relationships are shown in Figures 1 and 2. The two plots for noun vocabulary size by ND and WF respectively reflect the significant negative correlation, with a low number of nouns being comprised of high NDs and high WFs relative to larger vocabularies.

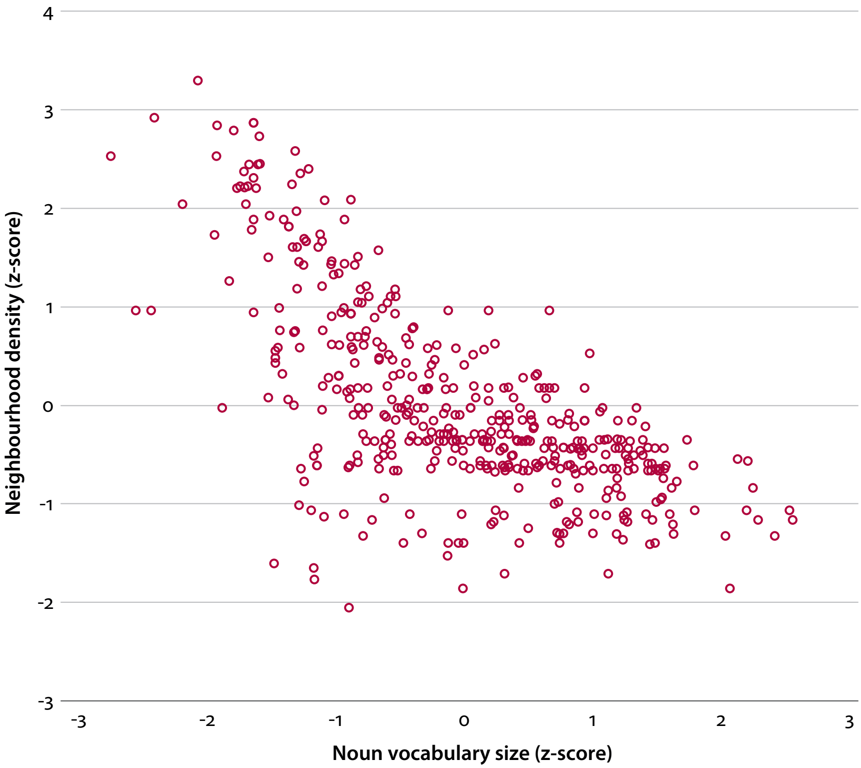

Figure 1. Scatterplot of ND by noun vocabulary size

As for total vocabulary size, multiple regression analysis was conducted. The variable to predict was in this case noun vocabulary size. The predictors are the same as before: WF and ND. The model is significant ($F(2, 453) = 398.83$, $p < 0.01$). WF and ND account for 63.6% of the variance in noun vocabulary size. This time WF and not ND is the strongest predictor according to the t values (Table 3). A hierarchical multiple regression showed that WF accounts for 49.4% of the variance in noun vocabulary size ($F(1, 454) = 222.90$, $p < 0.01$) and ND for 14.2% ($F(1, 453) = 178.00$, $p < 0.01$).

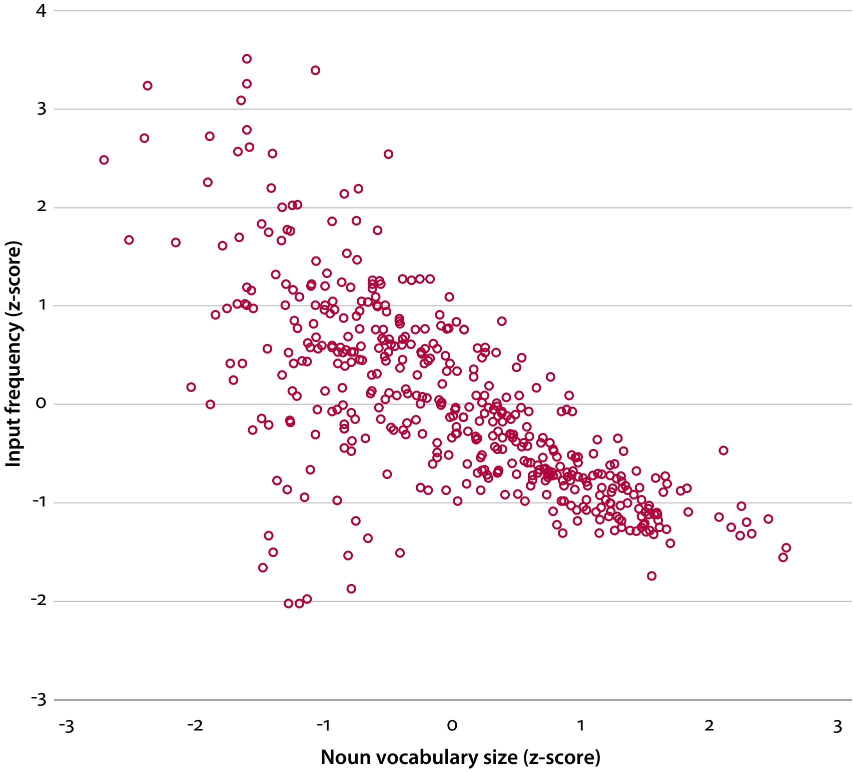

Figure 2. Scatterplot of WF by noun vocabulary size

The same tendency seen above for total vocabulary size is also valid for noun vocabulary size, but the effect is stronger. Children who present a small noun vocabulary size tend to produce words with high WF and high ND. As noun vocabulary size increases children tend to acquire more words with low frequency and sparse neighbourhood.

Table 3. Coefficients for the multiple regression predicting noun vocabulary size

	Standardised coefficients			
	β	*t*	*p*	Confidence interval (95%)
(Constant)		0.00	1.00	
ND	−0.44	−13.34	0.00	−0.50 to −0.37
WF	−0.49	−14.93	0.00	−0.55 to −0.42

4.3 ND and WF as predictors of predicate vocabulary size

As mentioned above, and following the methodology for total vocabulary size and noun vocabulary size, only the 382 children who produced at least 5 predicates were selected for this part.

For predicate vocabulary size, when correlations among variables are investigated, a striking difference appears compared with what was found for noun vocabulary size. No correlation is found between predicate vocabulary size and WF ($r(382) = 0.04$; $p = 0.47$) or predicate vocabulary size and ND ($r(382) = -0.09$; $p = 0.08$). WF and ND are not correlated either ($r(382) = 0.08$; $p = 0.12$). Therefore, WF and ND seem to have no influence on the size of predicate vocabulary, unlike what we have seen for the size of noun vocabulary.

Plots of predicate vocabulary size and ND and predicate vocabulary size and WF respectively are shown in Figures 3 and 4. The two plots show that no relationship can be found between the size of predicate vocabulary and ND or the size of predicate vocabulary and WF, although we do observe a high variability for both ND and WF for low vocabulary size.

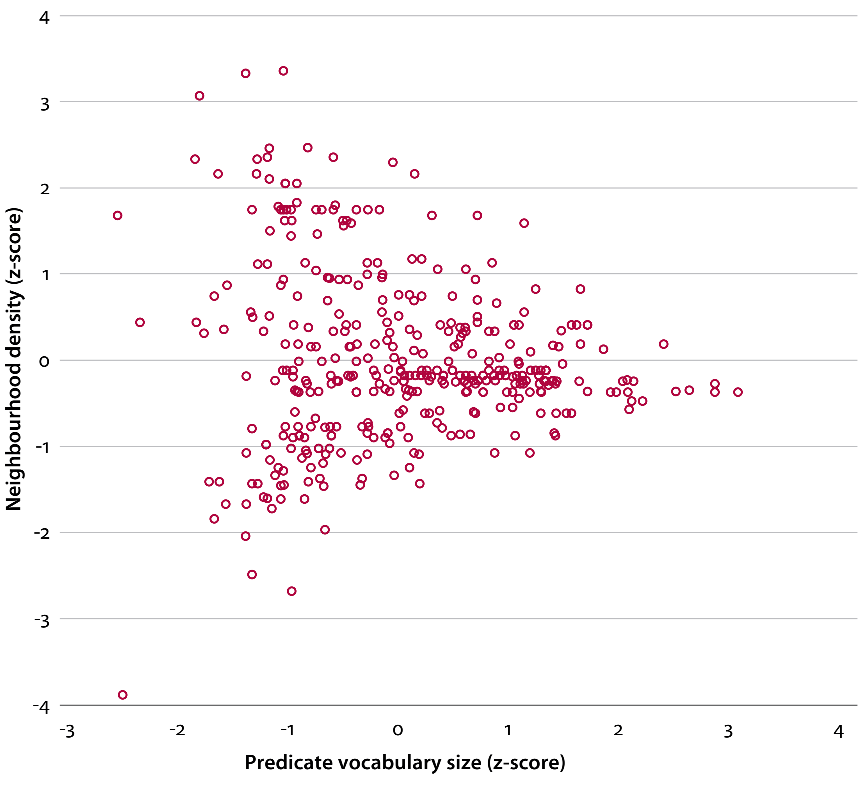

Figure 3. Scatterplot of ND by predicate vocabulary size

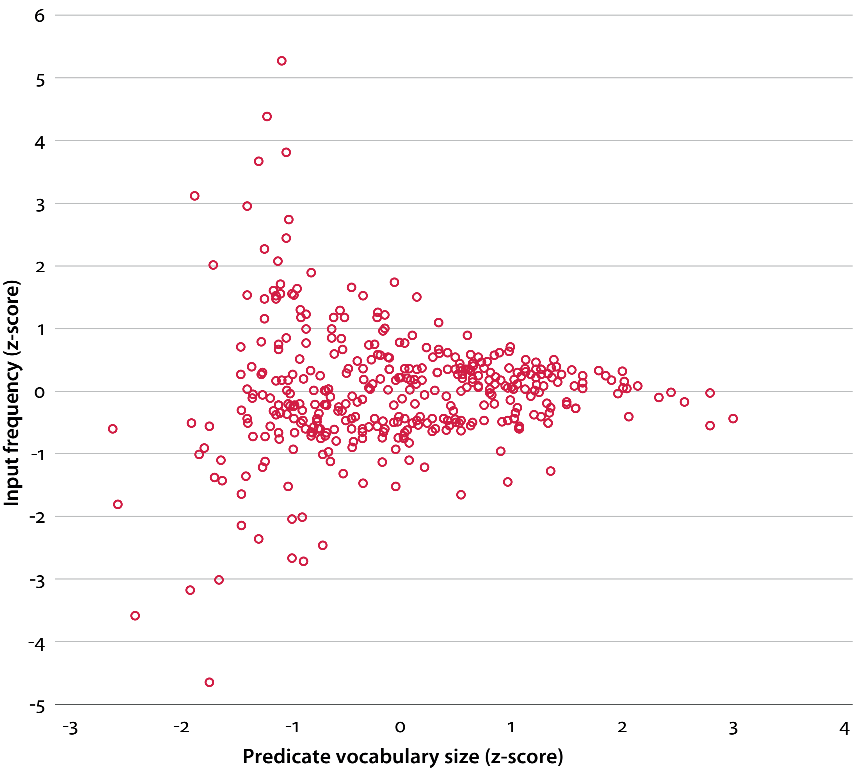

Figure 4. Scatterplot of WF by predicate vocabulary size

As no correlation was found between predicate vocabulary size and our possible predictors (WF and ND), no multiple regression analysis was attempted with predicate vocabulary size as the variable to predict.

5. Discussion

We have seen that ND and WF correlate negatively with the size of total vocabulary, predicting 45% of its variance. Children with low vocabulary size tend to have high ND and high WF words in their vocabulary. Subsequently, the question was: do we find the same trend within different grammatical categories? We found a strong negative correlation of ND and WF for the size of noun vocabulary predicting 63.6% of its variance, whereas no influence was found for the size of predicate vocabulary. We can conclude that the influence of ND and WF found when we looked at total vocabulary size was mainly due to the noun category.

The results provide additional evidence that early acquired words, at least nouns in this study, reside in dense neighbourhoods, whereas later acquired words reside in sparse neighbourhoods. Our work mirrors results obtained in previous studies (Hollich et al. 2002; Storkel 2001, 2004). The study also provides additional evidence that early acquired words (nouns in this study) are more frequent than later acquired words.

We found that WF correlates negatively with the size of noun vocabulary. This is the opposite of what was found by Stokes et al. (2012) for French. We replicated the work done in Stokes et al. (2012) using the same data but computing medians instead of means. The only change between these two studies concerns the choice of using medians instead of means. This choice was necessary due to a large and unequal dispersion of WF of the monosyllabic words ($m = 251.75$; $SD = 1158.84$; median = 47.31).We found that WF was, this time, negatively correlated with vocabulary size ($r(208) = -0.67$; $p < 0.01$).

The fact that WF is negatively correlated with the size of noun vocabulary is in line with previous work (e.g., Storkel 2009, Goodman et al. 2008). It is also in line with Stokes et al. (2012) which studied the influence of WF, ND, and word length in Danish. In this last study, Stokes et al. (2012) used the mean as in previous work. The hypothesis they offered for the negative correlation between vocabulary size and WF for Danish is the fact that they only included a few verbs (4) in the analysis, compared to many more in the English and French analyses, due to the Danish morphology of verbs. As shown in Table 4, nouns and predicates in French do not show the same WF distribution, and predicates represent 40.5% of the words selected from the FCDI. Another possible hypothesis is the fact that in Danish the dispersion of WF is limited (SD value is approximately one quarter of the mean), but this is not the case in French (SD value is more than four times higher than the mean, see Table 4).

Table 4. WF Mean and SD for different CDI dataset

CDI	Danish	French	French nouns	French predicates
Mean WF	99.89	251.75	66.94	523.77
SD WF	24.29	1158.84	88.63	1790.18

Using the median for French allowed us to avoid this dispersion problem and to find results in line with previous studies. However, one of the main results in Stokes et al. (2012, 2012) is only partially confirmed here. ND is indeed a predictor of vocabulary size, but only for nouns. The first nouns acquired by children have a dense neighbourhood. This factor is not a predictor for the size of predicate vocabulary. This finding may be due to the fact that predicates in French are in general acquired later than nouns. At that time children may have already changed their word-learning strategy, or other factors linked to predicates may play a role (*e.g.*, concreteness, syntactic complexity, informational load).

The results of our study fit perfectly with the Emergentist Coalition Model (Hirsh-Pasek, Golinkoff & Hollich 2000) which assumes that a range of cues are available for the child to enable word learning, but that their use can vary over time. As found in our data, the cues can be different according to the grammatical nature of the learned words: ND and WF seem to play a role in the age at which nouns are acquired, but not in the age at which predicates are acquired.

5.1 Further research

While this study provides strong insights into the influence of ND and WF on word learning by French-speaking infants and toddlers, there are several limitations that are important to keep in mind. The selection of monosyllabic words is its main limitation, we believe. Our adoption of this methodological choice was intended to enable comparable data with other languages and studies. It is possible that the results would be different if disyllabic words were included, especially considering that, in French, disyllabic words are more numerous than monosyllabic ones in terms of type (43097 disyllabic word and 9509 monosyllabic words are listed in *Lexique* 3). However, disyllabic words are less frequent than monosyllabic words in terms of tokens (73% of words heard by French monolinguals are monosyllabic and 21% are disyllabic), mainly due to the high frequency of monosyllabic grammatical words, such as pronouns and prepositions. In a pilot study, we tried to determine the influence of the phonetic complexity of words on age of acquisition using the IPC scoring (Index of Phonetic Complexity; Jakielski (1998)). Unfortunately, phonetic complexity of monosyllabic words is highly correlated with ND and almost no additional variation was explained by adding IPC to the model. Including words of more than one syllable should help to disentangle the effect of phonetic complexity and ND.

Finally, three other questions need to be explored. The first question concerns the type of vocabulary. This study only looked at expressive vocabulary. The next step will be to open the analysis to receptive vocabulary and see if we find similar or different results, in particular concerning the noun/verb dichotomy. Future work is also needed to further examine how the effect of lexical characteristics such as ND and WF may change over time. The last extension concerns children who continue to have limited vocabulary. ND was mentioned as a factor used by children to learn their first nouns. Do late talkers use this strategy for a longer period, or do they not learn their first words through dense neighbourhoods as do typically developing children?

Acknowledgements

We take the opportunity to acknowledge Stephanie Stokes (Professor at the University of Canterbury) for having invited us to dive more deeply into the data as well as Anne-Eleonore Lelarge, Master student at the University Lumière-Lyon2 for assistance.

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Appendix

Population: 462 children who produced at least five words

Age	Nb. of children	TV	Mean of Mean-WF.	Mean of Med-WF	Mean of Med-Log-WF	Mean of Mean-ND	Mean of Med-ND
16	11	13.00 (9.51)	147.38 (40.44)	92.69 (33.27)	1.93 (0.19)	26.98 (2.35)	27.41 (4.12)
17	10	23.20 (24.84)	172.24 (82.79)	90.74 (29.03)	1.94 (0.13)	29.21 (3.24)	30.10 (4.03)
19	10	49.50 (34.37)	179.79 (62.26)	84.07 (24.17)	1.91 (0.11)	25.86 (1.71)	26.40 (2.90)
20	28	50.96 (35.60)	174.92 (93.64)	73.59 (18.79)	1.85 (0.10)	25.93 (2.73)	25.73 (4.04)
21	49	49.90 (37.22)	193.61 (147.07)	74.70 (24.09)	1.86 (0.12)	25.98 (2.66)	26.11 (3.57)
22	39	61.54 (41.92)	198.49 (102.04)	72.29 (20.42)	1.84 (0.11)	25.74 (2.74)	25.18 (3.77)
23	35	64.71 (43.99)	198.11 (87.25)	77.91 (28.70)	1.87 (0.12)	25.52 (1.93)	25.37 (3.39)
24	88	78.78 (50.40)	190.70 (97.88)	69.64 (27.62)	1.82 (0.12)	25.40 (2.27)	25.20 (3.36)
25	40	105.80 (50.45)	206.03 (83.56)	63.04 (11.96)	1.79 (0.08)	24.35 (1.40)	24.20 (2.32)
26	30	98.87 (57.52)	197.14 (83.55)	68.44 (19.26)	1.82 (0.10)	24.49 (1.31)	24.10 (2.33)
27	24	116.75 (51.84)	232.81 (78.94)	63.85 (13.03)	1.80 (0.08)	24.46 (1.12)	24.00 (1.55)
28	34	126.38 (48.53)	244.08 (88.77)	63.24 (14.39)	1.79 (0.09)	24.02 (1.15)	23.06 (1.55)
29	35	149.77 (45.22)	258.75 (66.60)	59.18 (9.17)	1.77 (0.07)	23.71 (0.87)	23.07 (0.47)
30	29	142.45 (51.48)	229.26 (81.23)	57.06 (8.45)	1.75 (0.07)	23.87 (0.98)	23.24 (1.44)
All	462	86.60 (57.73)	205.04 (97.55)	69.58 (22.46)	1.83 (0.11)	25.14 (2.24)	24.86 (3.21)

Mean (Standard Deviation); Age in months; TV: Total vocabulary; Med: Median; WF: Word Frequency given per million words

CHAPTER 10

New perspectives on input-output dynamics

Example from the emergence of the Noun category

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This study addresses the role of input, i.e., child-directed speech, in child language acquisition. Proposing a dynamic approach of input-output relationships, we examine the development of noun determiners in the spontaneous production data of three monolingual children between one and three years old. Analyses show explosions in determiner use in the three children, although these vary in timing and amplitude. Such explosions are not found in the input, which rather presented striking fluctuations. Dynamic modeling (an extension of the Scaffolding Model) shows corresponding changes over time in child speech and child-directed speech, although the patterns are different across children. This argues for the idea of mutual influences between input and output, congruent with transactional adaptation models.

Keywords: adaptation, child-directed speech, dynamic modeling, early grammatical development, input-output relations, longitudinal data, noun determiners, scaffolding model

1. Introduction

It is well known that parents have the tendency to adapt their language to the child's linguistic abilities. Child-directed speech (CDS) uses shorter sentences and simplifies vocabulary and syntax. It becomes progressively more complex as the child becomes a more competent speaker, but it is always a bit more advanced than the language of the child (Snow 1972; Sokolov 1993; Golberg 2006; Matychuck 2005; Huttenlocher, Waterfall et al. 2007; van Dijk & van Geert 2013; Van Dijk, van Geert et al. 2013). However, the impact of this input in grammatical development remains controversial. In this paper, we propose a new perspective on the relationship between CDS (input) and child speech (output) during the acquisition of

DOI 10.1075/tilar.22.11bas

nominal determiners, which is a central aspect of early grammatical development in a number of languages. We argue that CDS is the result of a transactional process of dynamic adaptation between the child and the adult.

Determiner use and the emergence of the noun category

In languages with articles, such as Dutch, English, French and German, the acquisition of determiner use is a strong signal of the emergence of the noun category. After a variable period in which children generally omit determiners from their productions, they become able to use these morphemes in the contexts where they are required in the target language (i.e., in obligatory contexts). We consider that determiner use is acquired at that time, although this does not necessarily mean that all determiners are produced as correct forms, free of morphological or semantic errors. Being at the core of early grammatical development, this process has inspired a considerable amount of work, including pioneering studies on English which have taken opposing theoretical positions, in line with Universal Grammar approaches (Valian 1986) or with functionalist models arguing for a gradual item-based construction of abstract categories (Pine & Lieven 1997). In recent years, an increasing number of comparative works starting with the typological contrast between Germanic and Romance languages has shed light on this research field (Lleó & Demuth 1999; Lleó 2001; van der Velde 2004; Kupisch 2007; Guasti, De Lange, Gavarro & Caprin 2008; Rozendal & Baker 2008; Bassano, Maillochon et al. 2011; Bassano, Korecky-Kröll, Maillochon & Dressler 2013a; Bassano, Korecky-Kröll et al. 2013b). These studies generally show that determiners emerge earlier in Romance languages than in Germanic languages, and that determiner omission is more frequent and more enduring in Germanic languages. They also show that cross-linguistic variation is related to a set of interactive linguistic factors, including prosodic, lexical-semantic, morphological and syntactic influences (for review and analysis of these factors, see Bassano et al. 2013b; Bassano 2015).

The influence of the input on determiner use has been examined in some studies that analyzed differences in the input frequency of nouns with determiners vs. bare nouns, obtaining mixed results. Kupisch (2007) found a significant contrast in the token frequency of bare nouns between two Romance languages (French and Italian) and German, but considered that token frequency alone is insufficient to account for cross-linguistic differences in the rate of determiner acquisition. Contrasting data from Catalan, Italian and Dutch, Guasti and colleagues (2008) analyzed the rate of bare nouns in adults' speech at three successive points in the child's development. They considered that adults' use of bare nouns did not change during children's development and concluded that "children's omission of articles is not 'input-driven', at least not in a superficial sense" (2008: 110). However, a study on French-speaking children at ages of 1;8, 2;6 and 3;3 (Bassano 2010) suggests that subtle changes in CDS occur over time with respect to determiner use. These changes are revealed when convenient indicators are considered, such as frequencies of determiner use along with frequencies of correct and incorrect non-uses of determiner (rather than the classical index of determiner use in obligatory context, which ignores the number of correct non-uses of determiner), as well as the range of the different types of determiners and the diversity of the contexts in which they are used. These mixed results suggest that the impact of the input on children's determiner use is unclear and that we need more accurate analyses of this issue.

The present contribution takes a quantitative dynamic modelling approach to analyze input-output (i.e. CDS-child speech) relationships in the development of determiner use in the longitudinal data of three children acquiring different languages: French, a Romance language, and two Germanic languages close to each other, Austrian German and Dutch. All three languages use obligatory determiners which precede nouns (primarily definite and indefinite articles, possessive and demonstrative determiners) and are marked for gender, number and, in German only, for case. All three languages allow bare nouns in certain contexts, but they differ with respect to these contexts. French is known to be the most restrictive Romance language regarding determiner use, while Dutch and German allow more frequent bare nouns, as they have no plural indefinite articles and do not use articles before mass nouns in their non-specific uses. Although the overall perspective underlying this study is cross-linguistic (see Bassano et al. 2011, 2013a, b for details), the present contribution focuses on the comparison between child speech and CDS in individual data from each language.

Child-directed speech, child language acquisition and the scaffolding model

Research on input-output relations highlights that child language acquisition is related to input variables, such as token frequency of items, semantic transparency and diversity of form (Aksu-Koç, Terziyan & Taylan 2014; Behrens 2006; Lieven 2010 among others). Scaffolding models provide means to explain the relationship between CDS and child speech. The scaffolding model that we propose is based on the assumption that the language of the child and the language of the parent are related in the form of a bidirectional coupling, that is to say, the language addressed towards the child – the CDS – and the language produced by the child – child speech – are mutually coupled. The scaffolding model and its underlying dynamics have been amply discussed elsewhere (van Geert & Steenbeek 2005; van Dijk & van Geert 2013). The basic idea is that a parent's CDS is an adaptation of the parent's 'normal' speech, which the parent would use during communication with other adults, or older children for that matter. For instance, if a particular frequency of determiner use is typical of the parents' adult-directed speech, there exists a particular frequency of the parents' determiner use that is typical of the parents' language addressed to the child, and that depends on the current properties of the child's speech. This does not mean that parents produce ungrammatical bare nouns. Rather, in accordance with the child's language level and with other conversational and interactional parameters, parents use sentences with more frequent correct bare nouns (e.g., proper names, common nouns used as proper nouns, vocatives) and other types of words (e.g., interjections, action verbs), which may characterize a relatively simple language. When they feel that the child needs to refine her/his productions, they produce sentences with more nouns requiring determiners (although this is generally not deliberate). The frequency of determiner use in the parents' CDS is thus a result of adaptation of the parent to the properties of the child's speech. On the other hand, we assume that the parent's CDS provides a very important source of linguistic modelling for the child that somehow determines the child's learning about determiner use in their mother tongue. As the child's determiner use changes as a consequence of the child's language development, the parent is likely to change their adaptation to the child's language, and gradually move in the direction of their habitual (adult-directed) level of determiner use.

We assume that a similar principle holds for any property of the language output that is subject to developmental change in the child. The actual adaptation that a parent makes during CDS is an example of a short-term process (i.e., it takes place over the time scale of the actual communicative interaction), whereas the change in the amount of adaptation by the parent and the change in the child's characteristic level of determiner use are examples of long-term processes, taking place over the time scale of the child's language development, which in this particular case is a matter of months.

2. Data and coding

The three children were a French-speaking girl, Pauline, an Austrian German-speaking boy, Jan, both recorded until the age of 3;0, and a Dutch-speaking girl, Jessica, recorded until the age of 2;10. Data were obtained using spontaneous speech sampling in naturalistic conditions, similar for the three children. Each child was video-recorded twice a month at home during everyday activities, in interactive sessions, essentially with a parent (mother or father). The child's and the other participants' productions were collected and transcribed according to the CHILDES format.

Coding was applied to child speech and child-directed speech. It was conducted on monthly samples of 120 utterances for child speech and 100 utterances for CDS (close to the child's output). Samples comprised all the utterances (excluding vocalizations and completely incomprehensible productions) in one or several long and uninterrupted sequences of child/adult interaction. In order to analyze the use of determiners with nouns, we identified four central noun constructions (cf. Bassano 2000; Bassano, Maillochon & Mottet 2008; Bassano et al. 2011). A first "correct bare nouns" category corresponds to cases in which a determiner is not required in the standard adult language. This mostly corresponds to proper nouns or nouns used as proper nouns, nouns in idiosyncratic expressions, vocative constructions and contextual uses in the three languages, and, in addition, for Dutch and German, indefinite plurals and mass nouns (e.g., Du. *aardappels koken* 'cooking potatoes'; Gr. *sie trinken Wasser* 'they drink water'). "Determiner omission" corresponds to cases in which an obligatory determiner is lacking, while it is required in standard speech (e.g., Fr. * *moi goûter fraises* 'me taste strawberries'; Du. * *is dat snoepje*? 'is that candy?' Gr. * *Kassette dreht sich* 'tape turns (itself)'). A third category, "filler use", encompasses nouns preceded by a monosyllabic element that we considered as a precursor of a determiner, e.g., Fr. *[ə] chat* 'cat', Du. *[ə] beer* 'beer', Gr. *[ə] Maus* 'mouse') (for more information on the identification of fillers, see Veneziano & Sinclair 2000; Peters 2001; Bassano et al. 2011). Finally, "determiner use", the central category, encompasses nouns preceded by an adult-like determiner, such as the definite or indefinite article, a possessive or a demonstrative determiner (e.g., F. *le chat* 'the cat', Du. *een bal* 'a ball'; G. *unser Haus* 'our house').

The reliability of the coding procedure was assessed through various means by double-checking; initial agreement was high (80–90%) and disagreements were resolved in discussion. Coding permitted to calculate token frequencies of the different noun constructions (numbers and proportions of all nouns), from which the classical index of determiner use in obligatory contexts can be derived. However, as parents generally do not make grammatical errors on determiner use, this index is not relevant for CDS. Frequencies will be used here for comparing determiner use in children's outputs and inputs.

3. Initial analyses: Frequencies of the noun constructions in the three corpora

This first part of the results provides an overview of the noun constructions in the data of the three children and caregivers. Respective numbers of all noun tokens produced in child speech and in CDS are provided in the Appendix. Figures 1 to 3 show the proportions of the different noun constructions (percentages of all nouns) in the data of each participant. Beginning with the French-speaking child Pauline (Figure 1), it can be seen that determiner omission predominated at first (60% of nouns in the first months), diminished over time and disappeared at 2;5.

Determiner use was infrequent before 2;0, but showed an explosion from the age of 2;3. Filler use first increased, later diminishing and disappearing when determiners were systematically used. Correctly used bare nouns (30% on average) fluctuated locally but did not show clear developmental change. Thus, from the age of 2;6, the French-speaking child produced only two noun constructions: nouns used with determiners (65–70%), and correct bare nouns (30–35%). These were the only two constructions present in CDS, in relatively similar proportions (69% and 31%) to the child's use at 2;6, although they fluctuated. This means that by 2;6 the child has become target-consistent.

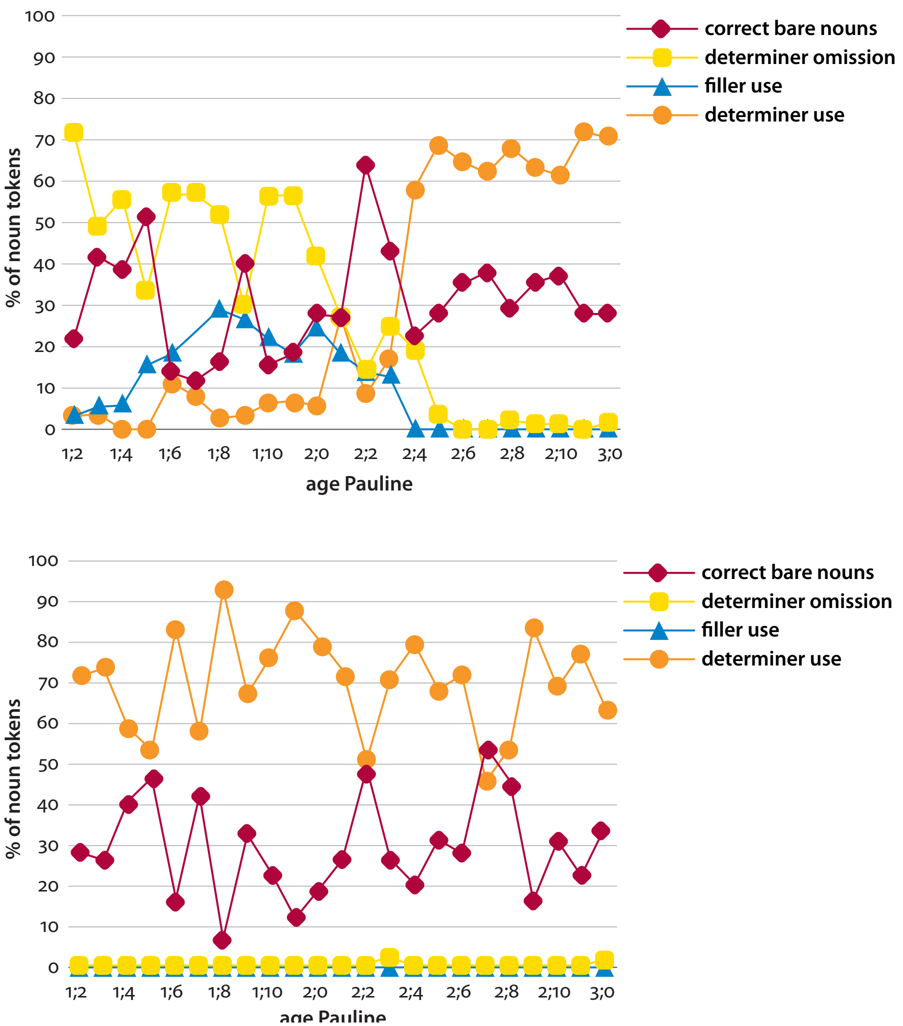

Figure 1. Frequencies of noun constructions in Pauline's data: child (top) and CDS (bottom)

In Jan's Austrian German data (Figure 2), determiner omission was very frequent until the age of 2;0 (more than 70%) and decreased abruptly. Accordingly, Jan did not use determiners before the age of 1;10, but the following explosion was particularly noticeable. This is related not only to the initial and persistent frequency of omissions, but also to the almost complete absence of fillers. Correct bare nouns (23% on average) showed local fluctuations, without clear developmental change. So, in Jan's output, as in Pauline's, we find only two nominal constructions from the age of 2;6: nouns with determiners (70–75%) and correct bare nouns (20–25%), the same two constructions which are present in the input, in similar proportions (82% and 18%) to the child's use at 2;6.

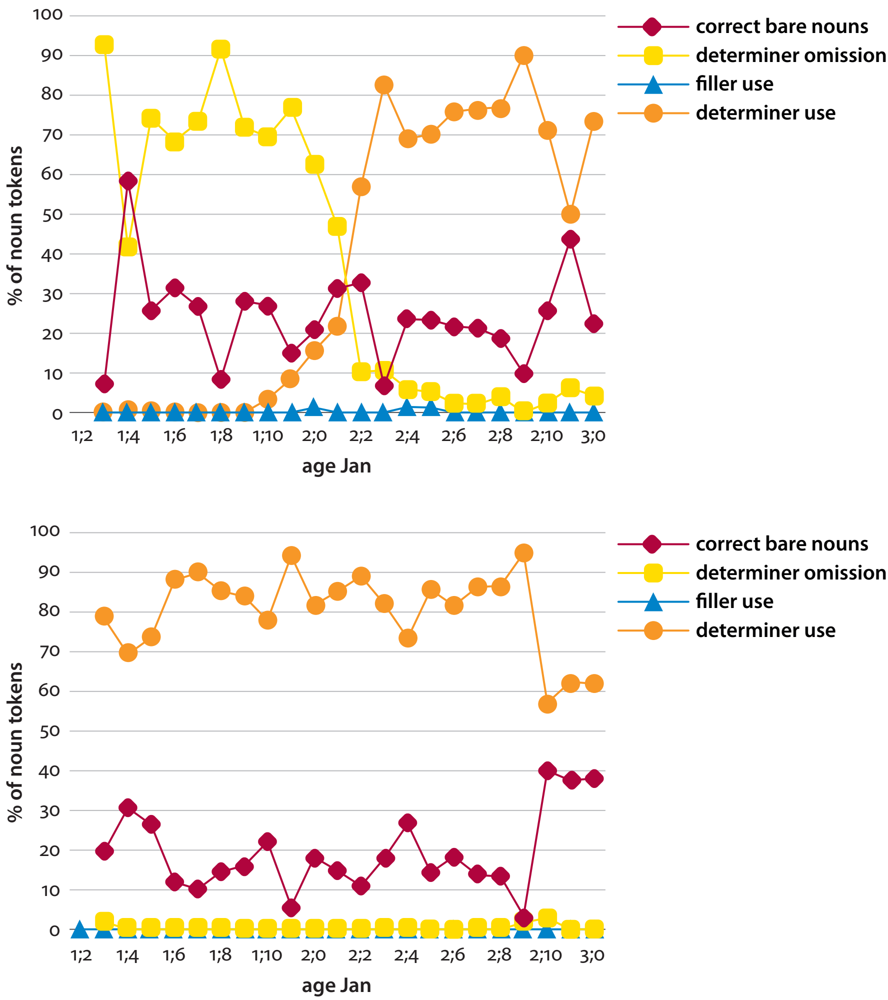

Figure 2. Frequencies of noun constructions in Jan's data: child (top) and CDS (bottom)

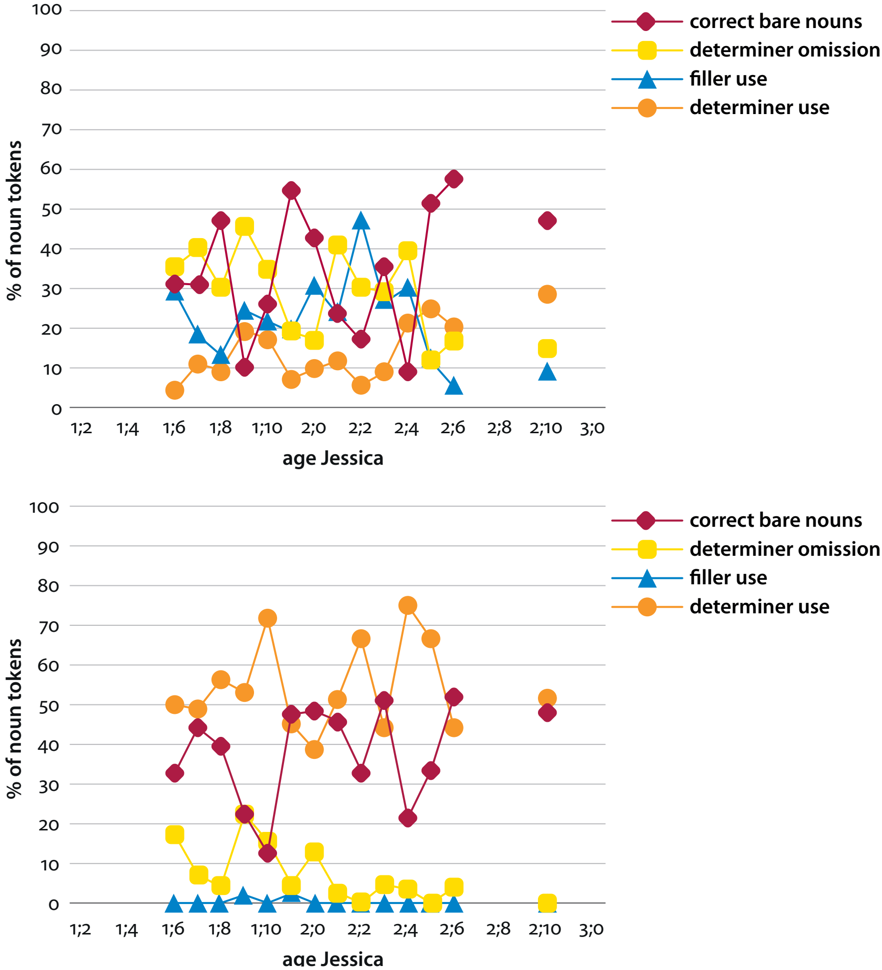

Figure 3. Frequencies of noun constructions in Jessica's data: child (up) and CDS (bottom)

For the Dutch-speaking girl Jessica (Figure 3), data were reduced in comparison to the other two children, since she was recorded only from the age of 1;6 to 2;6 plus an additional recording at 2;10. Determiner omission affected around 40% of nouns until 1;10 and decreased thereafter, but stayed at a 15% level in the last observations. Determiner use remained infrequent until 2;2 (less than 20%). It showed a clear increase at 2;3–2;5, but reached only 20–25%. Fillers showed a slightly inverted U-shaped curve, but were frequent during the entire trajectory, with an average of 22%. Correct bare nouns oscillated between 10% and 60% of all nouns, with an average of 35%, without showing clear developmental change. Thus, contrary to the other two children, Jessica has not reached the input level at 2;6 (she still presented more than 15% determiner omission and only 20% determiner use, which are not the adult rates). Jessica's input, which has relatively frequent correct bare nouns (38%), has on average 55% determiner use. Interestingly, it also presented omissions (imitative ungrammatical bare nouns), particularly frequent in the first observations.

In summary, explosions in determiner use were shown in the three children, although they varied in timing and amplitude. As could be expected, such explosions were not found in the CDSs. However, the frequencies of determiners in the CDSs presented certain general correspondences with the outputs. The CDSs presented quantitative individual differences in determiner use (82%, 69% and 55% respectively in Jan's, Pauline's and Jessica's CDS), in correspondence with the differences in timing and amplitude of determiner use explosion among the children (sharpest and earlier explosion in Jan, then in Pauline, later and attenuated explosion in Jessica). Correlatively, variation in the average frequency of bare nouns in the CDSs mirrored that of the children's production of correct bare nouns. Although the CDSs did not show 'developmental' changes in proportions of determiner use and bare nouns, they presented striking fluctuations, likely to reflect adaptation phenomena, as suggested above. This will be further examined with modeling techniques presented below.

4. The mathematical model

In order to transform the scaffolding model, the conceptual basis of which has been explained in Section 1, into a mathematical model, the conceptual relationships need to be transformed into mathematical expressions describing change over time in the variables of interest (Figure 4). In this particular case, the variables of interest are the frequency of use of determiners in Det+N contexts by the parent and by the child, in CDS and child speech respectively. In the model, the frequency of use of determiners in the parent's level of adult-directed speech is treated as a latent variable, the level of which will be estimated by the model. The equation describing the frequency of determiner use by the parent at a particular moment in time is determined by three parameters, namely the (estimated) level of determiner use in the parent's adult-directed speech, the level of determiner use in the child's speech, and a latent parameter that we called the parent's tendency to adapt. It is likely that parents will tend to differ in their tendency to adapt their language use to the language of their children, and this is a parameter that will be estimated by the model. We also assume that this tendency to adapt is subject to change. The assumption is that if parents observe no change in the child's use of a particular linguistic component – in this case determiner use – parents will tend to increase their adaptation to the child's language, to make it easier for the child to learn from CDS. We have also assumed that this process is largely automatic and is little controlled by deliberate decisions (van Dijk et al. 2013). Finally, the change in the child's level of determiner use is described by a growth equation, the assumptions of which have been explained in a variety of earlier publications (van Geert 1991, 1994, 2008). Mathematically formulated, this change is a function of the child's current level of determiner use, the determiner use in the input language, which in this particular case is primarily represented by the parent's CDS, and a growth rate, which is a latent, child-specific parameter that will be estimated by the model.

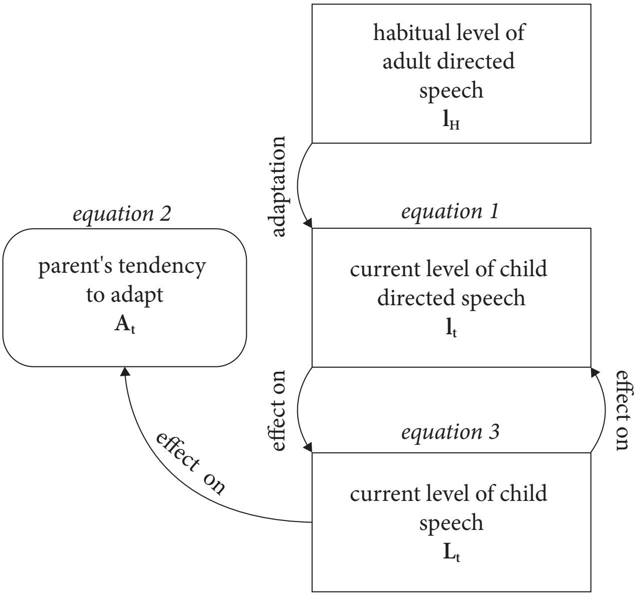

Figure 4. The scaffolding model: conceptual and mathematical aspects

These mathematical assumptions can be expressed in the form of three coupled equations, one describing the change in CDS (in this case operationalized as the frequency of determiner use in the parent's CDS at a particular moment in time), the second describing the change in the parent's tendency to adapt (which is a function of the child's linguistic progress, in this case in determiner use), the third specifying the change in child speech, i.e. the frequency of correct determiner use by the child. The mathematical equations are as follows:

First, the *actual adaptation* (I_t) of CDS to CS is expressed as:

$$I_t = I_H + s\,A_t\,(L_t - I_H)$$

That is, actual adaptation I_t is a function of the parent's habitual adult-directed speech level (I_H), the adaptation tendency (A_t), and the difference between the child's (L_t) and the parent's habitual level (I_H). The parameter 's' represents the rate of change.

Second, the parent's *tendency to adapt*, ΔA_t, is specified as:

$$\Delta A_t = a\, A_t\, (1 - \Delta L_t)$$

stating that the change ΔA_t in the adaptation tendency (A) is a function of the current tendency to adapt (A_t), the inverse of the amount of learning that takes place (here expressed as $1 - \Delta L_t$), and a constant change parameter, *a*. Parents with a strong natural inclination to adapt their actions to those of their children have a high value of *a*, and those who do not or only reluctantly adapt have a low value of *a*.

Third, the *adaptation by the child* (i.e. "learning" or "acquisition", and "growth") is expressed:

$$\Delta L_t = r\, L_t^p\, (1 - L_t/(q\, I_t))$$

implying that this change depends on a growth rate r, parental input I_t, the child's current level L_t, a growth exponent p, and a parameter q moderating the effect of the input (for a detailed description and justification of this model, see van Geert, 1991, 1994, 2008).

5. Modeling analyses: Relations between child speech and CDS in the three corpora

In order to provide a better opportunity to visually inspect and analyze the general trends in the data, the raw data (see Figures 1 to 3 for examples of raw data in the form of proportions) were processed in two ways. First, the raw data were smoothed by means of a nonlinear smoothing procedure, more particularly by means of a so-called Loess method (locally weighted scatterplot smoothing). In essence, this method draws a smoothed line across the data, showing general trends as well as local deviations from this trend. The model is somewhat comparable to the more generally known moving averages procedure. Second, these smoothed data were normalized in order to improve the qualitative comparability of the data. In absolute terms, the frequencies of determiner use in the parent and in the child are for the most part quite different, with the mother using considerably more determiners than the child. By normalizing the frequencies to a value between zero and one, the difference in absolute values is removed and what remains is a pattern of similar or dissimilar changes over time (see Figure 5).[1]

1. The choice for this type of normalization is justified by the fact that it equalizes the range of all variables, which greatly facilitates qualitative, visual inspection of local homogeneity among different variables (e.g., temporal similarities or dissimilarities in the change of the variables under study).

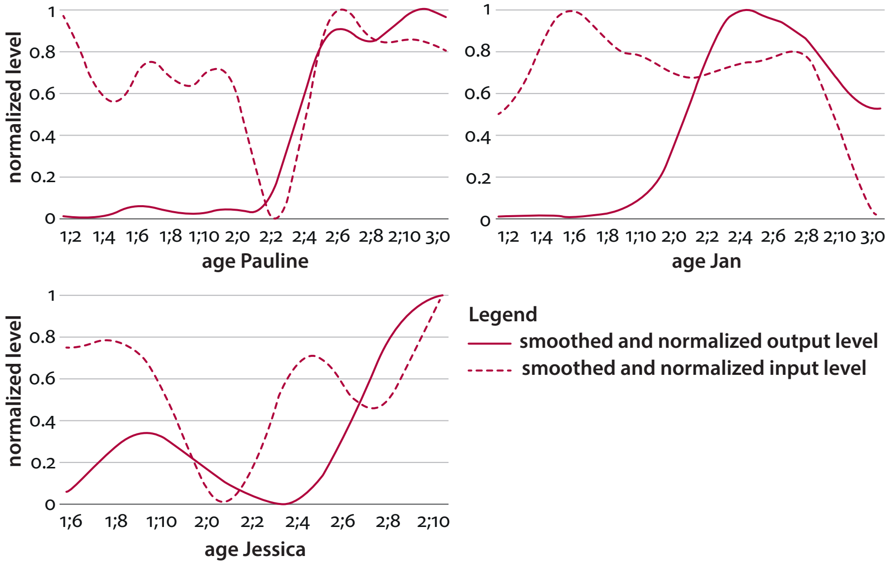

Figure 5. Smoothed and normalized curves for determiner use in the three corpora: output (child speech) and input (CDS)

This smoothed and normalized data from the French-speaking child Pauline showed that the child makes very little progress in determiner use between 1;2 and 2;0. During this period, the frequency of determiner use in the mother decreases, at first relatively moderately and with a sharp drop when Pauline is about 2;0. This drop just precedes the rapid increase in determiner use in Pauline, which lasts between about 2;2 and 2;6. This rapid increase is almost exactly mirrored, with some delay, in an increase in the number of determiners used by the mother. After the age of about 2;6, child and mother more or less stabilize the frequency of determiners (there is an oscillation within a relatively narrow band).

The data from the Austrian German-speaking boy, Jan, are less easy to interpret. Like Pauline, Jan shows a rapid increase in determiner use between 2;0 and 2;4, which is followed by a relatively sharp decline, suggesting a stabilization around the age of 3;0. The pattern is reminiscent of a so-called overshoot pattern, in which the frequency of use temporarily exceeds the frequency characteristic of a stable or mature situation. The data from Jan's mother show a pattern of an initial increase in determiner use, which is not followed immediately by a corresponding increase in Jan. In the mother's determiner frequency, there's a gradual decrease in the form of a shallow U-shaped intermediate period, in the middle of which we find the sudden increase in determiner frequency in Jan. At the end, the mother's determiner frequencies show a drop that mimics the drop in determiner frequency in Jan.

The Dutch-speaking child Jessica shows a somewhat comparable pattern, although the more limited period of data collection does not allow us to compare her data with those of the French-speaking and Austrian German-speaking children completely. However, Jessica's data also suggest a sharp increase in determiner use between the ages of 2;4 and 2;6. This sharp increase is preceded by a period in which the child shows a sort of inverted U-shaped growth, characterized by an initial increase and then decrease which began around 1;9. The decrease in determiner frequency is mirrored by a comparable decrease in the parental input frequencies, then shows another sharp increase. The latter is not directly followed by an increase in the child's frequencies, after which the parental frequencies show another drop. Finally, parental frequencies increase again, following the sharp increase in the child's frequencies with a short delay.

The model fitting (see Figure 6) provides partial support for the general theory of scaffolding explained in the introductory section, in that the model fits quite well with the input and output data from Pauline and Jessica and with the output data from Jan (R^2 values vary between 0.67 to 0.99, with the P values ranging from 0.002 to 0.03). However, the model fits very poorly with the input data from Jan (R^2 is 0.21, P value 0.16).

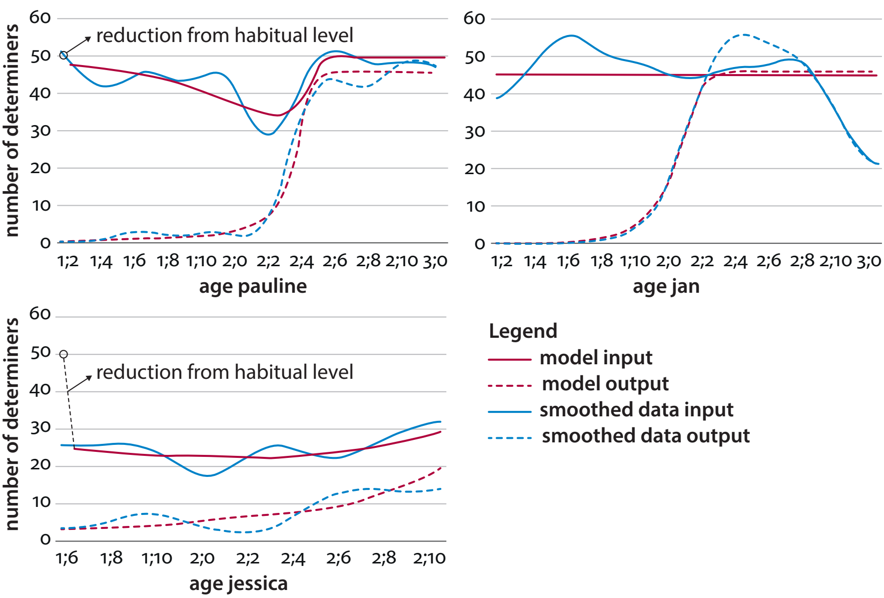

Figure 6. Model and data – Smoothed curves for determiner use in the three corpora: output (child speech) and input (CDS)

The parameters estimated for Pauline's input and output data confirm the assumptions of the scaffolding model, in terms of the bidirectional relationship between the two variables and the adaptation parameters. Pauline's data are also complete, in the sense that they cover the entire range between an almost complete lack of determiner use to a level of determiner use that is very close to that of the parent. In general, the data from Jessica also confirm the scaffolding model in terms of the relationship between the two variables and the adaptation parameters. In Pauline's as well as in Jessica's data, the model fit applies to the general trends in the change of the variables, such as the occurrence of a rapid change in Pauline's output and an initial decline followed by rapid change in the determiner production of Pauline's mother.

The model fit for Jan's data nicely reconstructs the rapid change in the child's determiner use, but fails to capture the overshoot phenomenon, i.e. the existence of a relative decline towards the end. It also fails to capture the form of the mother's determiner production, which it represents as a constant value. That is, the model views the parents' output as a randomly varying expression of a constant level of production, in which adaptation to the child's determiner production is completely absent. By doing so, the model illustrates the possibility of determiner growth that is only dependent on the average language input and does not, by necessity, require any particular form of adaptation. That is, the model treats various levels of adaptation, ranging from no adaptation at all to very strong adaptation as different scenarios resulting from the same underlying dynamic principles of linguistic change. The model fitting provides an illustration of the fact that the actual developmental processes are highly idiosyncratic and may show considerable interindividual differences (see for instance Molenaar & Campbell 2009). However, the model also shows that such idiosyncratic patterns, expressed in the form of different parameter values, may all be based on a single, underlying general dynamic model of developmental mechanisms.

Three further questions concerning adaptation models can be raised. First, it is important to note that adaptation should not primarily be seen as a consciously chosen pedagogical activity. Parent-child adaptation is in the first place an expression of a general human tendency, namely to more or less inadvertently show adaptation to interaction partners in interpersonal behavior (see for instance van Dijk et al. 2013, for a general discussion). Another question is whether structural differences between the three languages, which have been shown to influence determiner acquisition (Bassano et al. 2011; 2013b), play a role in adaptation processes. It is likely that such cross-linguistic differences are already reflected in the variables of the scaffolding model, so their influence on adaptation is likely to be indirect.

Finally, in dynamic systems model building, models are mathematical transcriptions of general, first principles, for instance of learning and of interpersonal adaptation. To test such models, their results are compared with the widest possible variety of empirical data. In this chapter, we have applied this model to parent-child interaction in the context of determiner use, but the model has also been qualitatively validated in the context of teacher-student interactions, which are supposed to follow the same, very general principles (van Geert & Steenbeek 2005).

6. Conclusion

This study contributes to going beyond traditional views concerning the role of input, in particular in early grammatical development. First, it shows that there exist subtle corresponding changes over time in input (CDS) and output (child speech) with respect to the development of determiner use. These changes can be revealed if convenient indicators (here, raw frequencies of determiner use rather than the classical index of determiner use in obligatory contexts) and convenient modeling techniques (here a scaffolding model) are used. Second, the model goes beyond the idea of a simple unidirectional form of causality concerning the role of the input, as it uses the concept of bidirectional influences. It describes adaptation as a mutual process that facilitates learning, rather than focusing on the question of whether adaptation is necessary for learning or not. Finally, the model conceives of learning as a process in which two components are intricately interwoven: on the one hand, the auto-catalytic process of change in which the learning of language depends on the linguistic knowledge already present and, on the other hand, a process of influence from the environment that, to a considerable extent, is triggered by the learners themselves.

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Appendix

Total number of noun tokens in the samples from the three corpora: output (CS = child speech) and input (CDS)

Child age	PAULINE		JAN		JESSICA	
	CS Noun tokens	CDS Noun tokens	CS Noun tokens	CDS Noun tokens	CS Noun tokens	CDS Noun tokens
1;2	32	71				
1;3	55	72	28	51		
1;4	52	66	48	62		
1;5	39	60	35	53		
1;6	44	65	54	67	48	58
1;7	51	73	41	69	55	43
1;8	38	57	72	55	53	49
1;9	30	52	50	62	58	49
1;10	32	47	59	50	23	32
1;11	44	66	94	69	42	42
2;0	36	52	83	44	52	31
2;1	22	45	83	54	34	37
2;2	36	49	58	46	53	57
2;3	47	45	75	67	34	43
2;4	62	49	68	49	33	28
2;5	61	73	77	63	68	35
2;6	71	82	83	60	59	52
2;7	71	96	47	44		
2;8	44	74	74	60		
2;9	79	73	51	59		
2;10	83	61	42	35	53	64
2;11	68	62	48	40		
3;0	61	75	49	42		

CHAPTER 11

Referential features, speech genres and activity types

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Based on a dialogic theoretical framework, this chapter explores the influence of speech genres and activities on the use of referring expressions. The study examines a corpus of 25 dialogues of French speaking children aged between 1;10 and 2;04 in various activities. Results show that referring expressions are not homogenously used throughout activities and genres. Everyday activities increase the use of nouns and strong demonstrative pronouns, games with toys positively affect the use of strong demonstrative pronouns and iconic material entails a more frequent use of clitic demonstratives and to a lesser extent of 3rd person pronouns. However, discourse in activities is made of various speech genres which strongly affect the use of clitic pronouns. Clitic demonstratives are preferred for labeling and evaluation but 3rd person pronouns are used for description and narratives. The discussion deals with the way these associations could be factors accounting for children's early choice of referring expressions.

Keywords: referring expressions, pronouns, activities, speech, genres, dialogic perspective, language acquisition

1. Introduction

The aim of this chapter is to bring to light the influence of speech genres and activities on the use of referring expressions, in particular 3rd person clitic pronouns. This study mobilizes a dialogic perspective to explain young children's early abilities in the choice of referring expressions.

It is now well established that very young children contrast emerging referring expressions according to the salient accessibility features of the referent, such as joint attention and previous mention (Allen 2000; Gundel & Johnson 2013; Hughes

DOI 10.1075/tilar.22.12sal

& Allen 2013; Salazar Orvig, Marcos, Morgenstern, Hassan, Leber-Marin & Parès 2010; Skarabela, Allen & Scott-Phillips 2013, among others). For instance, in various languages, children as young as two years of age tend to use null forms or 3rd person pronouns (3rdPP) when the referent is under attentional or discursive focus, whereas they prefer strong forms (lexical NP, strong demonstratives) when the referent has not been previously mentioned. Moreover children grow to more adult-like uses throughout linguistic development: in languages where the subject is obligatory, such as French or English, 3rdPP progressively replace null forms. In addition, greater availability of 3rdPP does not result in a greater number of non-relevant, deictic uses.

While studies on naturally occurring dialogues show convergent results for various languages, experimental settings reveal that children experience difficulties in dealing with perceptual cues when they are not scaffolded by discourse (Matthews, Lieven, Theakston & Tomasello 2006; Serratrice 2008; Wittek & Tomasello 2005). Studies on narratives also show young children misuse pronouns when introducing new referents or dealing with competing referents (de Weck 1991; Hickmann 2003; Karmiloff-Smith 1985; Peterson & Dodsworth 1991).

These controversial results have been interpreted from various perspectives related to the construction of reference: the textual/discursive competence, cognitive abilities and interactional mechanisms. Some of these approaches are based on the premise that children master, from the onset, the semantic values of referring expressions, and that they only need to develop pragmatic and cognitive skills. These perspectives disregard the gradual nature of the acquisition of semantic values and paradigms whereas, according to other approaches, such as usage-based ones, children start from non-analyzed expressions captured in specific contexts before using them in a productive way. Levy and Nelson (1994), for example, showed that children's uses of causal and temporal terms first reproduce their function in the parents' discourse (i.e. their pragmatic dimension), before grasping their meanings.

Usage-based approaches (Tomasello 2003) have also emphasized the role of children's experience of linguistic units through input and interaction. However, whereas the statistical dimension of the children's linguistic experience has been thoroughly explored for the acquisition of syntax and lexicon (see Lieven 2010, *inter alia)*, there have been fewer studies on the impact of its socio-pragmatic dimension. Yet children's linguistic experience occurs in culturally defined contexts (formats, Bruner 1985; scripts, Nelson 2007), characterized by their social goals, such as meals, bath, games and play. As Bruner (1985) puts it, these routinized activities expose children to conventional ways of interacting, negotiating, and discussing the world, and give them the opportunity to experience both language resources and social relations on a reduced and simplified scale. Our contention is that in these contexts, children experience the uses of referring expressions, which allows them to progressively discover their referential features. Consider the sequence in (1).

(1) Léa – 2;2 – MLU = 2.4, Activity: free game with toys[1]
In a discussion about the child's toys, her mother shows a baby boy

MOT	et ça c'est?	'and that is?'
LEA	[bebe]	
	'bébé'	'baby'
MOT	bon (…)	'well'

(…) the mother shows the doll to the child again

MOT	est-ce que tu trouves qu'il est propre?	'do you think he is clean?'
LEA	[wi]	
	'oui'	'yes'
MOT	non, mais regarde comme il est sale, tu lui as pas donné son bain? hein.	'no, but look how dirty he is. you haven't bathed him, have you?'
LEA	[u]	
	'où?'	'where?'
MOT	il est sale là + regarde là	'he is dirty there + look there'
LEA	[wi ilesal]	
	'oui, il est sale'	'yes, he is dirty'

In (1) the child takes part in a discussion about a baby doll. She takes up her mother's expression (*il est sale* 'he is dirty') after having experienced it in her mother's previous descriptions of the doll. The use of the 3rdPP is not only consistent with the fact that the doll is under their joint attention but also with its inclusion in the ongoing activity. As various authors have suggested (François 1984; Nelson 2007; Tomasello 2002), both early comprehension and emerging values of linguistic devices can be understood through their use within what Wittgenstein called language games "consisting of language and the actions into which it is interwoven" (Wittgenstein 1953: § 7).

The entanglement between language and action has also been addressed by two other concepts, akin to language games, *speech genres* on the one hand, and

1. Example captions indicate the name of the child, his/her age (years; months) and the Mean Length of Utterance (MLU) for the cited session. When the children's utterances are transcribed phonetically (between square brackets [ ]), the interpretation in French is given in inverted commas. An approximate English translation is also given between inverted commas. Braces indicate uncertain transcriptions or alternative interpretations. {X} stands for uninterpretable or inaudible segments. In the interpretations and translations, 'F' stands for a filler syllable. '+' stands for a pause. '§' marks overlapping segments.

activities on the other, which highlight different aspects of language uses. For *speech genre* we refer to Bakhtin's definition (see also François 1993; Wertsch 1991), for whom "utterances reflect the specific conditions and goals of each [area of human activity] not only through their content (thematic) and linguistic style, that is, the selection for the lexical, phraseological and grammatical resources of the language, but above all through their compositional structure" (Bakhtin 1986: 60). Bakhtin puts forward not only the inseparability of the three components (content, style and compositional structure) but also the close bond of speech genres and activities. On the other hand, activities are "structures of cooperation/collaboration that organize the interaction of individuals with their environment" (Bronckart 2004: 100);[2] they involve language to varying degrees, as a mediating tool for human action and development (Vygotsky 1978; Wertsch 1991).[3] Though activities and speech genres are intimately intertwined, they are not merged.[4] Activities are structured by their social purpose (i.e. business interactions, conversations between friends, meals, games), whereas speech genres are regular types of discursive organization (i.e. narratives, descriptions, argumentation) that can be mobilized in different activities, even though they are, at the same time, shaped by them.

Speech genres entail different ways to structure information and, therefore, contrasted uses of referring expressions (e.g. a narrative involves the maintenance of the referential chains of main characters, while recipes involve frequent introduction of new referents). As such, they predetermine the use and function of referring expressions (Fox 1987; Givón 1995; for a discussion see also Ariel 2008).

The influence of speech genres and activities on children's discourse has been mostly investigated in the field of speech acts and of the lexicon (Gleason, Phillips, Ely & Zaretsky 2009; Leaper & Gleason 1996, *inter alia*.) and syntax (Berman & Nir-Sagiv 2004; Chenu, Jisa & Mazur-Palandre 2012). Studies on the impact of speech genres and activities on children's use of referring expressions concern older children (see for example Jisa & Stomqvist 2002; Mazur-Palandre & Jisa 2012). In this chapter, we address the issue of toddlers' acquisition of referential features of

2. Our translation.

3. See also the fundamental contribution of Levinson (1979) addressing the relation between speech acts and speech events: "I take the notion of activity type to refer to a fuzzy category whose focal members are goal-defined, socially constituted, bounded events with constraints on participants, setting, and so on, but above all on the kinds of allowable contributions" Levinson 1979: 368).

4. In linguistics, this intricate relationship has also been addressed through different notions that share the view that language use is socially determined and that there are recurrent forms identified and mobilized by the members of a culture (see Halliday's (1978) or Biber's (1995) notion of *register*).

3rdPP through the perspective of the appropriation of these language games. This influence was investigated in a two-step process: for the first step, the more macroscopic one, dialogic sequences were characterized according to the activity in which participants were involved. The distribution of referring expressions was examined according to their occurrence in these various activity types. For the second step, speech genres were identified and referring expressions were characterized according to the genre in which they occured. Before presenting these results, we provide an overview of the corpus and methods of investigation.

2. Referring expressions in a French corpus

Uses of referring expressions were studied in 25 dialogues[5] of 23 French speaking children aged between 1;10 and 2;04 (see Table 1) in various situations, such as snack-time, picture reading, games, and play.

Table 1. Corpus of French-speaking children in naturally occurring dialogues

MLU group	MLU range	Age range	No. of children*	No. of observations
MLU group 1	1.3 – 1.92	1;10 – 2;03	7	7
MLU group 2	2.04 – 2.50	1;10 – 2;04	8	9
MLU group 3	2.52 – 2.96	1;10 – 2;03	9	9

* One child was observed at 1;10; (MLU group 1) 2;3 and 2;4 (MLU group 2).

Two kinds of statistical analysis were conducted: a Kruskal-Wallis rank sum test was run to compare the percentage of each referring expression across the three MLU groups; General Linear Mixed Effects Regressions (GLMER) were performed in order to assess the effect of contextual factors on the use of referring expressions. Successive binomial calculations were performed for each referring expression (as contrasted with all others) to assess the effect of each type of context (as contrasted to all others of the same category). Statistical models are presented in Appendix 1.

5. These data are part of a larger corpus analyzed for the research project, *DIAREF, Acquisition des Expressions Référentielles en dialogue: approche multidimensionnelle*, funded by the French National Agency for Research (ANR-09 – ENFT- 055). The data come from previous research projects (Marcos, Ryckebusch & Rabain-Jamin 2003; Marcos, Salazar Orvig, Bernicot, Guidetti, Hudelot & Préneron 2004; Morgenstern & Parisse 2010; Nashawati 2010; Salazar Orvig 2003).

2.1 The distribution of referring expressions

The age range under study corresponds to a noticeable development of grammatical units, and more specifically of pronouns. In order to capture the influence of speech genres and activities on the uses of 3rdPP (*il(s), elle(s)*, *le(s)*, *la*, i.e. 'he', 'she', 'it', 'they' 'him', 'her', 'them'),[6] we compared their use with the uses of three other referential devices, nouns, the clitic demonstrative pronoun *c-* (in *c'est*, a typical construction of spoken French, henceforth Clitic DP), and strong demonstrative pronouns (*ça*, *celui-ci*, *celui-là*, i.e. 'this' or 'that', henceforth Strong DP). Table 2 presents the frequencies of each type of referring expressions for each MLU group and the range between minimum and maximum values observed in individual children.

Table 2. Distribution of referring expressions in children's discourse according to MLU (Total % for each group and range of individual values)

	3rd PPs			Clitic DP			Strong DPs			Nouns			Other RE*			Total
	Total %	Range		Total %	Range		Total %	Range		Total %	Range		Total %	Range		100% =
		Min	Max		Min	Max		Min	Max		Min	Max		Min	Max	
MLU1	4.5	0	16.7	3.8	0	7.9	14.7	2.6	45.7	50.2	24.0	80.7	26.9	8.8	35.1	763
MLU2	4.9	0	14.9	10.1	0	18.2	9.7	2.0	18.4	50.8	39.6	80.7	24.6	9.1	35.4	1171
MLU3	8.2	1.4	33.9	11.6	6.0	18.6	7.5	0.0	13.3	49.8	11.9	64.2	23.0	6.1	50.9	1387

* Table 2 also includes the values of all other expressions (other pronouns, such as possessives or interrogatives, and fillers and null forms) even if henceforth they will not be mentioned.

As shown in Table 2, nouns are always the prevailing referring expressions (around 50%). Even though MLU group 3 presents a lower proportion of strong DPs (7.5%, compared to 14.7% in MLU1) and higher proportions of 3rdPPs (from 4.5 to 8.2%) and of clitic DPs (from 3.8 to 11.6%), differences between groups are not significant. Only clitic DPs grow significantly with MLU (see Appendix Table 2). This lack of significance is related to a wide individual variability. For each type of referring expression, large differences between minimum and maximum values remain similar throughout the three MLU groups. This striking variability suggests that grammatical development alone cannot account for the use or choice of referring expressions.

6. As in other studies (Salazar Orvig et al. 2010; Hughes & Allen 2013), 1st and 2nd person pronouns were excluded because their use is influenced by other interactional factors (see Caët 2013, and Salazar Orvig & Morgenstern 2015).

2.2 Uses of referring expressions

Let us now consider how children use these referring expressions. Expressions were categorized according to their referential uses and the discursive and attentional status of their referent, specifically whether the referent had been previously mentioned (DISCOURSE GIVEN), was under the attention of the dyad or part of the activity but had not been previously mentioned (ACTIVATED), was reintroduced after a topic change (REINTRODUCED), or was completely new in the interaction (NEW). A fifth category grouped all non-referential uses (NON-REF), such as labeling, predicative uses, expletives and vocatives.

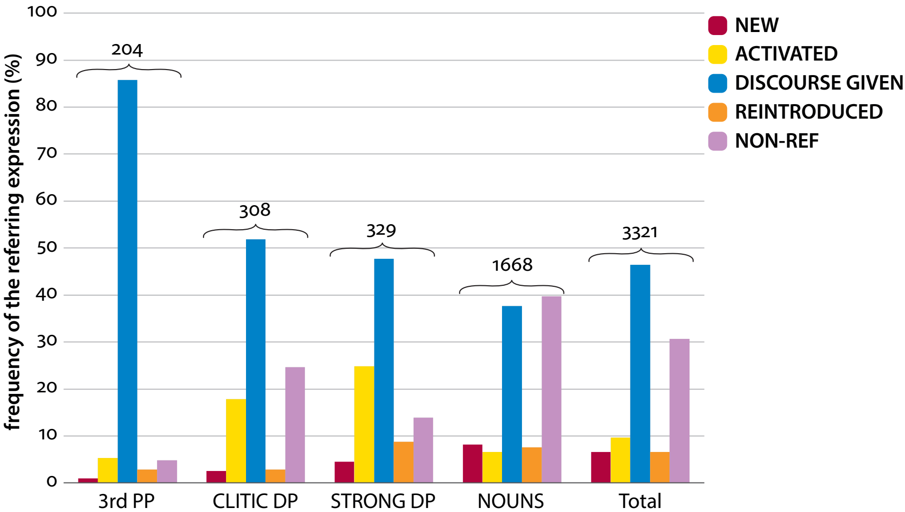

Figure 1. Referential uses of 3rd person pronouns, clitic and strong demonstrative pronouns and nouns*

Figure 1 presents the distribution of referential uses for nouns and the three types of pronouns as well as their global distribution for all referring expressions. For statistical purposes each category was contrasted to all the other categories and one variable with all other variables. For example, 3rdPP was contrasted to all other referring expressions and assessed with respect to discourse-given opposed to all other referential categories and so on for all referring expressions and the three activities. Figure 1 (see also Tables 1 to 4 in Appendix) shows clear differences in the use of referring expressions. Compared to the three types of pronouns, nouns have more non-referential uses and encode significantly less often discourse-given referents. 3rdPPs are used primarily to refer to a discourse given referent. They are more often associated with this status than other referring expressions. They are relatively infrequent for activated referents. Demonstrative pronouns (strong and clitic) are significantly more often associated with the latter. In addition, Clitic DPs share with 3rdPP the prevalence in discourse-given contexts.

These data reveal a complex picture with great individual variability for the frequency of referring expressions and yet a very consistent functional adequacy, already shown in most studies on reference in young children dialogues. This divergence between high variability and functional consistency suggests that pragmatic competence comes before actual grammatical competence. The question remains how to explain this pragmatic competence when two year old children lack the cognitive abilities underpinning reference. Let us now turn to the contexts in which children experience these expressions.

3. Referring expressions, activities and speech genres in family dialogues

The contexts of use of referring expressions were studied through a twofold analysis. The first aspect concerned the interactive contexts in which participants act and dialogue, *i.e.* activities, and the second aspect, the recurrent discursive patterns that compose activities, i.e. speech genres.

3.1 Activities and referring expressions

As our data were not collected on the basis of a homogenous protocol, our corpus contains a wide range of activities. In order to simplify the presentation, the various activities were gathered into three groups, in terms of their aims, main objects and actions.

a. **Everyday activities** (EVERYDAY) such as meals, bathing or dressing; these may unfold along two (or more) simultaneous tracks (see Goffman 1974): the primary interaction (such as dressing the child, feeding and eating) involves speech focused on the main actions and manipulated objects, while, simultaneously, participants can carry out detached conversations on various topics, even on absent referents or past and future events. Examples 4, 5, 9 and 10 give a glimpse of the heterogeneity of these communicative situations.
b. **Activities focused on iconic material** (ICONIC) in which participants are focused on pictures or other representations, be it a book, a photograph, an illustration, or a drawing. This includes joint picture-book reading (see 3) and board games like lotto or lotto-like puzzles (see 2).

(2) Clément, 2;3. MLU = 2.3, Activity: puzzle
The mother shows an animal on the puzzle board

MOT:	c'est quoi ça?	'what's that?'
CLE:	[de pɛ̃]	
	<*he shows the animal*>	
	'des (la)pins'	'rabbits'
MOT:	le lapin?	'the rabbit?'
CLE	[m]	'hm'
MOT:	non. regarde <*she whispers*> un lapin c'est pas grand comme ça	'no, look,<*she whispers*> a rabbit isn't that big'.
	<*she points to the same animal*>	
CLE	[se pɛ̃]	
	'c'est (la)pin'	'it's rabbit'
MOT:	c'est un +..?	'it's a+'
CLE	[se ɛ̃ pɛ̃]	
	'c'est un (la)pin!'	'it's a rabbit'
MOT:	un cheval.	'a horse'
CLE	[ɛ̃ piva]	
	'un cheval'	'a horse'
MOT:	ouais.	yeah

c. **Activities with toys** (TOYS), which include all games involving toy manipulation: building games, such as Lego® or toy bricks, symbolic play with figures, dolls, houses, farms, or other typical scripts (see 7), as well as playing with various object (see 8).

Figure 2 presents the distribution of referring expressions according to activity types.

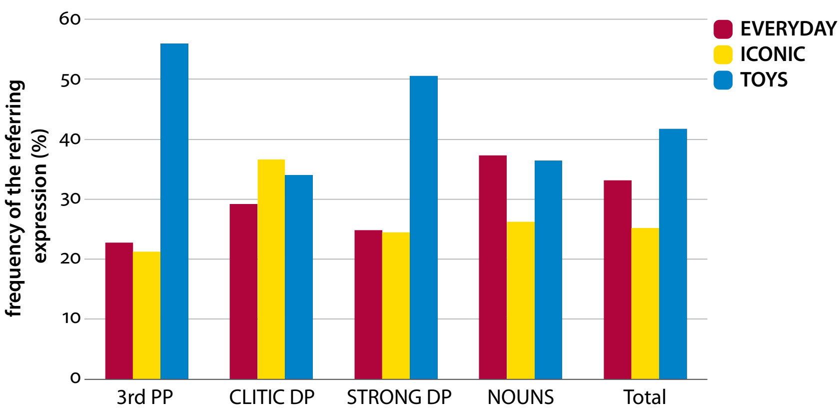

Figure 2. Distribution of referring expressions according to activities

Figure 2 shows that referring expressions are not homogenously used throughout activities. The generalized mixed effect models (see Tables 1 to 4 in the Appendix) assess the weight of activities as factors explaining the choice of each of the four types of referring expressions. Once again, each category was contrasted with all other categories and one variable with all other variables. For example 3rdPP was contrasted to all other referring expressions (nouns+demonstrative pronouns+ other referring expressions) and assessed with respect to one activity, for example, Iconic material contrasted to the other two activities, and so on for all referring expressions and the three activities. Whereas everyday activities significantly increase the use of nouns, they have the opposite effect on 3rdPP pronouns and clitic and strong DPs, which are significantly less frequent in these contexts. Games with toys positively affect the use of strong DPs, do not significantly affect 3rdPP and have a significant negative impact on nouns. Iconic material entails more frequent use of Clitic DPs, and, to a lesser extent, of 3rdPPs. These various associations between activities and referring expressions could be one of the factors explaining the great variability in the distribution of referring expressions across children.

3.2 Speech genres and referring expressions

Activities are themselves multiform with regard to speech. They mobilize various speech genres which present both specific structures and styles. Even though speech genres such as narratives, argumentation, description, and explanation are usually identified as discourse sequences, they are intrinsically heterogeneous. For instance, narratives include secondary genres such as description, explanation, and evaluation (see for example Labov's (1972) analysis of narrative syntax); argumentation sequences include narratives or descriptions typically used as arguments. In their varied communicative experience, children often face these complex patterns, as illustrated in (3), where the mother displays various speech genres while looking at a picture-book.

(3) Théo, 02;03, MLU = 2,23, Activity: joint reading
Théo and his mother are looking at a catalogue with Disney characters

MOT	c'est un petit garçon qu'est-ce qu'i(l) avait de particulier <le> [/] le Pinocchio	'it's a little boy. what did Pinocchio have in particular?'
THE	{xxx}	
MOT	il a un grand?	'he has a big?'
THE	{xxx}	
MOT	tu connais l'histoire?	'do you know the story?'
THE	[wi] 'oui'	'yes'

MOT	qu’est-ce qu’il a euh Pinocchio? il a un grand +++? regarde-moi, regarde *<she shows her own nose to Théo>*	‘what does hum Pinocchio have? he has a big … look at me, look’
THE	[ne]	
	‘nez’	‘nose’
MOT	oh il a un grand nez. et quand il raconte des mensonges? quand il dit pas la vérité	‘oh he has a big nose. and when he tells lies? when he doesn’t tell the truth’
THE	oh	‘oh’
MOT	son nez i(l) grandit, i(l) grandit, i(l) grandit	‘his nose it grows, it grows, it grows’
THE	[a gʁãdi]	
	‘F grandit’	‘F grows’
THE	[ɛ̃gãne]	
	‘un g(r)and nez’	‘a big nose’
MOT	il a un grand nez. exactement, il a un grand nez Pinocchio parce qu’il a raconté des mensonges.	‘he has a big nose. exactly, Pinocchio, he has a big nose because he told lies’

The dialogical sequence above includes a description of Pinocchio’s nose, the recall of a narrative (what happens when he lies) and an explanation (his nose grows because he lies). Therefore, an analysis at the sequence level would entail a unique characterization of the context (according to what would be considered the primary communicative intent) either as a narrative, an explanation, or a description, wiping out the diversity of speech genres displayed by the participants. In order to capture the conditions of the use of referring expressions, we opted for a more fine-grained analysis on the utterance level. Utterances were coded according to eight speech genres:

a. **NEGOTIATION:** when utterances aim to change or regulate immediate or future activities, actions and events (see Ninio & Snow 1996). These include directives, commitments, threats, instructions, rules, or proposed of new actions, and their respective responses (see 4).

(4) Serena, 02;03, MLU = 2.45, Activity: Snack

MOT	qu’est-ce que tu veux faire?	‘what do you want to do?’
SER	[omanɛʃ]	
	‘au manège!’	‘to (go on) the merry-go-round! ‘
MOT	tu veux aller au manège?	‘you want to go on the merry-go-round?’
SER	[nãdabɔʁlso]	
	‘nan d’abord F seau’	‘no, first to F bucket’[7]
MOT	d’abord au seau? Ah!	‘first to the bucket? oh!’

7. The child probably meant that she wanted to go play in the sandbox.

b. **DESCRIPTION:** when utterances encode the features of an object, a person, actions or events. This includes existential utterances, identifications, and comparisons. Descriptions of current actions or events (5) were also included in this category.

(5) Margaux, 02;03, MLU = 2.62, Activity: Snack

MAR	[ʃakul]	
	'ça coule'	'it is running'
MOT	il coule ton nez?	'you have a runny nose?'

c. **NARRATIVE:** utterances involve actions and events that are not located in the here and now of the interaction. They can correspond to fictional or personal experience narratives (6).

(6) Daniel, 2;4, MLU = 2.39, Activity: Conversation.
Daniel it talking with his sister (SIS) and the observer (OBS). The sister tells about their uncle, Gérard, who recently visited them

SIS	Gérard une fois il m'a fait toucher le plafond	'once, Gérard made me touch the ceiling'
OBS	c'est vrai?	'really?'
SIS	oui	'yes'
OBS	quand ça? hier?	'when? yesterday?'
DAN	[ijɛ tuʃe mɔ̃ tafɔ̃ tɔ̃tɔ̃]	
	'hier toucher mon plafond tonton'	'yesterday, touch my ceiling uncle'
OBS	il t'a fait toucher le plafond toi aussi, Daniel?	'he made you touch the ceiling too, Daniel?'
SIS	non pas lui, pas lui hein?	'no, not him, not him, right?'
OBS	non?	'no?'
DAN	[si amwa tuʃe {mɔ̃} amwa fãfɔ̃]	
	'si à moi toucher {mon} à moi plafond'	'yes to me touch {my} to me ceiling'

d. **EVALUATION:** corresponds to the expression of the speaker's positioning about a state of affairs. See in Example (7) the child's assessment (*est trop grand*, 'is too big') and her father's reply (*mais non c'est pas trop grand*, 'no, it's not too big').

(7) Iris, 01;11, MLU = 1.30, activity: playing with Mr. Potato Head®

FAT	mets-lui ses lunettes. mets-lui. regarde	'put his glasses on. put.(them) on look'
IRI	[nɔ̃ekʁɔgʁã]	
	'non est trop grand'	'no is too big'
FAT	mais non c'est pas trop grand	'no, it's not too big'
IRI	[nɔ̃ekʁɔgʁã. sepuʁʁis]	
	'est trop grand. c'est pour (I)ris'	'is too big. it's for (I)ris'

e. **LABELING** corresponds to the act of naming objects or events (8).

(8) Anaé2, 2;00 MLU = 2.67, activity: playing with various toys

ANA	[apul]	
	'F poule'	'F hen'
MOT	et tu / tu es sure que c'est une poule ça?	'and you you're sure that that's a hen?'
ANA	[we]	
	'ouais'	'yeah'
MOT	regarde bien	'look better'
ANA	[a::]	
	'ah'	'ah'
MOT	'c'est pas plutôt un pin(gouin)'	'isn't it rather a pen(guin)?'
ANA	++ [gwɛ̃]	
	'(pin)gouin'	'(pen)guin'
MOT	bah oui! c'est pas tout à fait une poule.	'well yes! it isn't really a hen'

f. **EXPLANATION:** corresponds to utterances that give (or ask for) the cause or reason of an event or a behavior (Veneziano & Sinclair 1995), as well as argumentative moves that aim to bring the interlocutor to a shared conclusion. In Example (9) the mother and child discuss the reason the child does not toast with her mother.

(9) Léa, 2;02, MLU = 2.40, Activity: Snack
Léa is drinking milk from her bottle. Her mother has a glass of water.

MOT	{on fait} tchin? +++ tchin tchin?	'do we say cheers? cheers +++ cheers?'
LEA	[e{fotjɛ}dəlotʃintʃin]	
	'hé! {faut qu'y ait} de l'eau tchin tchin'	'hey there has to be water cheers'
MOT	eh ben! tchin tchin. pour toi c'est de l'eau pour faire tchin tchin avec maman? on boit de l'eau? pas forcément hein:	'well! cheers. for you there must be water to say cheers with mum? we have to drink water? well, not necessarily'

g. **METALINGUISTIC USES:** include all questions, directives or comments on participants' speech behavior or linguistic forms, including clarification sequences as in (10).

(10) Ilona, 2;03, MLU = 2.58, Activity: snack

MOT	(…) tu veux d(e) la brioche?	'do you want a bun?'
ILO	[øwi]	
	'euh oui'	'hum yes'
MOT	hein?	'what?'
ILO	[wimwavøbʁijʃoʃokola]	
	'oui moi veux bri(o)che au chocolat'	'yes I want chocolate bun'

h. **OTHER:** all other kinds of utterances, including greetings, thanking, counting, performing acts in games, marking, back channel, exclamations, onomatopoeic sounds.
i. **UNCERTAIN:** refers to cases when the context does not allow characterization of the utterance.

Do speech genres influence the frequency of referring expressions? Figure 3 shows the distribution of 3rdPP, clitic demonstratives, strong demonstratives and nouns according to the speech genres in which they appear.

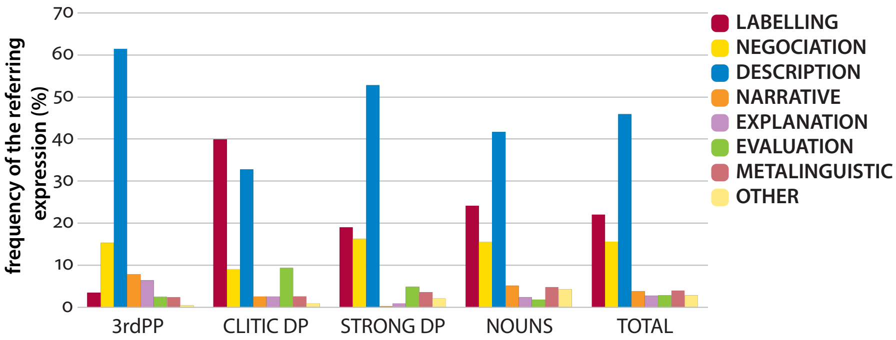

Figure 3. Distribution of referring expressions according to speech genres

Speech genres was the fourth variable considered in the generalized mixed models (see Tables 1 to 4 in the Appendix) in order to account for the choice of referring expressions. In this case, each type of referring expression was contrasted to all other referring expressions and assessed for the influence of one speech genre as contrasted with all the others. Figure 3 shows that the distribution of nouns reflects the overall distribution of referring expressions, except that they are significantly less often used for description and for evaluation. Strong DPs follow a similar pattern but they are dispreferred for narratives. In contrast, clitic forms, 3rdPPs and clitic DPs are more positively influenced by speech genres. Clitic DPs are more likely to be used for labeling and evaluative discourse and less for description and for negotiation. On the other hand, 3rdPP are significantly more likely to be used for description than for any other speech genre. Moreover, for 21 of the 25 observations studied, description ranges from 42% to 100% of the uses of 3rdPP. Similarly, even though narratives are not very frequent in our observations, children use significantly more 3rdPPs in this context than in the six other genres. 3rdPPs are significantly less frequent in labeling.

These results show that the use of emerging pronouns is strongly linked to speech genres. Considering 3rdPPs, the focus of this study, description appears as their prototypical genre. As can be seen in (11), this preferred genre does not necessarily reflect the adult's immediate uses where description is subordinated to negotiation. The child's negotiation utterances are solely acceptance and refusals without involving the use of referring expressions. However, she also replies to her mother with descriptive utterances which give her the opportunity to actually produce referring expressions.

(11) Léa 2;02 – MLU = 2,40 Activity: free game with toys
Léa and her mother are talking about a doll

MOT	il est sale là. + regarde là.	'he is dirty there. look there'
LEA	[wi ilesal]	
	'oui il est sale'	'yes he is dirty'
MOT	qu'est-ce qu'on fait alors?	'what do we do then?'

A pile of stuffed animals falls down

LEA	[bɛ̃. onɔ̃ etu tɔ̃be]	
	'ben. oh non! est tout tombé'	'well. oh no! it all fell!'
MOT	hein on lui donne le bain?	'so. do we give him a bath?'
LEA	[nɔ̃]	
	'non'	'no'
MOT	on le laisse sale?	'do we leave him dirty'
LEA	[wi]	
	'oui'	'yes'
MOT	à tes souhaits	'bless you'
LEA	[i:simba kɔmseʒoli]	
	'{i} Simba comme c'est joli'	'{ee}! Simba how pretty it is'
MOT	tu veux qu'on fasse une maison avec les legos.	'do you want to build a Lego house?'
LEA	[wi]	
	'oui'	'yes'
MOT	oui	'yes'
LEA	[wi. {isɔ̃dədɑ̃}]	
	'oui. ils sont dedans'	'yes. they are inside'
LEA	[wi]	
	'oui'	'yes'
MOT	ils sont dedans. tu les prends pour voir. tu me donnes les: donne-moi tous les legos: bleus.	'they are inside. you take them out and (we'll) see. you give me the: give me all the blue Legos'
LEA	[isɔ̃u?]	
	'ils sont où?'	'where are they?'
MOT	ben, cherche les.	'well, look for them'
LEA	[isɔ̃la]	
	'ils sont là'	'they are there'

4. How can speech genres affect the acquisition and use of referring expressions?

This study aims to contribute to the understanding of early appropriate uses of 3rdPPs by French speaking children, from a dialogic perspective. As noted above, previous studies have clearly shown that young children tend to use 3rdPPs when the referent is in focus, whereas they prefer strong forms (lexical NP, strong DPs) when it has not been previously mentioned. Undoubtedly, this early ability cannot be explained by a single factor. Without overlooking the possible influence of cognitive development on the one hand (De Cat 2015; Gundel & Johnson 2013), and of dialogue dynamics on the other (Matthews et al. 2006), not to mention factors pertaining to linguistic development itself, our contention is that communicative experiences both in their cultural and interactive dimensions (Vygotsky 1978; Bruner 1983; Clancy 1996; Nelson 2007 *inter alia)* form the basis on which this ability develops. We studied the contexts of use of 3rdPPs (compared to nouns and demonstratives) in a two-step process: through the general social context of activities and through their discursive components, i.e. speech genres. Both activity types and speech genres proved to be factors that clearly account for preferential uses of referring expressions. Games with toys entail the use of strong DPs whereas activities involving iconic material involve a more frequent use of Clitic DPs and 3rdPPs. Everyday activities increase the use of nouns and strong DPs. However, clitic forms are more strongly affected by speech genres than by activities. More specifically, description accounts for 61% of the uses of 3rdPPs whereas clitic DPs are more frequently used in labeling. On the other hand, strong forms (nouns and strong DPs) seem to be noticeably less influenced by speech genre, or only influenced in a negative manner: nouns are dispreferred for description while strong demonstratives are dispreferred for narratives.

Given these results, it is relevant to wonder why description is a particularly suited genre for the use of 3rdPP and how this prevalence could explain their early referential features in children's discourse. As Ariel (2008) puts it, when discussing Biber's data, the statistical distribution could be affected by discourse function, such as topicality. However, whilst, for Ariel, discourse functions explain the use of pronouns in various contexts, the question remains how these pervasive associations are developed in children.

Paradoxically, the close association of 3rdPPs and description cannot be explained by the precocity of the speech genre, given that description has not been identified as a use of language as early as labeling or negotiation (Ninio & Snow 1996). Rather, we propose that the explanation may lie in the discursive (or dialogic) position of descriptive utterances. As observed in examples (1, 3, 5 and 11), descriptive utterances often appear as a second move after the identification or the labeling of the referent. Therefore, these discursive moves necessarily concern previously-mentioned referents.

We can thus contemplate the possibility of an acquisition process that goes, as Nelson (2007) would say, from pragmatics to meaning. Children experience various aspects of reference on a reduced and simplified scale through routine activities. They first identify recurrent non-analyzed sequences like 'introduction of a referent followed by a description' which would contain 3rdPPs. These sequences can be seen as "formats" (Bruner 1985), which are typically recurrent and yet not completely repetitive. Children learn to contribute with the second part of the sequence through various dialogical moves, such as answers, uptakes or autonomous contributions. This first step of learning is not a simple memorization; it requires an active cognitive participation of the child, to retrieve the common contextual framework of sequences. Referential features of 3rdPPs would be first closely linked to the fact that, in the case of description, the discursive move is subsequent to the first mention of the referent, and thus that the referent is already present in the dialogue. Around age 2, the strong association between description and 3rdPPs could explain both individual variability for the occurrences of pronouns and their consistent use for previously-mentioned referents. Further accumulation and diversification of communicative experiences would allow children to generalize the use of 3rdPPs to all second position moves in other genres, as we can see in the first uses in narratives in our corpus. Our results thus suggest that children do not learn linguistic units with their semantic or referential value from the onset but that they first grasp how to use them in communicative situations. The constitution of the semantic and referential representation of the linguistic device would come in a third and last stage, when diversified experiences reach a critical mass. The fact that strong forms (nouns and strong demonstratives) seem less influenced by speech genres could be an argument to support this hypothesis. Indeed, as nouns and strong DPs are the earliest forms in language development, they might now be less dependent on original sequences and used in a more generalized manner than emergent clitic forms. This hypothesis is consistent with usage-based approaches and interactional analysis, but needs to be further investigated with longitudinal studies.

Acknowledgements

We thank the anonymous reviewers for their helpful comments, the team of the DIAREF project (*Acquisition des Expressions Référentielles en dialogue: approche multidimensionnelle*, ANR-09 – ENFT-055) for their collaboration and the *Agence Nationale de la Recherche* (ANR; French National Agency for Research) for the funding without which this research would not have been possible. The analysis reported here has been made by the authors with the collaboration of Marine le Mené and Salma Nashawati, to whom we are fully indebted.

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Appendix

Table 1a. Strongest GLMER model for 3rd person pronouns

Random effect	*Variance*	*SD*		
Sessions	1.047	1.023		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	−6.2808	1.1084	−5.666	<0.0001***
MLU	0.7787	0.4666	1.669	0.095104·
ATTENTIONAL AND DISCURSIVE STATUS: DISCOURSE GIVEN	2.1584	0.2094	10.309	<0.0001***
ACTIVITY TYPE: EVERYDAY	−0.6387	0.2364	−2.702	0.006889*
GENRE: DESCRIPTION	0.5596	0.1652	3.387	0.000707***

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.8505452

Table 1b. Comparative GLMER model for 3rd Person Pronoun with the same factors than Table 2a (model for Clitic Demonstrative Pronoun)

Random effect	*Variance*	*SD*		
Sessions	1.046	1.023		
Fixed effects	*Estimate*	*SE*	*z*	*p*
(Intercept)	64.2973	1.0908	−3.940	<0.0001***
MLU	0.6422	0.4629	1.387	0.16530
ATTENTIONAL AND DISCURSIVE STATUS: ACTIVATED	−0.6485	0.3225	−2.011	0.04431*
ACTIVITY TYPE: ICONIC	0.7079	0.2715	2.607	0.00914**
GENRE: LABELLING	−2.2196	0.3890	−5.706	<0.0001***

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.8135431

Table 1c. Additional GLMER model : genre narrative

Random effect	*Variance*	*SD*		
Sessions	0.9847	0.9923		
Fixed effects	*Estimate*	*SE*	*z*	*p*
(Intercept)	−3.0289	0.2253	−13.443	<0.0001***
GENRE: NARRATIVE	0.9095	0.3053	2.979	0.00289**

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.7804639

Table 2a. Strongest GLMER model for Clitic demonstrative pronoun

Random effect	*Variance*	*SD*		
Sessions	0.2794	0.5286		
Fixed effects	*Estimate*	*SE*	*z*	*p*
(Intercept)	−5.0309	0.6785	−7.415	<0.0001***
MLU	0.8848	0.2814	3.145	0.001664**
ATTENTIONAL AND DISCURSIVE STATUS: ACTIVATED	0.7498	0.1693	4.430	<0.0001***
ACTIVITY TYPE: ICONIC	0.6228	0.1750	3.558	0.000374***
GENRE:LABELLING	0.8692	0.1357	6.404	<0.0001***

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.7156903

Table 2b. Comparative GLMER model for Clitic Demonstrative Pronoun (same factors that model 1a for 3rd person pronoun)

Random effect	*Variance*	*SD*		
Sessions	0.3037	0.5511		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	−4.4419	0.2908	−6.412	<0.0001***
MLU	0.9500	0.2908	3.267	0.00109**
ATTENTIONAL AND DISCURSIVE STATUS: DISCOURSE GIVEN	0.3492	0.1246	2.802	0.00508**
ACTIVITY TYPE:EVERYDAY ACTVITIES	0.5088	0.1573	−3.234	0.00122**
GENRE: DESCRIPTION	−0.6693	0.1313	−5.098	<0.0001***

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.6993154

Table 2c. Additional GLMER models for Clitic Demonstrative Pronoun

GENRE Evaluation				
Random effect	***Variance***	***SD***		
Sessions	0.3996	0.6321		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	−4.4419	0.2908	−6.412	<0.0001***
GENRE: EVALUATION	0.9500	0.2908	3.267	0.00109**

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.699315

GENRE Negociation				
Random effect	***Variance***	***SD***		
Sessions	0.3996	0.6321		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	−2.4529	0.1544	−15.891	<0.0001***
GENRE: NEGOCIATION	0.6291	0.2085	3.017	0.00256***

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.6787568

Table 3a. Strongest GLMER model for Strong Demonstrative Pronouns

Random effect	*Variance*	*SD*		
Sessions	1.342	1.159		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	−2.1120	1.1803	−1.789	0.0735.
MLU	−0.5926	0.5070	−1.169	0.2425
ATTENTIONAL AND DISCURSIVE STATUS ACTIVATED	1.4695	0.1579	9.308	<0.0001***
ACTIVITY TYPE: TOYS	1.2617	0.2468	5.112	<0.0001***
GENRE: NARRATIVE	−2.4113	0.9978	−2.417	0.0157*

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.7768492

Table 3b. Comparative GLMER model for Strong Demonstrative Pronoun. (same factors that model Ia for 3rd person pronoun)

Random effect	*Variance*	*SD*		
Sessions	0.9224	0.9604-		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	−0.75407	0.97824	−0.771	0.4408
MLU	−0.74083	0.42780	−1.732	0.0833.
ATTENTIONAL AND DISCURSIVE STATUS: DISCOURSE GIVEN	−0.7566	0.12434	−0.609	0.5428
ACTIVITY TYPE: EVERYDAY ACTIVITIES	0.7955	0.16020	−4.947	<0.0001***
GENRE: DESCRIPTION	0.16929	0.12631	1.340	0.1801

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.7389183

Table 4a. Strongest GLMER model for Nouns

Random effect	*Variance*	*SD*		
Sessions	0.3496	0.5913		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	0.15430	0.59576	0.259	0.796·
MLU	−0.03112	0.25311	−0.123	0.902
NON REFERENTIAL	0.95985	0.08839	10.860	<0.0001***
ACTIVITY TYPE: TOYS	0.54630	0.12244	−4.462	<0.0001***
GENRE: LABELLING	−0.15763	0.09945	−1.585	0.113

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.6786509

Table 4b. Comparative GLMER model for Nouns. (same factors that model Ia for 3rd person pronoun)

Random effect	*Variance*	*SD*		
Sessions	0.4219	0.6495		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	0.328779	0.634334	0.518	0.6042
MLU	0.007119	0.273785	−0.026	0.9793
ATTENTIONAL AND DISCURSIVE STATUS: DISCOURSE GIVEN	0.748390	0.075478	−9.915	<0.0001***
ACTIVITY TYPE: EVERYDAY ACTIVITIES	0.656427	0.095211	6.894	<0.0001***
GENRE: DESCRIPTION	−0.203392	0.075548	−2.692	0.0071**

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.6837097

Table 4c. Additional GLMER model for Nouns: genre Evaluation

Random effect	*Variance*	*SD*		
Sessions	0.3918	0.626		
Fixed effects	***Estimate***	***SE***	***z***	***p***
(Intercept)	0.1262	0.1319	0.957	0.338802
GENRE: EVALUATION	0.8660	0.2304	−3.758	0.000171***

SD = Standard Deviation; SE = Standard Error; Number of observations: 3321; groups (Sessions): 26; C-statistics: 0.6347298

CHAPTER 12

Development of discourse competence

Spatial descriptions and narratives in L1 French

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This paper examines the development of discourse competence through the oral production of two text types: spatial descriptions and film retellings, collected from French children (aged 4, 7, and 10) and a control group of adult French speakers. Results suggest that for young children the construction of a static spatial description is intrinsically more complex and poses more difficulties compared to the production of narratives. The construction of a description of a multidimensional configuration implies a heavier cognitive load than the construction of a narrative based on a chronological – inherently linear – event structure. Based on the analysis of reference to entities, we identify phenomena reflecting specific difficulties for children when performing a descriptive vs. a narrative task.

Keywords: development of discourse competence, cognitive development, child L1 acquisition, static spatial description, narratives

1. Introduction

Within the functionalist approach adopted here, children must learn complex relations between forms and functions, and this process underlies the comprehension and construction of utterances in any given context. During L1 acquisition, children progressively master discourse skills that enable them to perform complex communicative tasks. Speakers show mastery of discourse competence when they adequately make use of two levels of linguistic organization – the sentence level and the discourse level – in relation to the situational and discursive context of speech, (e.g., the communicative goal, the status of the interlocutor(s), and shared (or unshared) knowledge). The resultant discourse is complex (conceptually and linguistically), coherent and cohesive, and establishes links between utterances in different referential domains, the role of which varies according to text type. The notion of discourse competence relates both to linguistic competence and to cognitive maturity.

DOI 10.1075/tilar.22.13wat

This article focuses in particular on the impact of text type on the development of discourse competence in children aged 4, 7 and 10. Our assumption is that the acquisition of processes required for the construction of discourse involves two fundamental components of linguistic competence – at sentence level to construe well-formed utterances based on morphosyntactic knowledge, and at discourse level, to organize and order utterances into a complex, coherent and cohesive discourse. In addition, the child must master a range of discourse patterns that underlie different text types, and learn to use linguistic forms with their specific functions in relation to the text types being produced.

Since the 1970s, many studies in L1 acquisition have focused on the development of reference management, but the results remain inconclusive. Hickmann (2000) provides an overview of the field and concludes (p. 94) that the main difficulty in comparing the different studies, beyond a general developmental move from a deictic anchoring to intra-discursive use and anaphoric reference, is due to extensive variability in the methodology. Studies examining the development of discourse competence vary in many ways, such as, type of texts, modes of response or type of stimuli, and prior knowledge (Berman 2016).

The project *Discourse Construction by Child and Adult Language Learners* (cf. Watorek 2004) was developed to control this heterogeneity. Its database contains oral discourse samples in five languages (French, Polish, German, Italian and English) collected from monolingual children aged 4, 7 and 10 years. Every child produced three types of text. This database makes it possible to evaluate not only the influence of language-specific factors on the development of discourse competence (cf. Lambert & Lenart 2004; Lenart & Perdue 2004; Lenart 2012), but also the impact of the communicative task during this development. It is this latter aspect that is explored in the present study, focusing on reference to entities in two text types based on a film retelling task and a spatial description. We can, thus, compare how the same speakers construct both text types and we can describe the specific difficulties faced by the children (French speakers aged 4, 7, 10) in each communicative task.

2. The Database – communicative tasks and discourse types

The database consists of three sets of productions: film retellings, picture retellings, and poster descriptions (Benazzo, Dimroth, Perdue & Watorek 2004), two of which are analyzed here. We refer to previous studies within the project which focused on spatial descriptions of a poster and retellings of a cartoon, both produced by French-speaking adults and children in the three age groups. These studies examined each text type separately (without contrasting them), to question the impact of L1 specificities. We reconsider these results and complement them by analyses of narratives and descriptions produced in French (children in the three age groups and adult native speakers; 20 participants per group). Our aim in this study is to systematically compare the structure of the discourse types examined in order to determine the possible influence of the communicative task and the type of discourse on the development of discourse competence.

The film retelling task is based on a four-minute silent cartoon for children (*Reksio*). After watching the cartoon, participants were asked to retell the story to an interlocutor who had not seen it, so the narrator could not rely on shared knowledge. The plot is simple and involves two main characters, a dog and his master, a small boy, in a wintry landscape. Both go ice-skating; the ice breaks, the child falls into the water and begins to drown. After multiple attempts, the dog manages to rescue his friend, and both return home safely.

The second task examined here is the description of a poster of an urban scene. Participants described the poster to an interlocutor who could not see it, but was told to make a drawing of the scene based on the oral description. The interlocutor was free to make comments on the participants' management of the task. However, they could not solicit information about the location of the various entities depicted. Thus, both tasks required children to produce discourse on their own, without help from the adult.

The text types examined here have been analyzed in many studies of both child L1 and adult L2 acquisition (Carroll, Murcia, Watorek & Bendiscioli 2000; Watorek 2003, 2004; Watorek et al. 2012; a.o.). In addition, underlying discourse patterns have been described in detail in native adult control groups of the various L1s. We review below studies that have identified the characteristics of both text types, with particular attention to reference to entities (cf. Trévisiol, Watorek & Lenart 2010; Watorek, Lenart & Trévisiol 2014).

The framework of analysis is based on the *Quaestio* model proposed by Klein and von Stutterheim (1991), which defines all texts as an answer to a global question, explicit or implicit – the *Quaestio* – which partitions the text into foreground and background information. Foreground utterances are direct responses to the *Quaestio*. Reference to time, space, entities (objects and people), processes (events, actions, states), and modality have different roles according to the global question defining the text type.

Static spatial descriptions and fictional narratives differ in their organization. Descriptions are based on the spatial domain, whereas narratives are based on the chronological ordering of events. We can therefore expect that, when telling a story, the speaker will construct anaphoric chains that involve time, protagonists and events, whereas the structure of the spatial description will call for anaphoric chains involving entities (people or objects) and space.

To construct a static spatial description, the speaker must establish a spatial localization, that is, a relation between an entity serving as a reference point and an entity to be located (*relatum* and *theme* respectively in Klein and Nüse 1997 terminology). The theme is an object that occupies a certain portion of space. Depending on the forms used in reference maintenance (cf. Carroll et al. 2000), the relatum can be an object together with its location if it is expressed by a PP ("beside the fountain is a bus stop"), or else it can be a spatial interval relatively independent of an object and its characteristics, which is generally expressed by an adverb ("and there we can see a fountain").

The *quaestio* of the spatial description has often been formulated (cf. a.o. Carroll & von Stutterheim 1993) as an abstract "*where* and *what* in L = the global space to be described". Any utterance that expresses a spatial relation of static localization is part of the foreground. This global *quaestio* determines the central conceptual domains of a given text type, in this case, the domains of space and entities (objects and people), and defines also the topic/focus structure of the foreground utterances. Relata-entities and spatial reference have topic status in the utterance, while thematic entities have focus status.

Concerning narratives, the speaker selects a complex global event, which is subdivided into individual sub-events mentioned in chronological order. The *quaestio* underlying the narrative can be formulated as "what happens to P (=protagonist) at T (=global temporal interval)". As in the static spatial description, it defines the conceptual domains associated with the narrative, specifically time, processes (events, actions and so on) and entities (primarily the protagonists), and structures the foreground utterances into topic-focus information. In a narrative, the topic corresponds to the global temporal interval and the main protagonist(s), and the focus is the information associated with the domain of processes. Background utterances in both types of discourse provide information relevant to foreground utterances.

In the domain of entities, information expressed for the first time in the discourse corresponds to *the introduction of referents*, which differs depending on the type of text. Animate referents are primarily the protagonists in a narrative, and both animate and inanimate referents in descriptions. The referential movement that characterizes progression may require *maintaining reference* (when successive utterances involve the same entities) or *a change of reference* (when different entities are mentioned in successive utterances).

With respect to referent introductions, an entity may be first mentioned either in the very first utterances of a narrative or later in subsequent discourse. Both cases occur in the narratives analyzed here. One of the two protagonists, the dog, is introduced in the first utterance of the narrative (*il y avait un chien* 'there was a dog'). The boy is mentioned for the first time only later in the discourse. At this point, actually, the boy is referred to as *the dog's master* (*le chien sort de sa niche et va voir son maître* 'the dog walks out of his doghouse and goes to see his master').

3. Construction of narratives and descriptions: Similarities in the development of discourse competence

Benazzo (2004), in a detailed analysis of the construction of film retellings from the same database, shows that French 4-year-olds express a series of juxtaposed facts in their narrative discourse, frequently omitting the central event of the boy's accident. In the absence of contextual information, the addressee, who does not share the child's knowledge of the story, cannot reconstruct the plot. Frequent referential ambiguity is typical of these narratives, although the utterances are well-constructed in morphosyntactic terms.

Watorek (2004) and Hendriks and Watorek (2008) show a similar phenomenon in the construction of spatial descriptions by the same speakers. At age 4, children produce descriptions in the form of a list of thematic entities loosely located via a global relatum in the situational context – the poster itself. The children list the entities they see without establishing spatial links between the themes and the relata. Their descriptions are based on the *here and now* of the immediate speech context as expressed by deictic anchoring.

Thus, the development of spatial descriptions is comparable to the development of narratives, as described by additional studies in the project. Lambert and Lenart (2004) emphasize that a third of the narratives produced by the 4-year-olds were characterized by the fragmentation of the narrated facts and required significant adult prompting. Benazzo (2004) also notes that 4-year-olds' narratives are very short and typically refer to series of facts juxtaposed or linked by *et/après* 'and/after'. Children aged 7 contextualize events via the introduction of the protagonists and spatio-temporal framing. Children at that age no longer list facts at the same level but organize their narratives on the basis of the goals of the protagonists and on the resolution of obstacles encountered on their way. Children aged 10 produce coherent and cohesive narratives, regularly marking causal and temporal relations.

We can therefore establish a parallel between spatial descriptions and narratives for children aged 4 both based on enumeration (of thematic referents in descriptions and facts in narratives). At age 7, both text types are organized in relation to a structuring entity, a salient relatum in descriptions and a macro-event in narratives. At age 10, discourse competence is reached, and the children can produce autonomous and communicatively effective discourse, similar to that produced by adult native speakers.

It therefore seems clear that 4-year-old children experience significant difficulties in the management of reference. The child also seems "deaf" to the requests of the interlocutor, who has no access to shared knowledge. The ineffectiveness of adult prompts in the productions of children aged 4 has also been noted in a study of misunderstandings and their influence on picture storytelling by children aged 4–11 (Veneziano & Hudelot 2006). The children in the study spontaneously told the story of a 'misunderstanding situation' represented on a series of pictures. They were then interviewed by an adult who asked them what reasons motivated the events, and were asked to retell the story. The study shows that children aged 4 construct both stories in the same descriptive manner. That is, adult prompting does not increase reference to internal states. Similarly, in the spatial description of the database, adult prompting does not facilitate discourse construction.

4. Construction of narratives and descriptions: Task influence on the development of discourse capacity

The studies cited above clearly reveal similarities in the development of the two text types across age groups. However, a more detailed comparative analysis of the French children's productions highlights an interesting difference in the level of difficulty associated with each type of text. To illustrate this difference, we describe specific characteristics linked to the development of narrative and descriptive capacity across age groups, and compare the two texts produced by the same child, with particular focus on the management of reference to entities.

4.1 Introduction of referents

Narratives
The retelling of the film *Reksio* requires the introduction of two main protagonists (a dog and a boy) who are referred to repeatedly throughout the narrative. The dog, which appears first in the film, should be introduced before the boy, who appears on stage later on. The two protagonists can also be presented simultaneously at the beginning of narration. Sometimes the boy is not introduced independently, but is presented for the first time in relation with the dog as his master.

The analyzed data show three strategies for the introduction of the protagonists (Examples (1)–(3) are extracts from the retellings of the adult French control group).

– Both protagonists are introduced simultaneously in the same utterance.

(1) *Il y avait <u>un petit garçon</u> et <u>un petit chien.</u>*
'There was a little boy and a little dog.'

– The protagonists are introduced in two steps, first the dog and then the boy.

(2) a. *c'est l'histoire d'un petit chien.*
'it's the story of a little dog.'

b. *alors il se réveille (…)*
'and so he wakes up (…)'

c. *et # il frappe à une porte*
'and he knocks on a door'

d. *et il y a un petit garçon qui vient lui ouvrir.*
'and there's a little boy who comes to open it.'

– The dog is introduced first, and the boy's mention is associated with the dog through the possessive *son* 'his' (*son maître, son ami* 'his owner, his friend') in complement or subject position.

(3) a. *donc c'est l'histoire d'un petit chien.*
'so, it's the story of a little dog.'

b. *il se réveille (…)*
'he wakes up (…)'

c. *et il décide d'aller voir son ami.*
'and he decides to go see his friend.'

While all three patterns are attested in the adult control group, there is a marked preference in this group for the association pattern – where the boy is introduced in a relational continued reference. In the child data, the choice of pattern varies with age.

Table 1. Introduction of protagonists in the narratives

Speakers (n = 20)	**Simultaneous intro (*dog* and *boy*) (1)**	**Separate intro (*dog* then *boy*) (2)**	**Introduction of *dog* + maintenance of *boy* in relation to dog (3)**
4 years	8	7	5
7 years	2	10	8
10 years	1	4	15
Adults	2	3	15

Pattern 3 is clearly preferred by adults and by 10-year-olds, and increases with age. But more detailed analysis of the utterances shows clear differences between child and adult constructions. Adults always introduce the boy protagonist using nouns such as *maître or ami* 'owner, friend' accompanied by a possessive, thereby encoding the ownership relation between the two (dog and his master). In contrast, the children use definite NPs (e.g., *le garçon, l'enfant, la fillette* 'the boy, the child, the girl') erroneously suggesting prior introduction of the referent leading to ambiguous reference.

This use of the definite NP and absence of possessive marking is typical of the 4-year-old introductions and declines with age (Example (4), 4-year-old).

(4) a. *y a un chien avec une niche.*
'there's a dog with a doghouse.'

b. *il monte les escaliers.*
'he goes up the stairs.'

c. *après il sonne à la sonnerie.*
'then he rings the bell.'

d. *après* ***le bonhomme*** *il ouvre.*
'then **the guy**, he opens.'

Among 7-year-olds, only two children out of eight chose pattern 3 (possessive+N). Among 10-year-olds, where pattern 3 is the most common, only one child used the definite article without prior mention of the referent; all the others referred to the boy with a possessive NP (possessive+N) like the adults.

Simultaneous introduction (pattern 1) is more frequent in the 4-year-old group (8 out of 20 children) than in the other groups (7-year-olds (2); 10-year-olds (1); adults (2)). In the rare cases where the dog and the boy are introduced in the same utterance, adults and older children use presentative and existential constructions (*c'est l'histoire d'un chien et d'un garçon / il y a un chien et un garçon* 'it's the story of a dog and a boy / there's a dog and a boy'). In contrast, 4-year-olds only mention the referents with NPs (*un garçon et un chien* 'a boy and a dog'), frequently after having been prompted to begin the story (Example (5), 4-year-old).

(5) *Interviewer:* *Raconte-moi le film que tu as vu?*
'Tell me about the movie you just saw?'
Child: *Je m'en rappelle plus.*
'I don't remember.'
Interviewer: *(…) bon qui est-ce qu'il y avait dans ce film?*
'(…) ok who was there in the film?'
Child: *un garçon et un chien.*
'a boy and a dog.'
Interviewer: *et qu' est-ce qu'ils ont fait?*
'and what did they do?'
Child: *ils ont joué.*
'they played.'

As illustrated in this example, 4-year-olds have difficulties in initiating the story. Adult questions help them anchor the discourse by stimulating conjoined introduction of the main protagonists and follow up. We return to the issue of referent maintenance further on.

Separate introduction of the boy (pattern 2) is typical of the younger groups (4 and 7 years) and is coded in relatively complex presentational constructions which do not differ clearly from those of the 10-year-olds and adults. This type of introduction is produced in the absence of adult prompting. Children may find it easier to deal with one referent at a time by introducing the dog first and providing additional information related to him and then introducing the boy (Example (6), 4-year-old). Dealing with conjoined referents (patterns 1 and 3) may prove more complex.

(6) a. *y avait un chien il sortait de sa maison en paille.*
'there was a dog he got out of his straw house.'

b. *il glissait*
'he slipped.'

c. *après il sautait* (…)
'then he jumped (…)'

d. *puis il est allé voir une maison*
'and then he went to see a house'

e. *où il y avait un petit enfant.*
'where there was a small child.'

This could explain the more systematic preference for pattern 2 in the 4- and 7-year-old groups, in contrast to the preferences in the 10-year-old and adult groups.

Note that, regardless of the pattern chosen, all speakers mention the two protagonists in the first utterances of the story, thereby providing anaphoric anchors for the following narrative.

Description

In descriptions, the speaker must opt for an entity, which serves as anchor point for the rest of the text. This entity, as a starting point for the description, initiates an anaphoric chain that forms the skeleton of the discourse. Contrary to the retelling task, where selection of the first entity is pre-determined by the film, description of a poster leaves the speaker free to choose which entity to mention first and the sequence by which further entities are introduced. The constraint imposed by this task is the need to explicitly elaborate spatial relations between the various entities and in relation to the poster as a whole.

Anchoring a description requires the introduction and spatial localization of a first entity-theme, in relation to a spatial interval defined by a relatum that corresponds either to the poster as a whole or to one of the subspaces depicted (Watorek 1996, 1998; Carroll et al. 2000; a.o.).

The relatum-entity, which serves as a reference point for the localization of the first thematic entity, can be introduced explicitly or left implicit, as contextually given.

Consequently two types of referent introduction can be distinguished in descriptions:

1. The two referents (*Relatum* and *Theme*) are introduced in the same utterance.

(7) a. *au premier plan de l'affiche* (Rel) *il y a une rue* (Th).
'in the foreground of the poster (Rel) there is a street (Th).'
b. *il y a une rue* (Th) *au premier plan de l'affiche* (Rel).
'there is a street (Th) in the foreground of the poster (Rel).'

Order of mention of the referents in the utterance may vary (Example (11)), although L1 French native speakers generally mention the relatum before the theme (cf. Hendriks & Watorek 2008). The relatum can be expressed in a locative construction referring to the poster, to some of its major subsections, or to one of the entities represented in it.

2. Only the theme is introduced, while the relatum, which is the entire poster, remains implicit.

(8) *il y a une rue* (Th).
'There's a street (Th).'

In this case, the relatum/the entire poster is considered as given information in the context of the communicative situation.

Comparisons of referent introduction in descriptions across groups reveal important differences between children and adults. Modes of introduction of themes and relata are summarized in Table 2.

Table 2. Introduction of referents in static spatial descriptions

Speakers (*n* = 20)	**Introduction relatum + theme**		**Introduction only theme**
	Rel+Th	**Th+Rel**	
4 years	1	2	17
7 years	2	8	10
10 years	11	4	5
adults	20	0	0

Adult native speakers all begin their descriptions by introducing both relatum and theme. In addition, the expression of the relatum precedes the NP introducing the theme, as illustrated in (9).

(9) a. *sur l'affiche* (=Rel) *je vois* *un quartier de ville* (=Th).
‘on the poster I see an urban quarter.’

b. *alors* *au premier plan à droite pour moi* (=Rel) *il y a une rue* (=Th).
‘so in the foreground on my right there is a street.’

In all the descriptions, adult speakers anchor their discourse by introducing a spatial interval referring to the poster relatum or to a subsection in which the theme-entity is located. Introduction of referents in children's descriptions shows gradual development over age.

Children aged 4 introduce a list of theme-entities vaguely localized with respect to the global relatum (the poster) which is left implicit in the situational context of discourse. The relatum is explicitly introduced by only 3 out of 20 children, but it is introduced with a deictic adverb (*ici* ‘here’, *là* ‘there’) by 2 of them. Consequently, their descriptions are also related to the discourse context. Referent introduction of this type influences the way children structure their discourse: they list the entities they see on the poster without establishing links between themes and relata. In this age group, introduced referents are hardly ever maintained in anaphoric relations (Example (10), 4-year-old). This is better described as a deictic anchored list of entities than as an introduction of referents in discourse.

(10) a. *un vélo avec un monsieur*.
‘a bicycle with a man.’

b. *une dame qui fait du vélo*.
‘a woman riding a bicycle.’

c. *un grand-père*.
‘a grandfather.’

This form of description evolves with age. The number of children who introduce unconnected themes implicitly related to the poster diminishes across age groups: at age four, 75% (17/20) of the children opt for implicit localization of the first theme, but only 50% (10/20) of 7-year-olds and 25% (5/20) of 10-year-olds do so. Like adults, the preferred strategy at age 10 is to introduce both theme and relatum in the first utterance, a strategy which leads to anaphoric anchoring of descriptions, but develops more slowly and gradually than in narratives.

4.2 Maintenance of reference to entities

Narratives

Once the protagonist(s) are introduced, reference to them must be maintained throughout the entire narrative, and temporal information must be provided about the events in which they are involved.

Comparison of the strategies used by children and adults shows a gradual development with age. The main difficulty for young children is linked to the use of linguistic means to refer to entities – NPs and pronouns – in a way that would enable their interlocutors to differentiate the two main protagonists. This difficulty increases when both protagonists are marked for the same gender, as is the case here.

Table 3 summarizes linguistic strategies for maintained reference. The ambiguous use of personal pronouns clearly decreases with age. The use of dislocations is similar in the two youngest groups, and declines by age 10, to reach only 2% in adult productions.

Table 3. Strategies of reference maintenance to protagonists in film retellings

Speakers (n = 20)	Personal pronoun	Ambiguous personal pronoun	Dislocations	NP
4 yo	31%	11%	21%	37%
7 yo	42%	9%	21%	28%
10 yo	54%	3%	12%	31%
adults	46%	0%	2%	52%

At 4 and 7, children have problems avoiding ambiguous reference, although this is notably more so in the younger group. Example (11c) (4-year-old) illustrates an ambiguous reference (in bold) after the context sentences (11a) and (11b). In these cases it is impossible to decide which protagonist is referred to without seeing the film (parentheses indicate intended referent of ambiguous pronouns).

(11) a. *il (=garçon) était dans l'eau*
'he (=boy) was in the water'

b. *et le chien a amené une échelle*
'and the dog brought a ladder'

c. *et **il (=garçon)** est monté dessus*
'and **he (=boy)** climbed on it'

Although these utterances are grammatically well-structured, the narrative is characterized by scarce contextual information and referential ambiguity. Similar difficulties are evident in 7-year-olds' narratives.

However, children of both groups also use dislocations, which are a means of avoiding ambiguity even when the protagonist is expressed by a NP and is not ambiguous, e.g. Examples (12b) and (12c) (dislocations in bold) after the context sentence (12a) (4-year-old).

(12) a. *et après ils ont fait de la glace.*
'and then they did the ice.'

b. *après* ***le garçon*** ***<u>il</u>*** *est tombé dans l'eau.*
'then **the boy** **<u>he</u>** fell in the water.'

c. *après* ***le chien*** ***<u>il</u>*** *a donné une échelle.*
'then **the dog** **<u>he</u>** gave a ladder.'

Dislocations are much less frequent in 10-year-olds' narratives, although occurrences are still attested. The 4- and 7-year-olds use more frequent dislocations and ambiguous personal pronouns. This reflects the fragility of their referential system, which converges with the result of studies on the evolution of cohesion in child language. Hickmann (1991, 2003) notes that children up to age 7 tend either to overly presuppose referents or to do the reverse and be overly explicit. This shows that mastery of the referential system is a relatively late development.

The evolution of strategies used to maintain reference to the protagonists across groups reflects the difficulties children face in managing this task. Ambiguous personal pronouns and dislocations in the productions of 4- and 7-year-olds manifest the fragility of the referential system. Notwithstanding young children's early capacity to use referential expressions appropriately in relation to context (see Hickmann, Schimke & Colonna 2015), full mastery of the referential system is a late development, which allows children at a later age to take into account (un)shared knowledge

Description

The static description task requires that each thematic entity be spatially associated with a relatum so that the first thematic entity introduced in discourse can serve in turn as relatum locating a new thematic entity. Watorek (1996, 1998, 2003, 2004) provides a detailed analysis of the referential movement in static spatial descriptions produced by L1 and L2 speakers of various languages. Generally, speakers select one option or the other: (i) a referent introduced as thematic is referred to in the following utterance as a relatum for the localization of a new thematic entity (Example (13)), or (ii) an entity is maintained as relatum for several successive utterances (Example (14)).

(13) a. *à droite de la place il y a une fontaine*
'on the right of the square, there is a fountain'

b. *a côté (**de la fontaine**) il y a un arrêt de bus.*
'beside (**the fountain**), there's a bus stop.'

(14) a. *au centre de l'affiche il y a une place* (Th)
'in the centre of the poster, there's a square (Th)'

b. ***où (=sur la place – Rel)*** *il y a une fontaine*
'where (=**in the square** – Rel) there's a fountain'

c. ***sur cette place*** **(Rel)** *il y a aussi un kiosque à journaux.*
'**in the square** (Rel), there's also a newsstand.'

Establishing anaphoric links between the first entity introduced and those introduced later constitutes a major challenge at age 4, as illustrated above (Example (10)). Watorek (2004) and Hendriks and Watorek (2008) show that children at this age experience difficulties in the construction of a static description. They produce a series of utterances listing entities perceived on the poster. This strategy implies an utterance structure that is limited to *existential verb + NP* or just an NP. The locative referent, the relatum, is frequently omitted and its use increases with time (see Table 4). The NP, the focused expression referring to the theme, is located with respect to the poster.

Table 4. Spatial description: percentage of the use of NP referring to the relatum in foreground utterances

Speakers (*n* = 20)	**NPs = Relatum**
4 yo	37.5%
7 yo	72.3%
10 yo	79.6%
Adults	86.6%

These locative expressions do not, in this case, serve to localize themes by establishing spatial links, but rather function as qualitative expressions (for example, "a truck is blue"). This use of locative expressions is illustrated below (Example (15), 4-year-old).

(15) a. *un vélo sur le trottoir* (? Rel).
'a bike on the pavement' (? Rel).

b. *y a une petite maison*
'there's a small house'

c. *un camion sur la route* (? Rel).
'a truck on the road' (? Rel).

In this example, where the child lists entities on the poster, the locative expression does not clarify the location of the various themes, since the relata used (pavement or road) have not been introduced beforehand. The spatial information seems to result from an afterthought. Hendriks and Watorek (2008) question the informational status of the locative expression that contains an NP denoting a relatum entity. Can this be considered a real topic? Probably not, since the topical relatum in 4-year-olds' descriptions refers to the poster as a deictically defined whole. Reference to individual elements that appear on the poster constitutes complementary information that does not serve to locate but to qualify thematic entities with additional properties, similar to the function of the underlined PP in *et là il y a un monsieur avec un chapeau* 'and here there's a gentleman with a hat'.

We can question the extent to which these descriptions meet the requirement of the addressee to reproduce the spatial configuration presented on the poster. Rather they manifest the difficulty that 4-year-olds face in carrying out a complex communicative task. This difficulty does not come from the linguistic complexity of the utterances. Children at this age have already mastered the linguistic system at the sentence level and can construct much more complex utterances than those attested in these descriptions. Similarly, we cannot make the assumption that the child has not yet acquired the necessary spatial concepts, as Johnston and Slobin (1979) have shown that the different relevant spatial relations are acquired at around 4 years of age.

Rather, 4-year-olds' descriptions show the limit of their discourse capacity in the implementation (without prompting) of their linguistic and conceptual knowledge regarding space. Consequently, the linguistic and conceptual complexity of discourse is influenced by these children's inability to handle a discourse activity without assistance at this age.

The descriptions produced by 7-year-olds reveal a more coherent organization of information. Mentions of ordered thematic entities are directly related to the context of production. Children group together sets of themes around salient entities that serve as relata (*maison* 'house', *rue* 'street', *place* 'square'), or around major subsections of the poster. Such a relatum may be maintained or left implicit (Example (16), produced by a 7-year-old).

(16) a. *y a une place.*
'there's a square.'

b. *y a quelqu'un qui fait du vélo.*
'there's someone riding a bike.'

c. *et y a des arbres.*
'and there are trees.'

The entity 'square', introduced in the first utterance, becomes the implicit relatum for a series of themes (someone, trees, bike, children) in Example (16 b–d). Information is coherently organized, although the sequences of descriptions at this age remain relatively implicit with respect to anaphoric links, particularly in reference to relata entities.

The descriptions of 10-year-olds are similar to those of adults. By that age, children have mastered the communicative task and can handle it effectively.

The comparison between 4-year-olds' descriptions and narratives shows a difference in the level of difficulty of these two text types. While 4-year-olds' narratives are insufficiently explicit and their references to entities remain ambiguous, they can still be considered as narrative texts that present a particular discourse structure. In contrast, descriptions produced by children at that age cannot be qualified as static spatial descriptions as they are restricted to an enumeration of entities with no anaphoric relations between them.

5. Discussion and conclusions

The results presented in this article address the impact of the communicative task and text type on the development of discourse competence. Children seem to face more difficulties with the spatial description task than with the narrative task. Static spatial descriptions evolve from deictic and implicit anchoring at age 4 to a coherent discourse established via anaphoric relations at age 7. By age 10, the productions are quite similar to those of adults. This contrasts with narratives showing that at age 4 children anchor and relate information anaphorically, but must still solve the problem linked to referential ambiguity.

Figure 1 illustrates the differences in the production of narratives and descriptions, summarizing the percentages presented in Tables 1 to 4.[1]

As far as narratives are concerned, the children introduce at least one of the two protagonists as early as age 4.[2] In contrast, in descriptions, the introduction of the relatum, which anchors the discourse, is gradually set up. Indeed, the 4-year-olds have difficulties with the anaphoric anchoring of their productions, and they only list entities that are on the poster. Only 25% of them actually locate the first theme.

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1. Percentages were calculated on the total number of referring expressions including both full and pronominal NPs (Det+N and Pronouns) used by all speakers within each age group to refer to relata-entities in descriptions and to protagonists in narratives.

2. The total number of introductions in the film retelling corresponds to 100%, as we included three types of introductions of protagonists in the narratives (see Table 1).

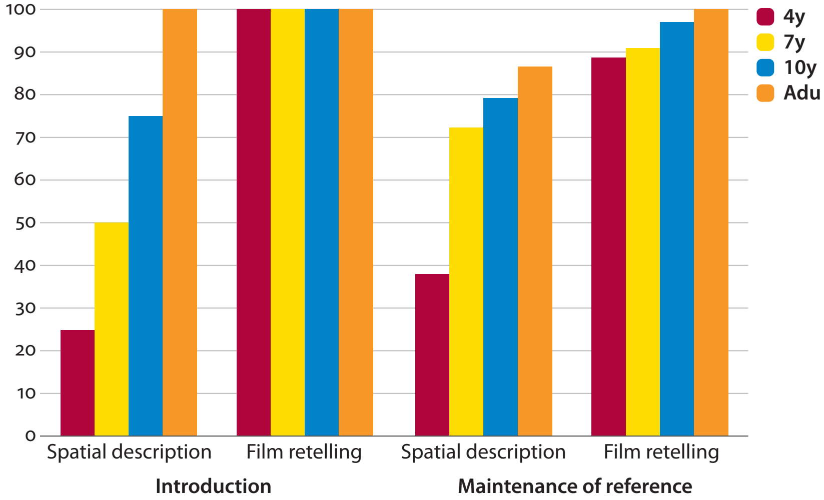

Figure 1. Percentage of NP use (complex and pronominal NPs) in descriptions and narratives as a function of referential movement (referent introduction *vs*. reference. maintenance)

We observe an evolution in the way the children describe: they essentially move from deictic anchoring to a more anaphoric system (see Table 2).

The analysis of maintained reference also shows clear differences between the two types of discourse. The increased use of NPs that build links between utterances is more gradual and slower in descriptions than in narratives. Indeed, the use of these strategies is poor in 4-year-olds' descriptions (37.5%) and drastically increases at age 7 (72.3%; see Table 4).

In contrast, in narratives, the percentage of forms indicating reference maintenance is already very high at age 4 (89%), and children use distinct NPs to refer to the protagonists. But, the main difficulty in building narratives lies in the need to disambiguate personal pronouns, as stated in Section 4.2. Thus, between ages 4 and 10, the evolution concerns the ability to use personal pronouns in such a way that the two protagonists, child and dog, are distinguished (ambiguous pronouns decrease from 11% at age 4, to 9% at 7, and only 3% at 10; cf., Table 3).

Our analysis of reference to entities in the two text types supports the findings of Hendriks, Watorek & Giulian (2004), who examined spatial reference in the same productions. Whereas children by the age of 4 have problems in describing static space, they manage to refer to dynamic space in narratives.

When seeking to understand differences relating to text type, one must also consider the impact of the type of stimulus material used in the two tasks. For example, Hendriks (1993) shows that in a study based on the retelling of a picture book by young children, 4-year-olds produced a description of each individual picture and did not interconnect the chain of events, despite instructions requesting a narrative. Yet, the 4-year-olds in the APN project managed to tell a story despite the difficulties related to the contextualization of events. It seems that visualizing the pictures that make up the story during the production task induces the construction of a sequential description. Consequently, the children in Hendriks' (1993) study may have produced descriptions rather than stories not because they did not know how to construct narratives or did not understand the instructions, but because they were conditioned by the task conditions and could not extract themselves from the visual input. Thus, the nature of the stimuli for the communicative task and their availability during narration have a significant effect.

The stimuli in our two tasks differ in several respects. The film *Reksio* features two main protagonists and the events in which they are involved. The task requires that the two protagonists be introduced and reference maintained to them in order to construct the sequence of events. In contrast, the poster presents multiple entities of all sorts that the speakers must organize by ordering and interrelating them. Consequently, there is no single way to represent the multidimensional spatial configuration. While in narratives the children can follow the chronological order of events, in the description task they are freer to choose how to organize spatial relations between the entities on the poster.

Planification processes vary according to differences in the elicitation material. For Levelt (1989), discourse production is a complex process where linearization constitutes the basis of the conceptualization phase of the message to be transmitted. The speaker must select, organize and linearize elements of information depending on the communicative goal and shared knowledge. The type of information to be conveyed according to text type may differ in complexity (*the speaker's linearization problem*). The event structure of narrative discourse is characterized by the *Principle of Natural Order* (PNO), whereby order of mention follows the chronological sequence of events. Compared to the description of multidimensional spatial configurations, the construction of a timeline might be easier (aside from simultaneous events). The spatial configuration in picture descriptions has no pre-established intrinsic linear order that the speaker can simply follow. Consequently, the linearization problem facing the speaker might be more demanding on cognition. We assume that a child whose cognitive capacity is still developing finds it more difficult to perform a spatial descriptive task than a dynamic storytelling task. Hence, children at age 4 solve the task by listing the entities they see on the poster with no coherent underlying structure. In addition, other data in our project (Watorek 2004; Hendriks & Watorek 2008, 2012) show major similarities across languages (Polish, French, English) in the repertoire of listed entities at age 4, typically including objects that are closely related to the child's daily life (e.g., bike, cars, children playing). Cross-linguistic differences are clearer from age 7 on, when children start producing well-constructed discourses.

The comparison of static spatial descriptions produced by 4-year-olds and adult learners of L2 French clearly shows that the children's difficulties could be related to the complexity of information planning. This could be motivated by their degree of cognitive development. However, children's discourse performance may be influenced by other factors. The level of difficulty in the building of the two types of discourse may be due to the content of the message, in relation to the task and to the communicative goal. An urban scene and a cartoon require different lexical items. Therefore, children aged 4 always enumerate the same entities that belong to the universe of childhood and leave out other entities that belong to the world of adults. This result is independent from the children's language (cf., Hendriks & Watorek 2012[3]). Watorek (2004) shows that even in the early stages of acquisition, adult L2 learners can produce descriptions that are far more communicatively effective and with much more complex discourse structure than children's descriptions, despite the rudimentary or idiosyncratic linguistic strategies at their disposal. Moreover, in the description task, the interlocutor has to reproduce the picture based on the child's descriptions while in the narrative task, the interlocutor is not supposed to give feedback on the child's speech. This communicative difference may have an impact on the production of the two types of discourse.

Finally, it would undoubtedly be of great interest to analyze the input directed to the child and their interaction with the adult. Such an analysis is not possible with the present database. It may be that the young children studied have been more often exposed to narratives than to spatial descriptions. It is well-known that texts most frequently read to children are stories based on an event structure. Furthermore, a discourse activity that consists of recounting events may be more common in the daily interactions of children with their families. Given that socialization practices in the input addressed to children vary depending on socio-cultural context (cf. Lieven 1994), such considerations must be empirically verified and located in a specific socio-cultural context. Future research is required to determine the qualitative and quantitative characteristics of child-directed input and its impact on language development.

3. Theses authors show that Polish, English and French children use the same lexical repertoires in their descriptions.

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CHAPTER 13

Texting by 12-year-olds

Features shared with spoken language

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The objective of this chapter is to investigate the development and use of the texting register. Our hypothesis is that this language register shares features with spoken language. In contrast to traditional writing, texting language is not the result of explicit academic instruction. Rather, it is acquired through daily interactions, as is spoken language. We collected a one-year longitudinal corpus of text messages (4,524 texts) produced by 19 teens aged 11–13 years, with no previous experience using a mobile phone. The messages were analyzed using orthographic indices (categories of spelling errors) and dialogic indices (presence/absence of an opening or closing). The data are discussed in terms of the specifics of the texting register. Unlike other registers, the texting register is not stable over time and evolves at an extremely rapid rate.

Keywords: SMS, texting, register, writing, orthography, adolescents, dialogic opening/closing, French, netspeak

1. Introduction

For over a decade, a new language register has been present in our daily lives: the texting register, used on the 160-character screen of our mobile phones. The examples below illustrate the major differences between texting and traditional language.[1]

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1. To simplify reading, traditional French and English translations of all texting examples can be found in the Appendix. Several translations into *texting-style* English have also been provided as examples.

DOI 10.1075/tilar.22.14ber

See Appendix for all examples of the texts cited in this chapter.

(1) *c toi ki socupe d chien a martin*
C'est toi qui s'occupe du chien à Martin?'
'are you taking care of Martin's dog'

(2) *cc alor ta dmende pour ce soir*
Coucou, alors, t'as demandé pour ce soir
'hey there you asked about tonight'

(3) *tro dégou t de pa etre alé au bal*
Trop degouté de pas être allé au bal.
'so disgusted that I didn't go to the dance'

(4) *emma*, *joyeux anniv gro bisou*
Emma, joyeux anniversaire gros bisous.
'Emma, happy birthday big kisses'

(5) *tu peux macheter des scoobidoo merci*
Tu peux m'acheter des scoubidous merci
'you can buy me some scoubidous thanks'

The typical register of written language is characterized by an asynchronous and monological communication mode. Linguistically, it is marked by greater lexical density and syntactic complexity than spoken language (Baron 1981; Biber 1988; Chafe & Tannen 1987; Halliday 1985; Harris 2000; Olson 1994). In every communication situation there is a specific set of linguistic signs that defines the communication register (Andersen 1996; Ellis & Ure 1977; Ferguson 1977; Ravid & Tolchinsky 2002).

Halliday (1964) defined register as "a variety of language" corresponding to a particular type of situation. The register is composed of linguistic features that are associated with the communicative situation. A register is a set of linguistic variations that are context-dependent (Biber & Conrad 2001; Eckert & Rickford 2001; Hudson 1980). Registers reflect different ways of expressing oneself, formulating intentions or ideas which are nevertheless fairly similar in meaning. These ways of expression depend on several factors: what is expressed (the content), the speaker (depending on factors such as level of education, culture), the addressee (depending on the status of the interlocutors) and the activity in which the participants are engaged. The communicative situation is interpreted by means of a conceptual framework using the terms *field*, *tenor* and *mode*. Unlike dialects that change according to the user, registers vary as a function of the use in a particular communicative situation (Halliday 1978).

The terms *register*, *genre*, and *modality*, although not all authors agree on their usage (Grimshaw 2003), nevertheless allow us to define the complex framework in which discourse is produced (Biber 1995; Guenthner & Knoblauch 1995; Ravid

& Tolchinsky 2002); in particular, all three involve a linguistic variation based on context. Genre is often used as a category superimposed on the concept of register (Eggins & Martin 1997; Martin 1992).

The concept of register can be applied to emailing by hypothesizing that this setting is defined by a specific set of linguistic signs that differ from those used in standard writing. Written dialogic registers such as emailing have been described (Volckaert-Legrier 2007; Volckaert-Legrier, Bernicot & Bert-Erboul 2009, 2013). Such registers are characterized by features of both spoken language (openings and closings, lexical density) and written language (syntactic complexity), as well as other, register-specific features (orthographic deviations and neographic forms).

The hybrid nature of texting – which also includes features from both traditional writing and traditional speech – has often been highlighted (Elmiger 2012). Terms such as *netspeak* or *cyberspeak* (Crystal 2001) are used to refer to the language employed during computer-mediated communication (CMC) in general. In French, Anis (2001) created the term *parlécrit*, and Daugmaudyté and Kedikaité (2006) note that the similarity to spoken language is evident in the frequency of purely phonetic transcription (i.e., replacing letters with numbers sharing the same sound: *2morro* for *tomorrow*). In terms of their form, text messages can be spelled in multiple forms that deviate from traditional standardized writing, with one type of these messages seeming to "transcribe" the regularities of speech (Stark 2011). Even if text messages are based on an asynchronous technology, they enable written conversations that are nearly as quick as spoken conversations with respect to the succession of speaking turns (Fernandez & Yuldashev 2011). This level of speed was of course impossible when paper letters were exchanged through the postal service. Netspeak also possesses features that are not shared with spoken or written language (Crystal 2001). A recurring aspect of texting is the dialogic structure of messages that do not systematically have an opening – the act of greeting one's interlocutor (Examples 1–5 – or closing – the act of taking leave of one's interlocutor (Examples 1–3) (Bernicot, Volckaert-Legrier, Goumi, & Bert-Erboul 2012a). Openings and closings are systematically found in traditional interactions.

Texting shares an additional feature with spoken language, one which, to our knowledge, has yet to be analyzed: its mode of development. Even if texting is a written communication mode, this register is acquired in interaction and is not the subject of explicit teaching, unlike traditional writing. In contrast, traditional written language is acquired through explicit, systematic teaching in a school setting, typically starting at age 6 years. It has been shown that spoken language is acquired through a child's exchanges by the age of 6 with the people in the child's environment. As of yet, however, no study has shown how texting develops in only a few months after a young person begins using it. This chapter presents a study that aims to fill this gap through a longitudinal study of texts sent by junior high school students between the ages of 11 and 12 years, all of whom were complete novices in texting. We will present previous research showing that texting offers two important characteristics that are particularly effective for adolescents: spelling forms that differ from those of traditional writing and a dialogic structure that differs from that of traditional interactions. Our hypothesis is that, with use, the text messages of 11- and 12-year-old junior high school students will become further and further removed from traditional language, both in terms of the form (spelling) and dialogic structure (message without opening and/or closing).

1.1 Evolution of text-message spelling with use: Previous studies

To date, nearly every single study of spelling in text messages has taken the density of *textisms* as its main defining feature. Textism density is the essential index used to evaluate the spelling forms used in texts. The production of textisms involves the use of symbolic abilities. A *textism* is defined as a change in the orthographic form of a word as compared to traditional writing. For each message, textism *density* was equal to the number of words with changes divided by the total number of words in the message. To illustrate, Example 6 contains 1 textism for 6 words (density = .17), whereas Example 3 contains 6 textisms for 9 words (density = .67). So far, only two studies have used a longitudinal method to analyze the evolution of textism density with use. Wood, Jackson, Hart, Plester and Wilde (2011) carried out a 10-week study of 9- to 10-year-old students (mean age 9;10) who had never owned a mobile phone. The participants were given access to mobile phones (and could text) during weekends and half-term break. The researchers collected the mobile phones on Mondays, then transcribed by hand the text messages the participants had sent. Textism *density* remained stable throughout the study (.129 after week 1, and .120 at the end of week 10). Wood, Meachem, Bowyer, Jackson, Tarczynski-Bowles and Plester (2011) recorded textism density produced by students between the ages of 8 and 12 (mean age 10;7) at the beginning and the end of one school year. All of the participants had their own mobile phones, with 8;1 as the average age of acquiring the phone (so, participants had approximately 2 years 6 months of experience). The children were asked to provide a sample of the messages they had sent at two points in time, the beginning of the school year and the end of the school year. The results showed that the average ratio of textisms rose from .33 to .40 between the beginning and the end of the school year. This slight increase masks the decreases at 8–9 years of age and at 11–12 years of age that remain to be explained. At both the beginning (T1) and the end (T2) of the year, the ratio of textisms was greater for the 11- to 12-year-olds than for the 8- to 9-year-olds (.42/.27 and .33/.07, respectively).

Cross-sectional studies of participants between the ages of 9 and 12 have shown the density values of textisms ranging from .34 to .53 (Bouillaud, Chanquoy & Gombert 2007; Bushnell, Kemp, & Martin 2011; Kemp & Bushnell 2011; Plester, Lerkkanen, Linjama, Rasku-Puttonen, & Littleton 2011; Plester, Wood, & Bell 2008; Plester, Wood, & Joshi 2009).

Ling (2010) analyzed data from six surveys in Norway (2001–2007, participants were over the age of 13) and showed that texting is not a cohort phenomenon but is a life phase phenomenon. Thus, when teens grow older, they make a more moderate use of texting than when they were younger, and stop using it in an intensive manner. Kemp, Wood and Waldron (2014) reported a steeper spike in the use of nongrammatical text abbreviations for secondary school students (mean textisms density = .40) than for primary school students ($m = .28$) and university students ($m = .20$). Consequently, we expected that there would be greater deviation from traditional writing with age.

1.2 Dialogic structure of text messages: Previous studies

When describing the traditional rules of spoken interaction between two people, Goffman (1967) insists upon the importance of greetings and leave-taking. These rituals are described as obligations which allow individuals to keep face (a positive social value) in a given situation. To define the interactive outline of written language, Herring (1996) offered a basic three-part structure in which the "contentful message" is preceded by an "opening epistolary convention" and followed by a "closing epistolary convention". Openings and closings are addressed directly to the interlocutor; they are discursive markers indicating how the speaker situates him/herself with respect to the addressee. Do we find this same structure in texting interactions: an opening (greeting one another), followed by the message (saying what one has to say), then a closing (taking leave)? Rettie (2009) notes that it is worth questioning the extent to which this three-phase structure is pertinent to computer-mediated interactions. The structure of technically asynchronous text messages with a quasi-synchronous functioning holds a specific study interest.

The studies on the structure of texting do not mention whether messages are part of an ongoing dialogue thread. We have found only two studies concerned with the evolution, with use, of the dialogic structure of adolescent text messages. Laursen (2005) shows that the complete sequence (opening – message – closing) was only very rarely used by 14-year-olds (even when taking into account interactions with a succession of two or three text messages). An analysis of texting by French-speaking adolescents aged 15–18 (Bernicot, Volckaert-Legrier, Goumi & Bert-Erboul 2012a) shows that the structure of messages differs from that of traditional interactions, since in 73% of cases, texts did not have the conventional opening – message – closing format (opening and/or the closing was missing). The message stood alone without either opening or closing in 23% of messages, a message – closing structure represented almost 47% of the messages, and the opening – message structure showed very low frequency (2.6%). Overall, 30% of the messages had an opening, 74% had a closing, and 77% had an opening and/or a closing.

Studies carried out on adults have shown a similar tendency. Only 10% of the messages in Ling's (2005) study contained an opening or a closing. Spagnolli and Gamberini (2007) found that 13% of the messages in their study had an opening while 35% had a closing, and in Spilioti's (2011) research overall 30% of messages included a closing. The arrival of smartphones has enabled the visualization of text-message exchanges as discussion threads. As a result, the interlocutor no longer necessarily considers each new message as a new contact, but rather as a part of a series of messages continuing from the preceding exchanges (Panckhurst & Moïse 2012). The study of conversational text messages (Panckhurst & Moïse 2011) has shown that closing formulas are more frequent than opening formulas. Panckhurst and Moïse (2012) found similar results in an analysis of a French corpus of text messages: among the formulas noted, 75% were closing formulas while only 25% were opening formulas.

Consequently, we expect messages containing an opening and/or a closing. Since we already know that in general, texts contain few openings and/or closings in this type of register, we can expect a decrease in the number of openings and/or closings, due to an appropriation of the register with use.

1.3 Aims

Previous studies have focused on children and young adolescents aged 8–12 for spelling and 14–18 for dialogic structure. Diverse methods have been used, from natural data collection to the simulation of writing words in text-message language in a paper-and-pencil situation. The resulting textism density (essential index used to evaluate the spelling forms used in texting) varied from .07 to .53. One of the variables was the participants' texting experience: never before, for a few months, for 1 year, 2 years, or 4 years. The two longitudinal studies (Wood, Jackson, Hart, Plester & Wilde 2011; Wood, Meachem, Bowyer, Jackson, Tarczynski-Bowles & Plester 2011) mentioned above did not demonstrate an evolution of textism density with experience. It should be noted that in the first case, the study period was relatively short (9 and 10 weeks), while, in the second case, the study period was one school year – but there, texting samples are only available for the beginning and the end of the year. Where the dialogic structure is concerned, the available studies are scarce and not analytic enough to draw any definite conclusions at this point. However, contrary to what is observed in traditional interactions, there are texting interactions without an opening and/or a closing. Openings seem to be absent more frequently than closings. This could be a specificity of texting as compared to other types of technically mediated communication. In electronic mail, even if they are not systematic, openings and closings are much more frequent (50–100% of emails have an opening or a closing, see Bou-Franch 2011; Volckaert-Legrier 2007; Waldvogel 2007).

In order to increase our understanding of the development mode of the texting register, a method must be used that allows for the reliable determination of the characteristics of messages actually produced by the texters. The present study focused on children aged 11–12. The methodology of this study enabled text messages to be collected from everyday life situations. The collection was carried out in a longitudinal manner (month by month) over a long period (12 months) with children who had no texting experience prior to the start of the study. This allowed the researchers to study the process by which text-message types evolve and to control the length of experience.

Our objective was to show the progressive development of the texting register with experience by studying two specific characteristics of this register: the spelling forms distinct from traditional writing and the dialogic structure of the messages, different from that observed in traditional interactions. We assumed that adolescents will adapt to this new mode of text communication and will produce textisms. Furthermore, the use of textisms was encouraged by the ergonomics of the phone (limitations imposed by the small screens and alphanumeric keypads) and the social interactions with text messages which were involved during the production of textisms by participants. Our first hypothesis was that, with use, there would be an increase in the number of forms deviating from traditional writing. Nowhere, neither in an institution nor in the family, do young adolescents receive explicit instruction in deviation from standard spelling. Example 6 (only one textism in six words) and Example 3 (six textisms in nine words) illustrate the variation expected (cf. § 2.4.1). Our second hypothesis was that with use, there would be an increase in messages without an opening and/or closing. In the same way as with spelling, nowhere do young adolescents receive explicit instruction in transgression of politeness (to not say “hello” and/or to not say “goodbye”). Example 4, with an opening and a closing, and Examples 1 and 3, without an opening and a closing, illustrate the variation expected (see Appendix for more examples and translations of the texts). The validation of our hypotheses would mean that the texting register emerges without explicit instruction, as is the case for spoken language.

2. Method

2.1 Participants

Nineteen adolescents in the sixth and seventh grades participated in the study, 10 girls and 9 boys (mean age = 11.7 years, *SD* = .59 of a year). They were recruited from a public junior high school located in a town in the Poitou-Charentes region of France. Students who had never owned or used a mobile phone were invited to participate in the study. The proposal was as follows: they would be given access to a mobile phone for one year, free of cost, with the agreement to "donate" at least 20 text messages (written by the students themselves) per month to the research team. The research team guaranteed the students' anonymity at every stage of the study. The students and their parents provided their written consent. All the participants were from middle-class backgrounds, of legal school age, and native French speakers.

2.2 Equipment

Equipment included two similar French mobile phone models (Sony Ericsson J132 or Alcatel OT-303) without an alphanumeric keyboard (not flip phones). The T9 key, which enabled predictive text and access to a dictionary, was deactivated. There were two types of cards for reloading the mobile phones, cards valid for one month equivalent to 30 minutes of voice communication or 150 text messages; and cards valid for five days with unlimited text messages. A 3G key and Vodafone Mobile Connect software installed on a computer allowed the research team to receive the text messages which were "donated" each month by the participants.

2.3 Data collection

Data collection took place over the 2009–2010 school year. At the beginning of each month, participants' mobile phones were automatically credited with a sum of 15 euros, the equivalent of 30 minutes of voice communication or 150 text messages. Once a month, participants' mobile phones were also credited with the sum of five euros, allowing an unlimited number of text messages to be sent over a period of five days. It was during this period that the participants were to send at least 20 text messages to the research team, freely chosen from the text messages that they had sent throughout the month and that they had written themselves. Via the 3G key, these text messages were fed onto a computer using the Vodafone text message software. A *cut-and-paste* procedure enabled the text messages to be entered into an Excel™ workbook. This procedure was repeated for 12 months.

Participants provided a total of 4,524 text messages,[2] on average, per participant, 19.84 text messages (*SD* = 3.02) per month and 238.10 text messages (*SD* = 36.24) for the year. Below are examples of two original messages which were collected.[3]

(6) *Oué suuuuper mé heuresement c k1 rève* [smiling smiley]
Ouais super mais heureusement c'est qu'un rêve [smiling smiley]
'Yeah super but luckily it's only a dream [smiling smiley]'

(7) *Salut sa va moi ouai sa se passe bien tes vacanse nous on*
Salut ça va moi ouais ça se passe bien tes vacances nous on

s'ammuse bien met ces mieu kan vous ette la. Bon
s'amuse bien mais c'est mieux quand vous êtes là. Bon

aplus :-):-D;-)
àplus [smiling smileys].

'Hi I'm ok is your vacation going well we're having fun but it's better when you're here. OK see you later [smiling smileys].'

2.4 Coding

To calculate textism density, the number of words in each text message was determined. For each original message, we used the automatic counting formulas in Excel to tally the number of words (defined as a letter string with a space on either side). Two examples of original messages are presented below.

(8) *Nn je pe pa venir.* (5 words)
Non, je peux pas venir.
'No I can't come.'

(9) *T tro cool jtd ofete heuresemen que je me sui*
T'es trop cool je te dis au fait heureusement que je me suis

reveile cet nui ma den es tombe toute seule i men reste
réveillé cette nuit ma dent est tombée toute seule il m'en reste

plu qune et jore toute me den. (29 words)
plus qu'une et j'aurai toutes mes dents.

'you are too cool I told you by the way luckily I woke up tonight my tooth fell out by itself I only have one more and then I'll have all my teeth.'

2. All of the text messages sent by the participants were taken into consideration, except for messages which were "chain letters" or "spam" (by definition not written by the participants themselves).

3. Cf. Appendix for the translations.

We considered two types of message indices, textism density and the dialogic structure.

2.4.1 *Coding of textisms*

The first element we took into account was textism density. A *textism* is defined as a change in the orthographic form of a word as compared to traditional standard writing. For each message, textism density was equal to the number of changed words divided by the total number of words in the message.

The coding of the textisms was based on the analytical grids of English (Grinter & Eldridge 2003; Plester, Wood, & Joshi 2009; Thurlow & Brown 2003) and French (Anis 2007; Panckhurst 2009). Panckhurst (2010) showed the particularities of French texting as compared to Italian and Spanish. Stark (2011) studied the morphosyntax in text messages written in Swiss French, examining texts in the three languages spoken in Switzerland: French, German, and Italian (Stark & Dürscheid 2011). Thurlow and Brown's (2003) classification is the most commonly used in English, and includes the following 10 categories:

– Shortenings (*bro* for *brother*)
– Contractions (*gd* for *good*)
– G-clippings (*goin* for *going*)
– Other clippings (*hav* for *have*)
– Acronyms (*BFPO* for British Forces Posted Overseas)
– Initialisms (*V* for *very*)
– Letter/number homophones (*2moro* for *tomorrow*)
– Misspellings (*cuming* for *coming*)
– Non-conventional spellings (*fone* for *phone*)
– Accent stylizations (*afta* for *after*)

All of Thurlow and Brown's (2003) categories were found in this study, except for g-clippings, which are specific to English (Bernicot, Volckaert-Legrier, Goumi & Bert-Erboul 2012b). The category of *agglutinations* was added to Thurlow and Brown's classification, i.e., cases where words were placed one after the other without a space (*patavoir* 'nothaveyou' instead of *pas t'avoir* 'not have you', or *jcroyé* 'ithot' instead of *je croyais* 'I thought').

With regard to the coding of the different types of textisms in this study, a very high intercoder agreement of 99.53% was found, on the basis of 250 messages chosen at random and containing 940 textisms.

2.4.2 *The dialogic structure of the messages*

Data collection does not allow us to know if the messages are part of an ongoing dialogue thread. Each message was broken down into three segments: the opening (O), the message itself (M), and the closing (C). These three segments correspond to the structure defined by Herring (1996) regarding written language and used to study the Usenet and LISTSERV messages. Our objective was to determine whether texting users respect this three-phase structure, whether they begin by greeting each other (O), say what they have to say (M), and then take leave (C). In interactions taking place via texts, unlike traditional oral (Goffman 1967) or written exchanges (Adam 1998; Herring 1996), there are messages with no opening, no closing, or without either. We defined four types of messages (see below with examples).[4]

(10) Message alone (M).
M: *Ouai a par que je mennui grave et toi*
M: Ouais à part que je m'ennuie grave et toi ?
'Yeah except that I'm really bored and you'

(11) Opening and message (O + M).
O: *slt* + M: *je vé pa au colèg é twa*
O: Salut, + M: je ne vais pas au collège et toi
'O: Hi + M: I'm not going to school and you'

(12) Message and closing (M + C).
M: *cc ca va* + C: *koi 2 9 mam*
M: coucou ça va + C: quoi de neuf maman
'M: hi you OK + C: what's new Mom'

(13) Opening, message, and closing (O + M + C).
O: *Slt tata c théo* + M: *g recu le coli le bonome blan*
O: Salut tata c'est Théo + M: j'ai reçu le colis le bonhomme blanc
é lé persso de catch son maran é jadore lé pinsse +
et les personnages de catch sont marrants et j'adore les pinces +
C: *bisou é merci*
C: bisou et merci

'O: Hi auntie it's Théo + M: I got the package the white guy and the wrestling characters are funny and I love the clips +C: kiss and thanks'

Note that the procedure of text collection did not allow us to take into account the degree of familiarity between the user and recipient, nor whether the messages were part of an ongoing dialogue thread.

4. See Appendix for additional examples.

3. Results

The results were analysed using a series of one-way ANOVAS with the independent variable as Experience (month 1, months 2, etc, month 12). For each ANOVA, the dependent variable was: (a) message length, (b) textism density, (c) dialogic structure.

For the message length (average number of words), the effect of experience was not significant, $F(11,198) = 1.15$, $p = 0.32$. The second one-way ANOVA assessed the effect of experience on textism density (total number of textisms divided by the number of words per message). Here, the effect of experience was significant ($F(11,198) = 3.89$, $p < 0.001$, $\eta^2 = .18$; see Figure 1). Textism density increased from month 1 (mean = .44) to month 12 (mean = .57).

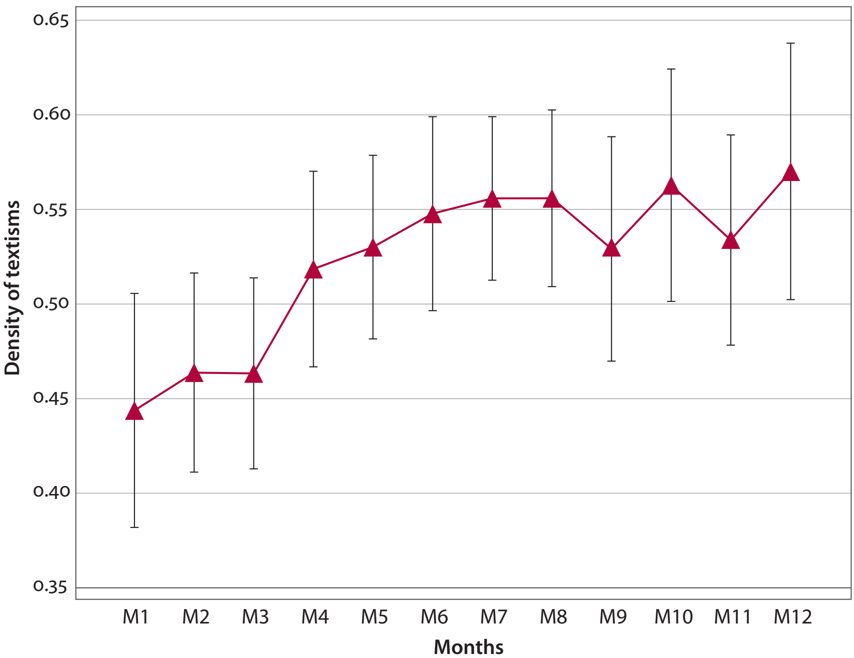

Figure 1. Evolution of textism density over one year, by months (M) of experience. (The vertical bars represent standard errors.)

In terms of the analysis of the dialogic structure of the text messages, four text-message structures were produced: message alone (M), opening and message (O+M), message and closing (M+C), or opening, message and closing (O+M+C). For each participant and each month, we calculated the proportion of each type of structure as a function of the total number of messages.

In 98% of cases, the text messages did not comprise the traditional O+M+C structure (therefore only 2% of the text messages had this structure). In 85% of the cases, the messages stood alone (M) without an opening or closing. The O+M category represented 9% of the messages while the M+C category represented 5%. Overall, 11% of the messages had an opening, 7% had a closing and 15% had an opening and/or a closing.

For the category that showed up the most frequently (M), we analyzed by means of an ANOVA the proportion of text messages as a function of experience. The experience factor was significant ($F(11,198) = 3.51$, $p < 0.0002$, $\eta^2 = .16$). The proportion of messages with an M structure increased from .76 in month 1 to .91 in month 12 (see Figure 2).

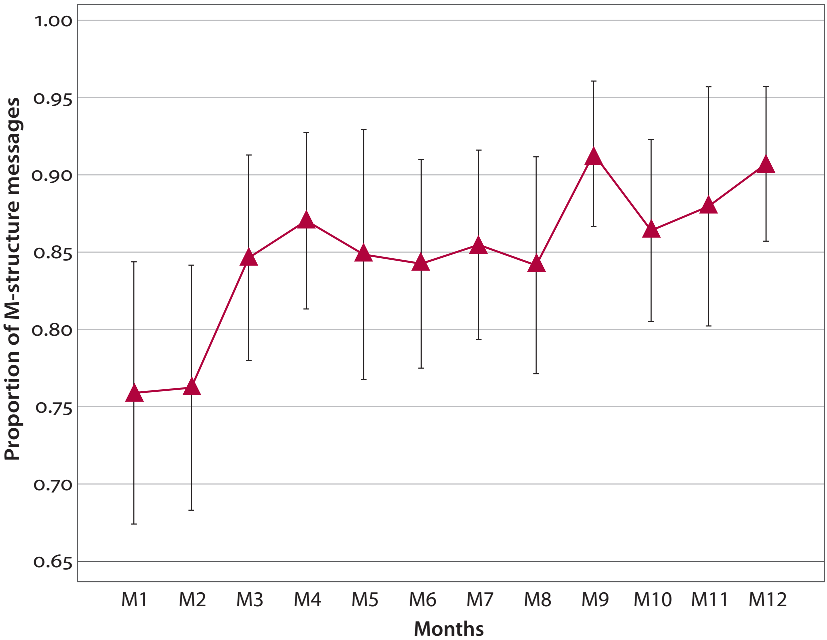

Figure 2. Evolution over one year of the proportion of M-structure messages (message alone with neither opening nor closing), as a function of months (M) of experience. (The vertical bars represent standard errors)

4. Discussion

Our longitudinal study, over the course of one year, enabled the collection of a large number of text messages (4,524) produced by junior high school students (11–12 years old) in everyday life situations. These text messages, sent to family and friends, remained short, with an average of seven words per message throughout the year. Goumi, Volckaert-Legrier, Bert-Erboul and Bernicot (2011) showed an average of 19 words per message for 13- and 14-year-old texters.

Textism density increased with experience, from .44 in month 1 to .57 in month 12. These results can be compared to the two previous longitudinal studies (Wood et al. 2011; Wood, Meachem et al. 2011). Our collection method, over a long period of time with an automatic text collection by the researchers, allowed the young adolescents to completely appropriate the mobile phone as a new mode of communication. The calculated densities of textisms were relatively high as compared to previous research (between .44 and .57 in our study vs. between .07 and .53 in the literature). Young people's productions can be described as follows: the more they texted, the more they have social interactions that enable them to express themselves in their text messages with forms that deviated from traditional spelling. Other forms of electronic communication could be considered as intervening factors to explain the high percentage of textisms presented at the first point of the data collection, whereas the children were not cellphone users before the beginning of the study. Their family and teachers did not teach them how to text. Other forms of texting were familiar to the participants in the study. Eleven of them had an e-mail address and 15 used Instant Messaging before the beginning of the study.

The proportion of messages alone (without an opening or closing) increased with experience, from .76 in month 1 to .91 in month 12. On average, this proportion is higher than that found in previous studies. It should be noted that no prior research has been carried out on the dialogic structure used by texters as young (11–12 years old). Furthermore, in our longitudinal study, we did not find a greater proportion of messages with closings than with openings, as observed in previous studies (Bernicot, Volckaert-Legrier, Goumi & Bert-Erboul 2012a; Panckhurst & Moïse 2011; Panckhurst & Moïse 2012; Spagnolli & Gamberini 2007). This is surely due to a "ceiling effect" as only 15% of the texts had an opening and/or closing. The productions of these junior high school students can be described thus: the more they used text messages, the more they were "impolite" (with regard to the rules of traditional interactions) in their text messages. Intervening factors other than experience (usage with age), such as familiarity with the recipient, could explain this result. But our experimental design did not permit us to know how diverse the addressees of the users were (see § 2.3). Another intervening factor not taken into account in our study is the social background of the user. For example, some cultures place greater emphasis on adhering to "protocol". Such social factors were not controlled for here. Some studies asked their participants about their opinion on the appropriateness of textisms (Drouin 2011; Drouin & Davis 2009; Grace, Kemp, Martin & Parrila 2015). But for the moment, none of these studies specifically addressed opinions on the (in)appropriateness of greetings.

Our results suggest that young adolescents, who start out as complete novices at texting, acquire the orthographic forms and dialogic structure of texting through interactions with those closest to them (friends, acquaintances, family members). These findings show that the texting register develops for novice adolescents tested in natural situations. Texting appears to be a written-language register, in the sense that it has its own specific set of orthographic signs (textisms) adapted to the communication situation (Biber & Conrad 2001; Eckert & Rickford 2001; Halliday 1964; Hudson 1980). As for oral communication, it is neither at school nor within their family that the texters in our study learned to make "spelling mistakes" (textisms) or to be "impolite" (messages alone without an opening and/or closing). Our data confirms that the texting register is acquired by young adolescents by means of interactions, as is the case for the oral register in children between the ages of 0 and 6 years (Andersen 1996; Ellis & Ure 1977; Ferguson 1977; Ravid & Tolchinsky 2002). This reasoning is reinforced by the fact that the participants of our study performed at grade level both with regard to traditional spelling and to their grades in French class.

Future research should take into account some other factors that were not taken into account here such as the organization of turn-taking sequences in texted conversations, familiarity with addressees, diversity of addressees, and social background of the users. The results of this study underline the complexity of texting, lending support to Crystal's (2001) proposition that computer-mediated communication should be considered a specific register of its own, different from traditional oral communication, written communication, or sign language. Contrary to the three other large registers, computer-mediated communication is not stable, and the extremely rapid evolution which it is currently experiencing makes it difficult for researchers to capture.

Acknowledgements

This study was supported by the French National Research Agency in a project entitled Adolescents and Computer-Mediated Writing: Prerequisites, Uses, and Learning (ANR-08-COMM-011-01). The authors would like to thank all the children and parents who participated in this project, as well as the Poitou-Charentes Regional Junior High School for collaborating in the collection of data. In addition, the authors would like to thank Martha Randy for translating this paper.

Editors' note: Josie Bernicot, first author of this chapter (and second author of another chapter), passed away before she could complete her work for this volume. She was a dear friend, a valued member of the research group (GDR *Adyloc*) that initiated this volume, and an esteemed colleague internationally known for her contribution to the pragmatics of language acquisition. She will be greatly missed by the entire community.

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Appendix. Translation of text messages into traditional French and English

Ex.	Original text message	In traditional French	In traditional English
1	*c toi ki socupe d chien a Martin* Eng.: *ru takN c/o martin's k9*	c'est toi qui s'occupe du chien à Martin	are you taking care of Martin's dog
2	*cc alor ta dmende pour ce soir* Eng.: *Ey der so u askD bout 2nite*	coucou alors tu as demandé pour ce soir	hey there so you asked about tonight
3	*tro dégou t de pa etre alé au bal* Eng.: *so >:-(dat I didn't go2the danC*	trop dégouté de pas être allée au bal	so disgusted that I didn't go to the dance
4	*emma, joyeux anniv gro bisou* Eng.: *Emma hpy bday xoxo*	Emma, joyeux anniversaire gros bisous	Emma, happy birthday big hugs
5	*tu peux macheter des scoobidoo merci* Eng. *Cn u by me sm scoubidou tx*	Tu peux m'acheter des scoubidous merci	you can buy me some scoubidou thanks
6	*oué suuuuper mé heuresement c k1 rève* [smiley] Eng.: *Yay gr8 but lckly it was nly a drm* [smiley]	Ouais super mais heureusement c'était qu'un rêve [smiley sourire]	yeah super but luckily it was only a dream [smiley]
7	*salut sa va moi ouai sa se passe bien tes vacanse nous on s'ammuse bien met ces mieu kan vous ette la. Bon aplus :-):-D;-)*	Salut ça va moi ouais ça se passe bien tes vacances nous on s'amuse bien mais c'est mieux quand vous êtes là. Bon à plus [smileys sourire]	Hi I'm OK yeah how is your vacation going we're having fun but it's better when you're here. OK see you later [smileys]
8	*nn je pe pa venir*	Non je peux pas venir	No I can't come
9	*t tro cool jtd ofete heuresemen que je me sui reveile cet nui ma den es tombe toute seule i men reste plu qune et jore toute me den*	Tu es trop cool j't'adore au fait heureusement que je me suis réveillé cette nuit ma dent est tombée toute seule il m'en reste plus qu'une et j'aurai toutes mes dents	You are too cool I told you by the way you luckily I woke up tonight my tooth fell out by itself I only have one more and then I'll have all my teeth
10	**Message alone (M).** **M**: *ouai a par que je mennui grave et toi*	ouais à part que je m'ennuie grave et toi	yeah except that I'm really bored and you
11	**Opening and Message (O + M).** **O**: *slt* + **M**: *je vé pa au colèg é twa*	**O**: salut + **M**: je vais pas au collège et toi	**O**: hi + **M:** I'm not going to school and you
12	**Message and Closing (M + C).** **M**: *cc ca va* + **C**: *koi 2 9 mam*	**M**: coucou ça va + **C**: quoi de neuf maman	**M**: hi how are you + **C**: what's new mom
13	**Opening, Message, and Closing (O + M + C). O:***slt tata c théo* + **M**: *g recu le coli le bonome blan é lé perssо de catch son maran é jadore lé pinsse* + **C**: *bisou é merci*	**O:** salut tata c théo + **M:** j'ai reçu le colis le bonhomme blanc et les personnages de catch sont marrants et j'adore les pinces + **C**: bisous et merci	**O:** hi auntie its Theo + **M:** I got the package the white guy and the wrestling characters are funny and I love the clips + **C:** hugs and thanks

PART III

Variation in types of acquisition and types of learners

CHAPTER 14

A unified model of first and second language learning

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The Unified Competition Model views first and second language learning as depending on a shared set of socio-cognitive processes. Differences between the two types of acquisition depend not on the expiration of a critical period, but on the operation of the risk factors of entrenchment, transfer, overanalysis, and isolation. Entrenchment is a neural process that arises from ongoing use of L1 across years. Transfer and parasitism arise from the dominance of L1 during initial L2 learning. Overanalysis stems from the tendency of adult learners to focus on content words, rather than phrases. Isolation arises from the tendency over time for L1 groups to reject the participation of out-group members and from increasing demands for the L1 group. These risk factors can be countered through the processes of resonance, decoupling, chunking, and participation that are available to all learners, but which must become sharpened to promote L2 acquisition.

Keywords: Competition Model, second language learning, critical period, entrenchment, overanalysis, transfer, social factors

1. Introduction

In his landmark study of the biological foundations of language, Lenneberg (1967) postulated a Critical Period for the acquisition of language that would terminate as a result of cerebral lateralization at puberty. Neuroimaging work conducted since then has shown that lateralization is already present at birth (Molfese, Freeman & Palermo 1975) and that it increases during the first two years of life (Mills, Coffey-Corina & Neville 1997). Although researchers no longer link age effects to lateralization, there is still widespread interest in the idea of a Critical Period (DeKeyser 2000) as a way of explaining age-related decline in the outcome of second language learning. However, without any demonstrable link to some specific epigenetic (Waddington 1957) mechanism, and without a sharply defined time for expiration,

DOI 10.1075/tilar.22.15mac

the application of the concept of a Critical Period to language learning lacks the requisite biological underpinnings.

To avoid this problem, Bley-Vroman (2009) has proposed that we can think of age-related decline in second language learning as reflecting a fundamental difference between learning languages in childhood and learning them in adulthood. This Fundamental Differences Hypothesis (FDH) loosens the link of age-related changes to any specific genetic determination. Empirical support for the FDH has come from studies, focused on specific language skills and periods, that detect major decrements in adult L2 learning (Birdsong 2005; DeKeyser 2000; Flege, Yeni-Komshian & Liu 1999; Johnson & Newport 1989; Kuhl 2010). There is no doubt that certain language learning abilities decline with age. However, the course of this decline is uneven (Werker & Tees 2005) and seldom marked by precipitous declines (Hakuta, Bialystok & Wiley 2003). Moreover, it is difficult to reconcile the existence of cases of completely successful second language learning in adulthood (Bongaerts 1999) with the notion of a fundamental difference. There are many adult learners who fail to achieve native-like proficiency, despite years of exposure, but this divergence mostly involves retention of an L1 accent, rather than inadequate ability to comprehend and communicate.

The Unified Competition Model or UCM (MacWhinney 2012) takes a very different approach to this issue. Instead of trying to isolate fundamental differences, the UCM attributes age-related variation in language learning to the interplay between risk factors and support processes. For L2 learning past early childhood, the model postulates the four risk factors of entrenchment, transfer, overanalysis, and isolation. To overcome these four risk factors, adults can rely on the four support processes of resonance, decoupling, chunking, and participation. These processes will be described in detail in Section 2 below. The UCM holds that all of these risk factors and support processes are available to both children and adults. In that sense, there is no fundamental difference between children and adults as language learners. What differs between language learning in childhood and adulthood is the way in which risk and support processes are configured.

Despite these similarities at the level of fundamental processes, there are four obvious differences between child and adult language learners. First, during the process of first language learning, infants are also engaged in learning how the world works. In contrast, adult second language learners already have a basic understanding of the world and human society. Second, infants are able to rely on a brain that has not yet been fully committed to specific tasks (Li, Zhao & MacWhinney 2007). In contrast, adult second language learners have to deal with a brain that has already been dynamically configured for the task of processing the first language. Third, infants can rely on an intense system of social support from their caregivers (Snow 1999). In contrast, adult second language learners are often heavily involved in L1 social and business commitments that distract them from L2 interactions. Fourth, children have not yet developed adult-like methods for executive control of attention. Although the executive control areas of the brain are active at birth (Doria, Beckman, Arichi & Merchant 2010), they continue to develop through childhood and adolescence (Asato, Terwilliger, Woo & Luna 2010; Casey, Giedd & Thomas 2000). Regularity and inhibitory control over behavior increases in complexity and refinement across the whole period of childhood and adolescence (Munakata, McClelland, Johnson & Siegler 1997). To the degree that language and language learning depend on executive control, we can expect differences between adults and children from these sources, although there is no sharp transition at any point.

Along with these four areas of difference, there are many shared features between L1 and L2 learners. Both groups try to learn the same target language; both need to segment speech into words; both need to learn the meanings of these words; both need to figure out the patterns that govern word combination in syntactic constructions; and both have to interleave their growing lexical and syntactic systems to achieve fluency. Thus, both the overall goal and the specific subgoals are the same for both L1 and L2 learners. In addition, the neurocognitive mechanisms available to solve these problems are the same for the two groups. Both rely on episodic memory to encode new forms and chunks; both have access to embodied encodings of actions and objects; both use statistical learning and generalization to extract linguistic patterns; and both solidify knowledge through routine and practice. Both groups are enmeshed in social situations that require a continued back and forth communication, imitation, and learning, as well as understanding with respect to shared intentions and common ground. One could recognize the shared nature of all those mechanisms and processes, but still claim that the remaining differences are fundamental (Bley-Vroman 2009). The question is whether those remaining differences are great enough to motivate two separate theories for learning and processing. The thesis of the UCM is that the inclusion of L1 and L2 learning in a single unified model produces a more coherent and insightful analysis. The fact that L2 learning is so heavily influenced by transfer from L1 means that it would be impossible to construct a model of L2 learning that did not take into account the structure of the first language. Unless the two types of learning and processing share virtually no important commonalities, it is conceptually simpler to formulate a unified model within which the specific areas of divergence can be clearly distinguished from the numerous commonalities.

2. Three frameworks

The classic version of the Competition Model (Bates & MacWhinney 1982; MacWhinney 1987) was designed to account for the end state of first and second language learning, but not the details of the learning process. As a result, it could not explain how proceduralization leads to increases in fluency and the avoidance of fossilization. This classic model also failed to incorporate information from our continually growing understanding of the neuroscience of language. Furthermore, it provided no role for social processes in second language acquisition. The UCM works to close these gaps while maintaining the core concepts of competition, cues, cue strength, and cue validity developed in the original Competition Model. To achieve this, it integrates the three frameworks that constitute the theoretical core of the Emergentist Program (MacWhinney & O'Grady 2015): competition, structural analysis, and timeframes.

2.1 Competition

Competition is fundamental to biological processes. Darwin (1859) showed how the evolution of a species emerges from operation of proliferation, competition, and selection. Proliferation generates variation through mutation and sexual recombination. Organisms with different compositions then compete for resources or rewards such as food, shelter, and the opportunity to reproduce. The outcome of competition is selection through which more adaptive organisms survive and less adaptive ones disappear. Language development and change are governed by these same three Darwinian principles.

In population genetics, selection operates through the dispersion of genetic patterns. In language, it operates in terms of the solidification of patterns of cues and cue strengths. We can illustrate this by looking at the ways in which cues compete for thematic role assignment in sentences with transitive verbs. For example, in the sentence *the boys chase the ball*, the two nouns (*boys* and *ball*) are possible candidates for the role of the agent or subject of the verb. However, the candidacy of *the boys* for this role is favored by three strong cues – preverbal positioning, subject-verb agreement, and animacy. None of these cues favors the candidacy of *ball*. Therefore, native speakers uniformly conclude that *the boys* are the agents. However, in certain ungrammatical sentences, the competition between the noun phrases can become tighter. The ungrammatical sentence **the ball are chasing the boys* illustrates this effect. In this sentence, the strong cue of preverbal positioning favors *the ball* as agent. However, the cues of subject-verb agreement and animacy favor *the boys* as the agents. Given a competition of this type, listeners are often quite unsure which of the two noun phrases to choose as agent, since neither choice is perfect. As a result, listeners, as a group, are slower to make this choice, and their choices are nearly evenly split between the two possibilities.

Competition Model experiments use sentences in which cues have been randomly combined to measure the strength of the underlying cues. Typically, the subject's task is to determine which of two or more nouns in the sentence is the actor. This basic sentence interpretation method has been used in 52 empirical studies involving 18 different languages. The predictions of the model have also been tested using self-paced reading, eye-movement monitoring, ERP, fMRI, and crossmodal priming methods. Across these various experiments and languages, the cues involved come from a very small set of linguistic devices. Languages mark case roles using five possible cue types: word order, case marking, agreement, intonation, and verb-based expectations. For simple transitive sentences with two nouns and a verb, the possible word orders are NNV, NVN, and VNN. In addition, the marking of the cases or thematic roles of nouns can rely on affixes (as in Hungarian or Turkish), postpositions (as in Japanese), prepositions (as in Spanish), or articles (as in German). Agreement marking displays correspondences between the subject and the verb (as in English) or the object and the verb (as in Hungarian and Arabic). Some of the features that can be marked through agreement include number (as in English), definiteness (as in Hungarian), gender (as in Arabic), honorific status (as in Japanese) and other grammatical features. Intonation is seldom a powerful cue in thematic role identification, although we have found that it plays a role in some non-canonical word order patterns in Italian and in the topic marking construction in Hungarian. Verb-based expectations vary markedly across verb types. High activity transitive verbs like *push* and *hit* tend to serve as cues for animate agents and inanimate patients. Stimulus-experiencer verbs like *amaze* and *surprise* cue animate patients and either animate or inanimate agents.

Competition Model experiments put these various cues into systematic conflict using orthogonalized analysis of variance designs. The extent to which cues dominate or control the choices of agent nouns in these experiments is the measure of their *cue strength*. The core claim of both the classic and unified versions of the Competition Model is that cue strength is determined by cue validity. Cue strength is defined through experimental results; cue validity is defined through corpus counts. Using conversational input data such as those available from the CHILDES <http://childes.talkbank.org> or TalkBank <http://talkbank.org> corpora, we can define *cue reliability* as the proportion of times the cue is correct over the total number of occurrences of the cue. Cue *availability* is the proportion of times the cue is available over the times it is needed. The product of cue reliability and cue availability is overall *cue validity*.

Early in both L1 and L2 learning, cue strength is heavily determined by availability, because beginning learners are only familiar with cues that are moderately frequent in the language input (Matessa & Anderson 2000; Taraban & Palacios 1993). As learning progresses, cue reliability becomes more important than cue availability. In adult native speakers, cue strength depends entirely on cue reliability. In some cases, we can further distinguish the effects of *conflict reliability*. When two highly reliable cues conflict, we say that the one that wins is higher in conflict reliability. For example, in the case of Dutch pronouns, only after age 8 do L1 learners begin to realize that the more reliable cue of pronoun case should dominate over the more frequent, but usually reliable, cue of word order (McDonald 1986).

When adult native speakers have sufficient time to make a careful decision, cue strength is correlated at levels above 0.90 with cue reliability. However, when cue strength is measured online during the actual process of comprehension, before the sentence is complete, other factors come into play. During online processing, listeners tend to rely initially on a single cue with good reliability and high availability without integrating the effects of that core cue with other possible cues. This happens, for example, during online processing of sentences in Russian (Kempe & MacWhinney 1999). Cue strength is also heavily influenced during the early phases of learning by the factors of *cue cost* and *cue detectability*. Cue cost factors arise primarily during the processing of agreement markers, because these markers cannot be used to assign thematic roles directly. For example, in an Italian sentence such as *il gatto spingono i cani* (lit. the cat push the dogs), the listener may begin by thinking that *il gatto* is the agent because it occurs in preverbal position. However, because the verb *spingono* requires a plural subject, it triggers a search for a plural noun. The first noun cannot satisfy this requirement and the processor must then hope that a plural noun will eventually follow. In this example, the plural noun comes right away, but in many cases it may come much later in the sentence. This additional waiting and matching requires far more processing than that involved with simple word order or case marking cues. As a result of this additional cost for the agreement cue, Italian children are slow to pick it up, despite its high reliability in the language (Bates, McNew, MacWhinney, Devescovi & Smith 1982).

Cue detectability factors play a major role only during the earliest stages of learning declensional and conjugational patterns. For example, although the marking of the accusative case by a suffix on the noun is a fully reliable cue in both Hungarian and Turkish, 3-year-old Hungarian children show a delay of about 10 months in acquiring this cue when compared to young Turkish children. The source of this delay seems to be the greater complexity of the Hungarian declensional pattern and the weaker detectability of the Hungarian suffix. However, once Hungarian children have “cracked the code” of accusative marking, they rely nearly exclusively on this cue. Because of its greater reliability, the strength of the Hungarian case-marking cue eventually comes to surpass the strength of the Turkish cue.

Although Competition Model experiments have focused on the issue of thematic role assignment in simple transitive sentences, the principle of competition applies to all areas of sentence processing (MacDonald, Pearlmutter & Seidenberg 1994; MacWhinney 1987). For example, in a sentence such as *the women discussed the dogs on the beach*, there is a competition between the attachment of the prepositional phrase *on the beach* to the verb or the noun *the dogs*. In this case, the competition can be resolved either way. However, in a sentence such as *the communist farmers hated died*, the competition between the adjectival and nominal readings of *communist* is initially resolved in favor of the adjectival readings, because of the presence of the following noun *farmers* and then the verb *hated*. However, once the second verb is encountered, the listener realizes that the adjectival reading has taken them down a garden path. At that point, the weaker nominal reading of *communist* is given additional strength and the alternative reading is eventually obtained.

Three decades of work with child and adult monolinguals and second language learners across 18 languages within this framework have yielded the following empirical generalizations:

1. When given enough time to make a careful choice, adults assign the role of agent to the nominal with the highest cue strength.
2. When there is a competition between cues, the levels of choice in a group of adult subjects will closely reflect the relative strengths of the competing cues.
3. When adults are asked to respond immediately, even before the end of the sentence is reached, they will tend to base their decisions primarily on the strongest cue in the languages, essentially ignoring the presence of all the weaker cues.
4. When the strongest cue is either missing or neutralized by being coded on two separate nominal phrases, the next strongest cue will dominate.
5. The fastest decisions occur when all cues agree and there is no competition. The slowest decisions occur when strong cues compete.
6. Children begin learning to comprehend sentences by first focusing on the most available cue in their language.
7. As children get older, cue strengths converge on the adult pattern with the most reliable cue growing most in strength.
8. As children get older, their reaction times gradually get faster in accord with the adult pattern.
9. Compared to adults, children are relatively more influenced by cue availability, as opposed to cue reliability.
10. Cue strength in adults and older children (8–10 years) is not related to cue availability (since all cues have been heavily encountered by this time), but rather to cue reliability. In particular, it is a function of conflict reliability, which measurs the reliability of a cue when it conflicts directly with other cues.
11. Past the first years of childhood, learners tend to transfer cue strengths from L1 to L2.

A bibliography of 142 studies supporting these conclusions can be found on the web at <http://psyling.talkbank.org/CM-bib.pdf>.

2.2 Structural analysis

Complexity arises from the hierarchical recombination of small parts into larger structures (Simon 1962). For language, the smallest parts are the articulatory commands of output phonology, the auditory features of input phonology, and the perceptual features underlying semantics. These articulatory and auditory patterns combine into words that combine into phrases that combine into mental models that compose interactions and narratives. Within each of these major structural levels, we can distinguish additional substructures. Within phonology, words are structured into tone groups composed of syllables that are composed of onsets, nuclei, and codas, which control clusters of articulatory gestures. Within the lexicon, morphemes can be combined into compounds, phrases, inflected forms, and derivations. Syntactic patterns can be coded at the most elementary level in terms of item-based patterns, which are then grouped on the next level of abstraction into constructions, and eventually general syntactic patterns. Mental models are based on an interlocking system of role assignment, space-time configuration, causal relations, and perspective taking. This decomposition of the levels of language processing, as displayed in Table 1, derives from structural analysis (Hockett 1960).

Table 1. Levels of linguistic processing

Map	Area	Processes	Theory
1. Input Phonology	auditory cortex	extracting units	statistical learning
2. Output Phonology	IFG, motor cortex	targets, timing	avalanches, gating
3. Semantics	Distributed	imagery	embodied cognition
4. Lexicon	Wernicke's area	gangs, fields	DevLex, resonance
5. Syntax	IFG	slots, sequences	item-based patterns
6. Mental Models	dorsal cortex	deixis, roles	perspective theory
7. Interaction	social network	sequencing, affiliation	CA, sociolinguistics

The levels distinguished by structural analysis are richly interconnected. This means that, although they are partially decomposable, they are not modular in the sense of Fodor (1983) but rather interactive in the sense of McClelland (1987). In order to achieve gating and activation, processing levels must be interconnected in a way that permits smooth coordination. The UCM assumes that these interconnections rely on methods for topological organization that are used throughout the cortex (Hauk, Johnsrude & Pulvermuller 2004; Wessinger, Buonocore, Kussmaul & Mangun 1997).

Structural analysis has many important consequences for our understanding of relations between first and second language learning. Age-related first language entrenchment operates in very different ways in different cortical areas (Werker and Hensch 2014; MacWhinney, in press). In second language production, contrasts and timing relations between the levels of conceptualization, formulation, and articulation (Levelt 1989) produce marked effects on language performance (Skehan 2009), although similar effects can be found also in first language acquisition (Snow 1999).

2.3 Timeframes

To fully understand the mechanics of learning and processing, we must also examine how structural levels operate across contrasting timeframes (MacWhinney 2005, 2014). Broadly speaking, we can distinguish four major timeframes:

1. *Processing*
   The timeframe of processing occurs at the moment of speaking. Here, psycholinguists have focused on the neural basis for online processing of words and sentences during production and comprehension, whereas conversation analysts have focused on the social basis for the ways in which we take turns and share ideas.
2. *Consolidation*
   Online processing leads to the storage of experiential traces in memory. Some traces last only for seconds, whereas others persist across decades. Memory processes can also support the emergence of higher levels of structure through generalizations that vary through the course of a human lifespan.
3. *Social Diffusion*
   Linguistic forms diffuse through processes of social memesis (Mesoudi, Whiten & Laland 2006) across interactional networks. Sociolinguists have shown that the changes triggered by these processes can extend across days or centuries.
4. *Genetic Diffusion*
   Within timeframes ranging from decades to millennia, we can trace the diffusion and consolidation of genetic support for producing spoken and written language (Arbib 2014).

3. Risk factors and support factors

The UCM extends the classic Competition Model by providing characterizations of additional neurocognitive, developmental, and social forces that control competition. These forces operate on very different time scales, varying from seconds to years (MacWhinney 2014). However, all of these forces have their effect at the moment of speaking by imparting strength to particular cues and by affecting the timing of the interaction between cues. Some of these forces operate to restrict the smooth acquisition of second languages. We can refer to these as "risk factors". Other forces serve to promote both first and second language learning. We can refer to these as "support factors".

Table 2 presents these factors in terms of these two dimensions. This analysis of the task of second language learning into risk and support factors is provided as an emergentist replacement for the earlier concept of Critical Periods. In the next sections we discuss each of the four risk factors and ways in which their negative effects can be mitigated through reliance on support factors.

Table 2. Risk factors and support factors for second language learning

Risk factors	Support factors
Entrenchment	Resonance
Transfer	Decoupling
Overanalysis	Chunking
Isolation	Participation

The increased availability of support factors in adulthood can be linked to the overall growth of executive function discussed earlier, because proper application of each of these support processes requires some executive control. Krashen (1994) has claimed that the growth of executive control over language can lead to a blockage of natural processes, producing "learning" rather than "acquisition". The UCM takes a sharply contrasting position on this issue, holding that executive control can allow adults to make use of support processes that help them to overcome the limitations of the four risk factors. In this regard, it is interesting to note that habitual use of executive control processes in adulthood can function as a general method for developing protection against intellectual decline (Bialystok, Craik & Luk 2012; Stern 2009).

3.1 Entrenchment

Entrenchment is a basic neurodevelopmental process. At birth, the cerebral cortex of the human infant is designed to process general auditory patterns, but this processing is not yet language specific. Across the first years, neural territory becomes increasingly committed to the patterns of the first language. The structuring of cortical areas to achieve efficient processing has important consequences for age-related changes in language learning. For example, motor cortex has two parallel systems, one of which is hard-wired and entrenched and one that remains plastic throughout development (Yamamoto, Hoffman & Strick 2006), making motor relearning possible. The UCM postulates that differences in the ways in which specific cortical areas undergo entrenchment will lead to variations in age-related effects for specific linguistic levels. In particular, the hard-wired nature of connections between motor cortex and motor pathways will make it difficult to undo or retune aspects of articulatory planning (Major 1987). Auditory cortex also shows signs of early commitment and entrenchment (Kuhl, Conboy, Padden, Nelson & Pruitt 2005), along with retention of a capacity for reorganization (Zhou, Panizutti, de Villers-Sidani, Madeira & Merzenich 2011). In contrast, the greater plasticity and interconnectedness of temporal cortex with other areas (Kemmerer 2015) make it possible for adults to acquire L2 vocabulary at a faster rate than children (Nation 2001; Snow & Hoefnagel-Hohle 1978). Ongoing studies of the relative plasticity of different cortical areas will help connect predictions from neuroscience to observed patterns of L2 learning.

The processes of commitment and entrenchment can be modeled using self-organizing maps (Kohonen 2001), a computational formalism that reflects many of the basic facts of neural structure. Simulations of lexical learning from real input to children have shown how the organization of lexical fields into parts of speech becomes increasingly inflexible across learning. The detailed operation of these processes has been modeled for lexical and phonological structure using DevLex (Li et al. 2007) and for auditory structure using DIVA (Guenther & Gjaja 1996). The UCM assumes that cortical maps exist for each of the structural levels in Table 1, including syntax (Pulvermüller 2003) and mental models (MacWhinney 2008).

3.2 Resonance

The risk factor of entrenchment can be counteracted by the support factor of resonance. Resonance provides new encoding dimensions to reconfigure old neuronal territory, permitting clearer encoding of L2 patterns. Because this encoding operates against the underlying forces of entrenchment, special configurations are needed to support resonance. Resonance can be illustrated most easily in the domain of lexical learning. Since the days of Ebbinghaus (1885) we have understood that the learning of the associations between words requires repeated practice. However, a single repetition of a new vocabulary pair such as *mesa – table* is not enough to guarantee robust learning. Instead, it is important that initial exposure be followed by further repetitions timed to provide correct retrieval before forgetting prevents efficient resonance from occurring (Pavlik & Anderson 2005). Because robustness accumulates with practice, later retrieval trials can be spaced farther and farther apart. This is the principle of "graduated internal recall" that was formulated for second language learning by Pimsleur (1967).

The success of graduated interval recall can be attributed in part to its use of resonant neural connections between cortical areas. While two cortical areas are coactive, the hippocampus can store their relation long enough to create an initial memory consolidation. Repeated access to this trace (Wittenberg, Sullivan & Tsien 2002) can further consolidate the memory. Once initial consolidation has been achieved, maintenance only requires occasional reactivation of the relevant retrieval pathway. This type of resonance can be used to consolidate new forms on the phonological, lexical (Gupta & MacWhinney 1997), and construction levels.

The success of graduated interval recall also depends on correctly diagnosing the point at which a new memory trace is still available, albeit slightly weakened. At this point, when a learner attempts to remember a new word, sound, or phrase, some additional work will be needed to generate a retrieval cue. This retrieval cue then establishes a resonance with the form being retrieved. This resonant cue may involve lexical analysis, onomatopoeia, imagery, physical responses, or some other relational pattern. Because there is no fixed set of resonant connections (Ellis & Beaton 1995), we cannot use group data to demonstrate the use of specific connections in lexical learning. However, we do know that felicitous mnemonics provided by the experimenter (Atkinson 1975) can greatly facilitate learning.

Orthography provides a major support for resonance in L2 learning. When a learner of German encounters the word *Wasser*, it is possible to map the sounds of the word directly to its orthography, as well as to the visual-tactile image of water. Because German has highly regular mappings from orthography to pronunciation, calling up the image of the spelling of *Wasser* is an extremely good way of activating its sound. When the L2 learner is illiterate, or when the L2 orthography is unlike the L1 orthography, this backup orthographic system is not available to support resonance. L2 learning of Chinese by speakers of languages with Roman scripts illustrates this problem. In some signs and books in Mainland China, Chinese characters are accompanied by Romanized Pinyin spellings. This provides the L2 learner with a method for establishing resonant connections between new words, their pronunciation, and their representations in Chinese orthography. However, in Taiwan and Hong Kong, characters are seldom written out in Pinyin in either books or public notices. As a result, learners cannot develop resonant connections from these materials. In order to make use of resonant connections from orthography, learners must focus on the learning of Chinese script. This learning itself requires constructing other resonant associations, because the Chinese writing system is based in large part on radical elements that have multiple potential resonant associations with the sounds and meanings of words.

3.3 Transfer

In L2 learning, new forms must be entered into maps that are already heavily committed to L1 patterns. One way of solving this problem is to align L2 forms with analogous L1 forms. When the forms align well, mapping an L1 form to L2 will result in *positive transfer*. But when there are mismatches, then the alignment produces *negative transfer*. However, both forms of transfer lead initially to a *parasitic* relation of L2 forms and concepts on L1. In the Revised Hierarchical Model, Kroll has emphasized the extent to which beginning second language learners depend on preexisting L1 pathways for mediating the activation of L2 lexical items (J. Kroll & Sholl 1992). For example, when hearing the word *perro* "dog" in Spanish, the learner may first translate the word into English and then use the English word to access the meaning. At this point, the use of the Spanish word is *parasitic* on English-based knowledge. Later on, the word *perro* comes to activate the correct meaning directly. In this sense, parasitism is a direct and nearly inevitable initial consequence of transfer.

The UCM holds that L2 learners will attempt transfer whenever they can perceive a match between an item in L1 and a corresponding item in L2. Within industrialized cultures, it is often easy to transfer the basic pragmatic functions that help structure conversations and the construction of mental models. The transfer of lexical meaning from L1 to L2 is also largely positive, although there will be some mismatches in meaning (Dong, Gui & MacWhinney 2005) and translation ambiguities (Prior, MacWhinney & Kroll 2007). We also expect transfer from L1 to L2 for auditory and articulatory maps. It is reasonable enough to map a Chinese /p/ to an English /p/, even though the Chinese sound has a different time of voicing onset and no aspiration. The result of this type of imperfect transfer is what leads to the establishment of a foreign accent in L2 learners. Transfer is also easy enough for the semantics of lexical items (Judith Kroll & Tokowicz 2005). In this area, transfer is often largely positive, particularly between languages with similar linguistic and cultural patterns. In the initial stages of L2 word learning, this type of transfer requires very little reorganization, because L2 forms are initially parasitic upon L1 forms.

However, transfer is difficult or impossible for item-based syntactic patterns (MacWhinney 2005), because these patterns cannot be readily matched across languages. For the same reason, transfer is unlikely for the formal aspects of conjugational or declensional patterns and classes. The fact that transfer is difficult for these systems does not mean that they are easy for L2 learners, but rather that they must be learned from the bottom up without any support from the L1.

When learners have several possible L1 forms that can transfer to L2, they tend to prefer to transfer the least marked forms (Eckman 1977; Major & Faudree

1996). For example, as Pienemann, Di Biase, Kawaguchi, and Håkansson (2005) have noted, Swedish learners of German prefer to transfer to German the unmarked Swedish word order that places the subject before the tense marker in the German equivalent of sentences such as *Peter likes milk today*. Although Swedish has a pattern that allows the order *Today likes Peter milk*, learners tend not to transfer this pattern initially, because it is the more marked alternative.

3.4 Decoupling

To counter the risk factor of transfer, the learner needs to engage the support factor of decoupling. This process works to access words, meanings, syntactic structures, and phonological forms directly without mediation through L1. To achieve decoupling, the learner needs to think and operate in L2 without switching back to L1 or relying on L1 structures. Working in L2 without recourse to L1 can rely in part on inner speech (Vygotsky 1934) and in part on assuming an L2 identity(Pavlenko & Lantolf 2000). When we activate inner speech, we are using language to build up mental models to control our thinking and plans. Vygotsky (1934) observed that young children would often give themselves instructions overtly. For example, a two-year-old might say, "pick it up" while picking up a block. At this age, the verbalization guides the action (Asher 1969). Later, as Vygotsky argues, these overt instructions become inner speech and continue to guide our cognition. L2 learners go through a process much like that of the child (Berk 1994; Nelson 1998). At first, they use the language only with others. Then, they begin to talk to themselves in the new language and start to "think in the second language." At this point, the second language begins to assume the same independent status that the first language attains for the child.

Decoupling also helps us understand the growth of the ability to engage in code switching. If a language is being repeatedly accessed, it will be in a highly resonant state. Although another language will be passively accessible, it may take a second or two before the resonant activation of that language can be triggered by a task (Grosjean 1997). Thus, a speaker may not immediately recognize a sentence in a language that has not been spoken in the recent context. On the other hand, a simultaneous interpreter will maintain both languages in continual receptive activation, while trying to minimize resonant activations in the output system of the source language.

3.5 Overanalysis

The third risk factor facing the adult L2 learner is overanalysis. Because adults learn L2 words more quickly than children (Snow & Hoefnagel-Hohle 1978), they tend to process L2 input by pulling out recognizable lexical forms. This allows them to quickly grasp the general meaning of an utterance, but it also means that they do not pick up longer stretches or phrases as single items. Thus, in both perception and production, they tend to pass over or miss the function words and grammatical markers which play such an important role in the L2 system. For example, learners of German often learn the word *Mann* "man" in isolation. If, instead, they would learn phrases such as *der alte Mann, meines Mannes, den jungen Männern*, and *ein guter Mann*, they would have a good basis for acquiring the declensional paradigm for both the noun and its modifiers. If learners were to store larger chunks of this type, then the rules of grammar could emerge from analogic processing of the chunks stored in feature maps (Bybee & Hopper 2001; Ellis 2002; MacWhinney 1982; Tomasello 2003). However, if learners analyze a phrase like *der alte Mann* into the literal string "the + old + man" and throw away all of the details of the inflections on "der" and "alte," then they will lose an opportunity to induce the grammar from implicit generalization across stored chunks.

3.6 Chunking

The antidote to overanalysis is chunking. In perception, chunking involves segmenting the input into either already learned chunks or new stretches that are acquired as new chunks (McCauley, Monaghan & Christiansen 2015). The term "chunking" is also often used for a related process that operates primarily in production to achieve fluency. This is the process of *proceduralization* (Anderson 1993) that transfers material in declarative memory into a smoothly operating procedure requiring minimal attentional control. Because proceduralization results in the formation of production units, it is closely related to *chunking* (Newell 1990). Cognitive models differ in how they formalize the relation between proceduralization and chunking. The UCM use the term *proceduralization* to refer to the unitization of sequences that unfold in time, whereas *chunking* refers to the unitization of simultaneous perceptions or single words. Chunks function as single, unanalyzed lexical wholes or formulas (Sidtis 2014), whereas procedures are more relevant to syntax and may have room for flexible variation. For example, in Spanish, L2 learners can learn *muy buenos días* "very good morning" as a chunk. This chunk is based on a series of connections between preexisting lexical items, stored within the lexical map in the posterior cortical areas in the temporal lobe. However, this pattern could also be learned as a flexible procedure triggered by the word *muy* "very" that would allow other completions such as *muy buenas tardes* "good afternoon" or *muy buenas noticias* "very good news".

Chunking focuses on storage in posterior lexical areas, whereas proceduralization relies on storage in frontal areas for sequence control (Broca's) that then point to lexical items in posterior areas. Proceduralization is initially less robust than chunking, but it is capable of greater extensibility and flexibility (Gobet 2005) across constructions beyond the level of the item-based construction. For example, a Spanish phrase such as *quisiera comprar…* (I would like to buy…) can be used with any manner of noun to talk about things you would like to buy. In each of these cases, having produced one initial combination, such as *quisiera comprar una cerveza* (I would like to buy a beer) may be halting at first. However, soon the result of the creation process itself can be stored as a chunk. In this case, it is not the actual phrase that is chunked, but rather the process of activating the predicate combination (*quisiera comprar*) and then going ahead and filling the argument. In other words, we develop fluency by repeated practice in making combinations.

Once learners have developed fluency in the combination of well-learned words, they can still experience disfluency when trying to integrate newly learned words into established constructions. For example, even if we have learned to use the frame *quisiera comprar* fluently with words such as *una cerveza* (a beer) or *un reloj* (a clock), we may still experience difficulties when we need to talk about buying "a round trip ticket to Salamanca" (*un billete de ida y vuelta para Salamanca*). In this selection, we might have particular problems when we hit the word *para* since the English concept of "for, to" can be expressed in Spanish using either *por* or *para* and our uncertainty regarding the choice between these two forms can slow us down and cause disfluency or error. In general, for both L1 and L2 learners, disfluencies arise from delays in lexical access, misordering of constituents, and selection of agreement markings. Fluency arises through the practicing of argument filling and improvements in the speed of lexical access and the selections between competitors.

Paradis (2004) argues that L2 learners cannot fully proceduralize a second language, and that L2 productions must remain forever slow and non-fluent. We can refer to this position as the *Proceduralization Deficit Hypothesis* (PDH). This hypothesis is a specific articulation of the general Critical Period Hypothesis (CPH). In this regard, we can point to work using artificial language systems (Friederici, Steinhauer & Pfeifer 2002; Müller, Hahne, Fujii & Friederici 2005) that shows how, if the rules of the target language are simple and consistent, L2 learners can develop proceduralization, as measured by an early left anterior negativity (ELAN) response, a couple of months of training. Thus, it appears that proceduralization can be successful in adult learners, as long as cues are consistent, simple, and reliable

(MacWhinney 1997; Tokowicz & MacWhinney 2005). This finding is in accord with the UCM analysis, rather than the PDH analysis, because it shows that the crucial factor here is not the age of the learner, but the shape of the input.

It is important not to confuse proceduralization with implicit learning. Although L1 learning relies primarily on implicit learning, L2 learning involves a complex interaction of both explicit and implicit learning. In formal contexts such as classrooms, a second language may be learned through explicit methods. However, this knowledge can then become proceduralized and automatized, producing good fluency. The effects of clear, explicit instruction are illustrated in a computerized tutorial system for teaching the gender of French nouns (Presson, MacWhinney & Tokowicz 2014). In this experiment, participants who knew no French were given simple cues to French gender. They were able to achieve 90% accurate gender assignment across 23 cue types, after only 90 minutes of computerized practice in the use of these cues. Moreover, this ability was retained across three months without any further training.

In a review of the role of explicit rule presentation, MacWhinney (1997) argued that L2 learners can benefit from explicit cue instruction, as long as the cues are presented simply and clearly. Once a simple pattern has been established in explicit declarative form, repeated exposures to a cue can use the scaffolding of the explicit pattern to establish proceduralization. As in the case of lexical learning, the method of graduated interval recall can further support proceduralization. In addition, error correction can help to tune cue weights (McDonald & Heilenman 1991). Of course, proceduralization can be achieved without scaffolding from explicit instruction. However, if explicit scaffolding is available, learning will be faster.

3.7 Isolation

The fourth risk factor for older L2 learners is social isolation. As we get older, full integration into a second language community can become increasingly difficult. There are at least three reasons for this. First, as we age, it can become increasingly difficult to set aside L1 allegiances and responsibilities. Second, L2 communities tend to be more immediately supportive of younger L2 learners. As children get older, peer groups become increasingly critical of participants who fail to communicate in accepted ways. Third, as we age, we may develop images regarding our social status that make it difficult to accept corrective feedback, teasing, or verbal challenges, even if these are excellent sources of language input. The cumulative effect of these social factors is that positive support for language learning can decrease markedly across the lifespan. Unless older learners focus directly on making friends in the new community and developing a full L2 persona (Pavlenko & Lantolf 2000), they can become isolated and cut off. The cognitive consequences of these social patterns is the loss of both comprehensible input (Krashen 1994) and opportunities to engage in fluent output (Swain 2005).

3.8 Participation

The antidote to isolation is participation. Older learners can increase their participation in the L2 community in a variety of ways. They can join religious groups, athletic teams, or work groups. Often these groups are highly motivated to improve the language abilities of new members, so that they can function smoothly within the group. Older learners can also engage in formal study and expose themselves to L2 input through books, films, and music. When these methods for increasing participation operate in concert with the processes of chunking, resonance, and decoupling, L2 learning will lead to increasingly high levels of fluency and correctness. Formal instruction can also incorporate insights from activity theory (Engeström 1999; Ratner 2002) to guide a contextualized curriculum. Many syllabi already make use of a simple form of activity theory when they compose units based on specific activities such as ordering food at a restaurant, asking for directions, dealing with car problems, or transferring money across bank accounts. Multimodal video materials linked to transcripts can be used to further support this type of activity-based learning of vocabulary, pragmatics, and syntax.

3.9 Applications

The formulation of risk factors and support factors provided by the Unified Competition Model has important implications for the teaching of second languages. For learners in the preschool and early school years, the risk factors of entrenchment, overanalysis, and isolation are not yet serious concerns. Transfer will lead to some initial problems, but they can be overcome. These learners can acquire additional languages using more or less the same methods they used to pick up their first language. At this age, instruction should focus on providing rich input and opportunities to talk. Just like adults, children need to focus their attention explicitly on words, sounds, and constructions. However, they can learn without corrective feedback, because they find it so easy to pick up new phrases without having to combat heavily entrenched forms. For children learning a second language, the principle danger is that, once instruction or exposure to a language ceases, they will soon lose their ability to use that language (Burling 1959). In other words, children are particularly susceptible to L1 attrition (Schmid 2011). For immigrant children, the major challenge during this period is to provide social situations that allow them to integrate fully into peer group contexts (McLaughlin 1985). During the middle school years, second language instruction should become increasingly explicit. For 10-year-olds, instruction can still rely principally on songs, phrases, and games. However, adolescents will begin to shift into adult mode in terms of relying on resonance, decoupling, chunking, and participation.

For adolescent and adult learners, instruction should include both contextualized and decontextualized components. Decontextualized components should focus on the resonant practice of basic skills in auditory phonology, articulatory phonology, lexicon, and syntactic constructions. This type of basic skills practice can be controlled through computerized presentation with the results tailored to the individual student level (Pavlik et al. 2007) and relying on the method of graduated interval recall to maximize efficiency. We have implemented systems of this type <http://sla.talkbank.org> for learning Chinese sound patterns through Pinyin dictation, Chinese vocabulary, French dictation, and French gender (Presson et al. 2014). These online systems automatically provide the instructor with students' scores to allow them to monitor students' progress through each phase of each module. Basic skills training should first focus on chunking (Yoshimura & MacWhinney 2007) and resonance.

In parallel with decontextualized training, learners can rely on contextualized materials for promoting internalization and participation. Computerized presentation of realistic video interactions linked to transcripts can be particularly effective, as in the DOVE transcript browser illustrated at <http://talkbank.org/DOVE>. These various methods, both contextualized and decontextualized, can be integrated into a single learning platform deployed on web-connected laptops and tablets, in accord with the Language Partner system (Presson, Davy & MacWhinney 2013). Mobile devices can be used to record real-life interactions (Clark, Wagner, Lindemalm & Bendt 2011) for later analysis in the classroom. For example, a learner of Icelandic recorded her interactions in a bakery in Rejkjavik. These data were transcribed and the transcripts were linked to audio records. The resulting corpus, called IceBase, was used by Gu∂rún Theodórsdóttir as the basis for her dissertation in the Conversation Analysis framework and the relevant data are available to researchers from <http://talkbank.org>. In the classroom, these materials could help students understand conversational practices, pragmatic norms, linguistic forms, and methods for negotiating meaning. Instructors can also configure learning tours of the type illustrated at <http://sla.talkbank.org/tours> in which students are guided through the city to promote interactions with people in stores, restaurants, buses, and museums to learn more about the city and the language.

4. Summary

The classic version of the Competition Model was based on three decades of empirical studies of first and second language learners. To account for the dynamics of second language learning, the details of age-related changes in learning success, the role of social factors, and our growing understanding of the brain, it was necessary to extend the model to deal with the processes of entrenchment, transfer, overanalysis, and isolation that constitute risk factors for second language learners. To counter these risk factors, second language learners can maximize their reliance on the support factors of resonance, decoupling, chunking, and participation that are also available to first language learners. Together, these processes constitute components of a unified model of both first and second language acquisition.

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CHAPTER 15

On-line sentence processing in simultaneous French/Swedish bilinguals

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Within the Competition Model, *cue validity* and *cue cost* can serve to make predictions about real-time sentence processing in a cross-linguistic perspective. Previous research with monolingual children and adults in French (Kail 2004) and Swedish (Kail et al. 2012) proposed that cue cost is determined by contextual and structural information, word order and morphology. On the basis of on-line grammaticality judgments, we investigated whether these cue cost constraints are equally efficient and follow the same hierarchy in simultaneous French/Swedish bilinguals and in their monolingual counterparts. Although bilinguals were slower and less accurate, the weight of each cue cost component was similar for both groups. Bilinguals' longer detection times are linked to specific interactions between cue cost components not observed in monolinguals. This result is compatible with the cognitive cost implied by the need to inhibit the non-relevant language during bilingual processing.

Keywords: Competition Model, cue cost, on-line grammaticality judgment, simultaneous bilinguals, French, Swedish, bilingual processing, detection times

Introduction

For many years, bilingual research on language comprehension has been dominated by questions regarding the representation in memory of lexical information in two languages. More recently, the topic of bilingual sentence processing has received more attention, and research and theory have progressed far beyond the word level. This growing importance is well-attested in Heredia and Altarriba's book (2002) and in chapters and reviews (Dussias 2001; Frenck-Mestre 2005; de Groot 2011).

DOI 10.1075/tilar.22.16kai

On-line sentence processing in monolingual and bilingual children is still an emerging field. The rarity of these studies is most certainly linked to methodological difficulties. Nevertheless, some publications (Sekerina, Fernandez & Clashen 2008; Heredia & Stewart 2002; Kail 2011b) provide overviews on innovative methods ranging from behavioral paradigms (word monitoring, probe recognition, gating, real-time grammaticality judgment) to paradigms involving eye tracking and event-related potentials. These methods can be used with children aged 5 years and older to study relatively complex syntactic and morphosyntactic phenomena.

Our goal in this chapter is to present bilingual developmental data on the on-line integration of two basic grammatical constraints, word order configurations and morphological agreement during sentence processing in two contrasted languages: French, a Romance language, and Swedish, a Germanic language. The purpose is to identify what on-line processing procedures are affected by the specificities of the languages and what procedures seem to be general. Previous results obtained with monolingual children and adults (for a review, see Kail 2011a) provide the basis to investigate whether sentence processing in each language by bilingual children is similar or not to their monolingual counterparts. Following the pioneer work of Grosjean (1989), our intent is not to compare monolingual and bilingual performance per se but to deepen our knowledge of on-line sentence processing constraints in general. Moreover, the French/Swedish bilinguals are simultaneous bilinguals, exposed to both languages from birth. In contrast to late bilinguals, simultaneous bilinguals seem to show an advantage in the acquisition of word order or inflectional morphology in both languages even when they are less proficient in one of their languages (Genesee 2002; De Houwer 2005). Consequently, the relevance of our findings for other types of bilinguals remains an open question.

1. Sentence processing in the Competition Model

Real-time language processing requires the listener or reader to integrate linguistic cues into the ongoing sentence representation. Language is a complex system that involves different types of information (i.e., phonological, syntactic, semantic, morphosyntactic) that must be retrieved and used to achieve comprehension. Different psycholinguistic theories agree that information must be retrieved and used in normal on-line comprehension, but there is still some debate about the timing of information use and the nature of the interplay between syntactic and lexical-semantic information (Dussias 2001).

Our framework is the *Competition Model* (CM) (MacWhinney 1987; MacWhinney & Bates 1989), an integrative-activation model of language comprehension and language use that emphasizes qualitative and quantitative linguistic variations across languages. In this model, the informational value of linguistic forms in a given language plays a probabilistic role in mapping surface forms to their underlying functions as directly as possible. The CM assumes parallel processing, so that the language processor can use compound input cues that work across linguistic boundaries, e.g., prosody, morphology, lexicon, and syntax. In contrast to modular theories in which different pieces of linguistic information are computed sequentially by separate processors, the CM processes information from various sources via a common set of perceptual, representational, and retrieval mechanisms. Different cues cooperate and compete with each other in language comprehension, where coalitions and competitions represent the mediation process between forms and functions. When parallel activation of the formal and functional levels leads to competition, the co-evaluation of different linguistic sources becomes necessary and is directly determined by the validity of these cues in the particular language.

The major predictive construct of the CM is *cue validity*, evaluated as the product of *cue availability* (how often a cue is there when needed) and *cue reliability* (how often an available cue leads to the right interpretation). For example, to assign the agent function, word order has a higher validity value in English than animacy or morphological agreement, while the opposite pattern characterizes Italian and French. Thus, English speakers rely more on word order in sentence comprehension while Italian and French speakers rely more on animacy and verbal morphology. According to the processing hypotheses proposed in this model, *cue strength* in a given language, (i.e., the probability attributed by the subject to specific linguistic information in order to assign a specific function) is determined by cue validity. A substantial body of studies (for reviews, see MacWhinney & Bates 1989; Kail 1999; Bates, Devescovi & Wulfeck 2001) conducted over a wide range of languages revealed a strong correlation between cue validity and cue strength in sentence processing. The results also supported the assumption that children acquire sentence comprehension strategies in a sequence that is predictable from the cue validity of the grammatical devices in the adult language. The second basic notion that Kail (1989) proposed to implement in the CM is *cue cost*, which refers to the amount and type of processing required for the activation of a given form when cue validity is held constant. In line with an earlier proposal by Ammon and Slobin (1979), we suggested that cues are distributed along a continuum that ranges from *local processing* (an interpretation can be computed as soon as the cue is encountered) to *topological processing* (the interpretation is delayed until all information is stored and compared). In some languages such as French (Kail 1989), Italian (Devescovi, D'Amico & Gentile 1999), and German (Lindner 2003), cue validity and cue cost interact during development. Some predictions based on the idea that children acquire sentence-interpretation strategies in an order that can be predicted from cue validity in the adult language have been updated to take into account the greater short-term memory demands of topological processing.

Assuming that cue validity and cue cost interact to determine cross-linguistic variation in the use and development of sentence-interpretation strategies, the investigation of cue cost requires more information about how listeners allocate their attention and make predictions in the course of sentence processing (Kail 1999; Kempe & MacWhinney 1999; Devescovi & D'Amico 2005; Staron, Bokus & Kail 2005).

Kail and team have developed an international cross-linguistic program in order to specify the notion of cue cost in on-line sentence processing. Our starting point considers that the processing system is involved in a continuous readjustment when assigning syntactic and thematic roles in a sentence. Such a system tends to combine the various sources of linguistic information by conferring meaning as soon as possible on the basis of processing cues, integrating linguistic fragments into larger structures compatible with the information already processed. This mode of parallel processing optimizes local attachments between units, thus decreasing the cognitive load for the processor. We propose that processing cues are integrated as a function of three factors: *contextual information* (the amount of previous information), *structural information* (the level of constituents concerned by the violation), and *the type of the violation* (agreement vs. word order). All these factors, which are presented in detail below (§ 3), have a status within the CM, but the last one is more directly linked to cue validity in a language. To summarize, taking as background the Competition Model as well as our previous on-line cross-linguistic studies of monolingual children and adults in four languages (French, Portuguese, English and Swedish), the specific goals of the present study are: (a) to investigate whether the cue cost factors on which French and Swedish monolingual children and adults rely are equally efficient for simultaneous French-Swedish bilinguals; (b) to evaluate whether in both of their languages, these cue cost factors follow the hierarchy found in their monolingual counterparts.

2. Selected characteristics of French and Swedish

Swedish and French present some interesting contrasts specifically as regards word order and inflectional morphology. These have been taken into account when constructing the experimental sentences.

2.1 Word order

French

Standard grammars (Arrivé, Gadet & Galmiche 1986; Riegel, Pellat & Rioul 1994) present French as having an SVO canonical word order. The first NP in a sentence is most frequently the agent. Unlike Italian, Spanish, and Portuguese, which are also SVO Romance languages, French does not permit subject ellipsis. Despite its prominence, the canonical SVO order occurs along with other orders imposed by syntactic, pragmatic or contextual constraints. A major exception to SVO order is the use of SOV order. SOV order in French is primarily due to the existence of a double series of clitic pronouns: preverbal direct object (*le, la, les*, e.g., *Je la vois* 'I her see') and preverbal indirect object (*lui, leur*) pronouns. VSO order is found in the interrogative form (*Prend-il le train ce soir?* 'Is taking he the train this evening?').

Finally, combinations of left and right topicalization and cliticization are responsible for extending the range of possible word orders found in French. Nonetheless, this variability clearly operates within definite limits. French tends to conserve canonical SVO in many constructions. The isolated sentences used in our experiment contain neither clitics nor topicalization.

Swedish

Swedish has a canonical word order, SVO, for declarative sentences. Like all Germanic languages except English, Swedish is a V2 (verb-second) language. However, the V2 rule does not apply in embedded clauses. In main clauses, whenever an adverbial, a subordinate clause or an object is topicalized and occurs in sentence-initial position, subject-verb inversion is obligatory because the second position of the sentence is targeted for the verb as in the following examples:

(1) *Nu kommer han* (XVS)
'Now comes he'

(2) *När jag kom hem, träffade jag Lisa* (XVS)
'When I came home, met I Lisa'

(3) *Glass gillar han* (OVS)
'Ice cream likes he'

The VS option is used extensively in Swedish. In a corpus of spoken Swedish (Jörgensen 1976), a nearly even distribution between the two options was observed: 40% exhibited the XVS pattern and 60% the SVX-pattern.

Another word order violation concerns the position of adjectives, where French and Swedish are also diametrically contrasted. In Swedish, adjectives are placed before the noun, with no exceptions, in contrast to French where adjectives are either preposed or postposed. Thus, postposing the adjective in Swedish is unambiguously a violation of word order.

2.2 Verbal and nominal agreement

French

Verbal agreement in French is determined by the number of the subject and, in some constructions, by its gender. In the oral modality, the inflectional system of French comprises many ambiguous forms, particularly with the verbs belonging to the first conjugation (ending in *-er-* in the infinitive form, like *chanter*) which are the most frequent.

(4) a. *je chante* [ʃãt] I sing-1st SG, 'I sing'
b. *tu chantes* [ʃãt] You sing-2nd SG, 'You sing'
c. *il chante* [ʃãt] He sing-3rd SG, 'He sings'
d. *ils chantent* [ʃãt] They sing-3rd PL, 'They sing'

Various other written inflections (*-s* and *-nt*) are inaudible. In the absence of strong information, *il chante* [ilʃãt] can be confounded with *ils chantent* [ilʃãt] ('he sings' vs. 'they sing', respectively). In our experiment, we used second and third conjugations in which the plural inflection is audible (e.g., *Il remplit* vs. *ils remplissent*, he fill-3rd. SG 'he fills' *vs.* they fill-3rd.PL 'they fill').

As a general rule, nominal agreement concerns gender and number agreement of various units such as articles, adjectives, possessive and demonstrative pronouns. According to Tucker, Lambert and Rigault (1977), 60% of the nouns in the French lexicon have exclusive gender, masculine or feminine, e.g., *le garçon* the boy-MASC 'the boy', and *la table* the table-FEM 'the table'. French nouns with variable gender belong to two main sets: homonyms distinguished by the fact that the gender of the article changes the meaning (*vase; tour; moule; manche; mémoire*; for example *le vase* 'the-MASC vase' vs. *la vase* 'the-FEM mud') and nouns of professions without meaning change (*ministre; journaliste; photographe; commissaire*).

The masculine gender is more frequent than the feminine and the phonological information of the last syllable of the noun often has a high predictive value for gender assignment (e.g., le voisin-MASC, la voisin**e**-FEM, le dans**eur**-MASC, la dans**euse**-FEM).

Swedish

The paradigm of Swedish verbs (Teleman, Hellberg & Andersson 1999) is considerably less complex than the French one: there is no subject-verb agreement; neither number nor person is marked morphologically; verbs are only marked for tense.

For regular verbs, there are two main groups, the *-ar* and the *-er* groups. The only available choice for creating an audible, clear-cut distinction between correct and incorrect verb forms in our experiments was the contrast between the infinitive and the present form of *-er* verbs, *ringa* vs. *ringer* (‘to phone’ vs. ‘phone(s)’).

Swedish noun morphology is relatively rich and complex. There are two genders: common (also called *uter*), *en*, and neuter, *ett*. The common gender is three times as frequent as the neuter (Allen 1971) and includes practically all animate nouns. The indefinite article is a preposed free morpheme, as in many languages: *en kaka* (a cake). The definite article is a postposed suffix on the noun e.g., *kaka***n**’ (cake-the) ‘the cake’, gender-sensitive in the singular: *kak***an** ‘the cake’ versus *vin***et** ‘the wine’, but neutralized to the *-na* morpheme in the plural: *kakor***na** (cakes-the) ‘the cakes’, *viner***na** (wines-the) ‘the wines’.

Nouns and adjectives are inflected for gender, number and definiteness. Determiners and adjectives agree in gender, number and definiteness with the head noun. Morphological marking for definiteness on both the article (*den/det* ‘the’) and the noun (*-n/-t*) is obligatory in adjectival attributive NPs, the only adjectival NP used in the experiment. This is called “double definiteness” and is characteristic of Swedish. The double definiteness also has consequences for the adjective, which takes on a strong and a weak form. The strong form is used in indefinite plural contexts, *god***a** *kak***or** ‘good cakes’. The weak form, also an *-a*, marks both singular and plural definite; as in ‘*den god***a** *kaka***n**’ ‘the good cake’ and ‘*de god***a** *kakor***na**’ ‘the good cakes’.

3. Main factors of cue cost

Three cue cost factors were tested on two basic grammatical constraints, word order and morphological agreement in an on-line grammaticality judgment task. By definition, a grammatical violation in a sentence prevents the integration of the corresponding linguistic information. Within the Competition Model, the study of Wulfeck (1993) was one of the first to examine real-time grammaticality judgments in school-age English children. The violation detection paradigm enables children as young as 6 and adults to detect a grammatical violation in a sentence as quickly as possible (Blackwell, Bates & Fisher 1996; Kail & Bassano 1997; Lambert & Kail 2001).

3.1 Violation Position: Early vs. late

The first factor concerns the amount of linguistic information available to the listener at a given moment, which contrasts early versus late integration of cues (violation position). Based on previous research (Wulfeck, Bates & Capasso 1991; Wulfeck 1993; Kail & Diakogiorgi 1998) showing that on-line detection of grammatical violations is context-dependent, it was hypothesized that violations occurring in a late position, as illustrated in Example (5a), should be detected more easily and more rapidly than early violations (5b) at every age level in all languages.

(5) a. *Chaque semaine, après avoir fait les courses au marché* ***remplit la voisine*** *le frigo.*
‘*Every week, after shopping at the market, “**fills the neighbor**” the fridge’

b. *Chaque semaine,* ***remplit la voisine*** *le frigo après avoir fait les courses au marché.*
‘*Every week, “**fills the neighbor**” the fridge after shopping at the market’

3.2 Violation Span: Intraphrasal vs. interphrasal

Phrase structure was tested by the violation span; following Kail (2004) and Kail, Kihlstedt and Bonnet (2012), it was hypothesized that, in all languages, violations within the same constituent (intraphrasal) should be detected more easily and more rapidly than violations concerning elements belonging to different constituents (interphrasal). Example (6) shows two word order violations, one intraphrasal (6a) and one interphrasal (6b):

(6) a. *Chaque semaine,* ***voisine la*** *remplit le frigo après avoir fait les courses au marché.*
‘*Every week, “**neighbor the”** fills the fridge after shopping at the market’

b. *Chaque semaine,* ***remplit la voisine*** *le frigo après avoir fait les courses au marché.*
‘*Every week, “**fills the neighbor”** the fridge after shopping at the market’

3.3 Violation Type: Agreement vs. word order

Finally, violation type was investigated, i.e., the cue validity of word order and morphology. It was predicted that violations of cues which are the most valid ones in a language should be more easily and more rapidly detected than less valid ones at every age level, as also shown in previous research (Kail & Diakogiorgi 1998; Wulfeck et al. 1991; Lambert & Kail 2001; Costa 2005). The first and the second cue cost factors correspond to general on-line processing constraints during linguistic integration processes, whereas the third one is language-specific and linked to cue validity.

The following section gives a brief summary of the cue cost results in French and Swedish monolinguals, before presenting the corresponding bilingual study.

4. Previous results on cue cost in French and Swedish monolinguals

The monolinguals' results have been previously published (Kail 2004 for French; Kail et al. 2012 for Swedish). In this summary, only detection times are reported, for reasons of space.

Detection times analyses were conducted on correctly-rejected sentences. Not surprisingly, in both languages, children were significantly slower than adults at detecting grammatical violations. This age effect was monotonic and was tested for a linear trend across the four age levels in every language.

The first finding was the strong effect of *contextual information* (violation position) in the cue integration process. In both languages, violations occurring late in the sentence were consistently detected more quickly for both word order and agreement violations at every age level, but a bit less in the adults. This effect can be interpreted as indicating that listeners were using their grammatical knowledge to build expectations over the course of the sentence from 6 years onwards. Similar results were obtained in Portuguese and English using the same experimental design (Kail, Costa & Hub Faria 2010; Kail 2011a). This recurrent position effect across languages and its systematic decrease with age argue in favor of considering contextual information as a general developing on-line processing factor, irrespective of the language. This factor explained more than 80% of the variance between 6- to 8-9-year-olds.

The second finding concerned *structural information* (violation span). As predicted, in both languages violations within the same constituent were more rapidly detected than violations across different constituents. This result shows that on-line processing requires important working memory capacities for violations that cross the constituent boundary. This factor increased with age in Swedish, explaining 78% of variance in adults. In French, the violation span effect became significant at age 10. No age interaction was found in Swedish or in French.

The third finding concerned the relative weight of *agreement vs. word order cues*. In Swedish, the morphological complexity of the NP (double definiteness) did not allow for contrastive predictions. Swedish children of all ages and adults did not detect agreement violations more rapidly than word order violations. As predicted for French, agreement violations were more rapidly detected than word order violations at every age level and this effect was more significant in the older groups (10-year-olds and adults). These findings confirm previous studies showing the greater impact of agreement cues as compared to word order ones in on-line sentence processing on various tasks (word monitoring, Charvillat & Kail 1991; grammaticality judgments, Kail & Bassano 1997). This impact can be interpreted as reflecting the cost benefits of agreement cues: localness in French, but topological distance in Swedish.

The hierarchy of cue cost factors was captured in a separate ANOVA conducted in each language for each age group. In French, this analysis revealed significant changes as a function of age. In the youngest groups (6;8 and 8;6), the most crucial factor was violation position, explaining more than 85% of variance (violation position > violation type > violation span). At 10;10 the hierarchy of factors changed and violation type became the dominant factor (violation type > violation span) explaining 60% of variance in accordance with cue validity. In Swedish, among the youngest groups, the hierarchy was violation position (70% of variance) > violation span > violation type. The hierarchy of factors changed in the adults: violation span > violation position > violation type. Violation span became the most important factor by far (78% of variance).

In sum, the developmental hierarchy for cue cost factors indicated a change from general processing factors to language-specific factors at around age 10. In on-line processing, cue cost was not directly linked to cue validity. In fact, cue cost factors seemed to limit the application of cue validity.

5. Method

5.1 Participants

The 41 bilingual participants consisted of simultaneous Swedish/French bilingual children (from birth) from the *Lycée Français* in Stockholm and a group of bilingual adults, students in Stockholm. The age groups were the same as for the monolinguals: 6-7-year-olds (mean age 6;8), 8-9-year-olds (mean 8;6) and 10-11-year-olds (mean 10;10). The children and the adults were tested by a bilingual experimenter in both their languages, at a two-month interval. Half of the subjects began with one language and the other half with the other language. To account for language dominance, parents filled a very detailed biographical questionnaire adapted from Liu, Bates and Li (1992), in order to evaluate qualitatively the proficiency of the children in each language (self-reported proficiency).

5.2 Linguistic material

Stimuli were declarative sentences with an animate subject, a verb, a direct object and an adverbial transitive complement which could easily be shifted (e.g., placed before or after the subject noun). The overall length of each sentence was controlled (21–25 syllables).

Some minor modifications had to be made in the Swedish sentences to create sentences testing the same phenomena as in French. For example, the minimal NP, article+noun, was taken as a basis for violation at the intraphrasal level. In French, the intraphrasal word order violation was realized by placing the article after the noun in the minimal NP: **voisine la* 'neighbor the'. The same violation is impossible in Swedish, where the definite article is fused with the noun as a suffix: *grann**en*** 'the neighbor' (cf., § 2.2 above). This impossibility led to the introduction of an attributive adjective in the Swedish NPs. Adjectives in Swedish are always prenominal, as are articles in French. Thus, moving an adjective to a postnominal position, as in **den grannfrun turkiska* 'the neighbor Turkish', provides an unambiguous intraphrasal word order violation similar to French **voisine la* 'neighbor the'. Although NPs in Swedish were a bit longer as a result, it seemed more important to have comparable intraphrasal violations of word order in both languages (cf., Appendix).

360 sentences were constructed, consisting of 40 grammatical sentences and 320 ungrammatical sentences with the same contents as the grammatical ones. There were five different sentences at every level of a 2 x 2 x 2 design, representing orthogonal combinations of two positions (early vs. late), two structural spans (intraphrasal vs. interphrasal) and two violation types (word order vs. agreement). Each participant processed 40 grammatical and 40 ungrammatical sentences.

5.3 Experimental apparatus

Participants' grammaticality judgments were recorded using PsyScope (Cohen, MacWhinney, Flatt & Provost 1993). The stimuli were read by a native speaker, tape-recorded, and digitally stored in a microcomputer. Each violation detection time was recorded from the point in the sentence after which no legal completion could render the sentence grammatical.

Participants were asked to decide whether each sentence was grammatical and to indicate their choice via a button box, pressing a red button for ungrammatical sentences and a green one for grammatical sentences. Children were instructed to listen carefully because they would hear each sentence only once, and to respond as quickly as possible. By pressing the button, the participant stopped the timer that had started at the offset of the violation and the time needed to detect the violation was computed.

6. Cue cost in simultaneous French /Swedish bilinguals

Results for the bilinguals were similarly analyzed in terms of global performance: accuracy and detection times, adopting the predictions for the three cue cost factors presented in Sections 3.1–3.3 above.

6.1 Are simultaneous bilinguals less efficient than monolinguals?

6.1.1 *Accuracy of on-line grammaticality judgments*

Children's and adults' undetected violations consisted of over-acceptance (incorrectly accepting an ungrammatical sentence). A mixed design ANOVA was carried out with every age group (4) x violation position (2) x violation span (2) x violation type (2) x languages (2). In this design, age group was the only between-participants factor. ANOVAS were run with participants (F1) and sentences (F2) as a random factor.

Table 1. Accuracy: undetected violation rates (%) by age group and language

	French		Swedish	
	monolinguals	**bilinguals**	**monolinguals**	**bilinguals**
6–7	25	50	44	54
8–9	20	33	37	41
10–11	18	32	32	34
adults	3	7	19	30

Not surprisingly, there was an overall developmental effect $F1(3,37) = 12.53$, $p < .0001$ and $F2(3,156) = 47.14$ $p < .0001$, but also specific age group effects according to the language.

In French, two significant differences were observed: between the two younger bilingual groups (bilingual 6–7-year-olds: 50% vs 8–9-year-olds: 33%) $F1(1,16) = 5.39$, $p = .03$ and $F2(1,78) = 4.05$, $p = .04$ as well as between the 10–11-year-olds (32%) and the adults (7%), $F(1,21) = 16;18$, $p = .0006$ and $F2(1,78) = 85.87$, $p < .0001$. Globally, bilingual accuracy in French was considerably lower than in the monolinguals, at all age levels. An important main effect of violation span was obtained, with greater sensitivity to intraphrasal violations involving articles and nouns as compared to interphrasal violations involving subject – verb relations (agreement or word order, late or early in the sentence) $F1(1,37) = 20.87$, $p < .0001$ and $F2(1,156) = 37.74$, $p < .0001$. Such an effect was found in some groups (8–9 and 10–11, respectively $F1(1, 8) = 10.73$, $p = .01$ and $F2(1,39) = 10.10$, $p = .002$; $F1(1,12) = 13.19$, $p = .003$ and $F2(1,39) = 32.93$, $p < .0001$) and disappeared in the adults (see Table 2). A qualitative analysis indicated that among the eight linguistic structures, any structure including an interphrasal violation elicited more undetected violations than others. A very similar result was obtained in French monolinguals.

Table 2. Accuracy: undetected violation rates (%) by age group for French language

	Violation span		Violation type	
	intraphrasal	**interphrasal**	**word order**	**agreement**
6–7	43	57	55	46
8–9	25	41	37	28
10–11	20	44	34	31
adults	7	6	11	3

In Swedish, no significant difference was obtained between the four adjacent age groups. Nevertheless, a significant effect was observed between the youngest (6–7 years, 54%) and the oldest (10–11, 34%) children ($F1(1,20) = 5.73$, $p < .02$ and $F2(1,78) = ns$). At all age levels, bilingual accuracy in Swedish was very similar to the corresponding data obtained in Swedish monolinguals, i.e., considerably lower than for French monolinguals. On the other hand, bilingual accuracy was similar in both of their languages except in adults, who clearly showed a higher percentage of undetected violations in Swedish (30%) than in French (7%) $F1(1,9) = 7.92$, $p < .01$ and $F2(1,39) = 119.83$, $p < .01$.

6.1.2 *Detection times*

ANOVAs on mean detection times for correctly rejected ungrammatical sentences were carried out with participants (F1) and sentences (F2) as random factors (see Figure 1).

As was the case for the monolinguals, bilingual children were slower than bilingual adults at detecting grammatical violations. The overall analysis yielded a significant main effect of age on detection times ($F1(3,37) = 12.98$ $p < .0001$ and $F2(3,156) = 274.17$, $p < .0001$). Some specific age-group effects according to the language were observed. In French, the only significant difference occurred between the 10-11-year-olds (2662 ms) and the adults (1215 ms) ($F1(1,21) = 25.84$, $p < .0001$ and $F2(1,39) = 382.64$, $p < .0001$). Thus, one important change occurred during development in French. Similarly, in Swedish, there was a significant difference between the 10-11-year-olds (2334 ms) and the adults (1539 ms). On the other hand, one difference was observed between the two languages: whereas Swedish detection times are quite comparable in monolinguals and bilinguals (but not for adults), French detection times are considerably longer in the bilingual groups. Therefore, it could not be generally argued that the bilinguals are less efficient as regards accuracy and detection times.

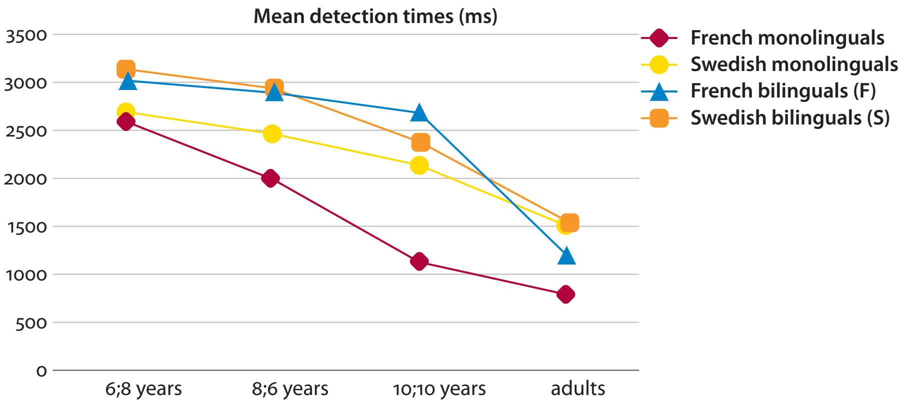

Figure 1. Mean detection times (ms) in bilinguals tested in French and in Swedish (with reference to monolinguals)

6.2 Similar patterns of cue cost in bilinguals and monolinguals

6.2.1 *Contextual information: Violation Position (early vs. late)*

The results concerning violation position are shown in Figure 2.

French

As predicted, late violations were detected more rapidly than early ones F1 (1,37) = 52.54, $p < .001$ and $F2(1,156) = 75.09$, $p < .001$. All age groups were faster at judging sentences when the violation occurred later in the sentence: at age 6–7 ($F1(1,8) = 15.41$, $p = .04$ and $F2(1,39) = 84.10$ $p < .001$), at age 8–9 ($F1(1,8) = 8.58$, $p < .01$ and $F2(1,39) = 4.86$), at age 10–11 ($F1(1,12) = 21.52$, $p = .0006$ and $F2(1,39) = 14.70$, $p = .0005$), or among adults ($F1(1,9) = 11.78$, $p = .007$ and $F2(1,39) = 12.60$, $p = .001$). These results are very similar to our previous results on French monolinguals (Kail 2004).

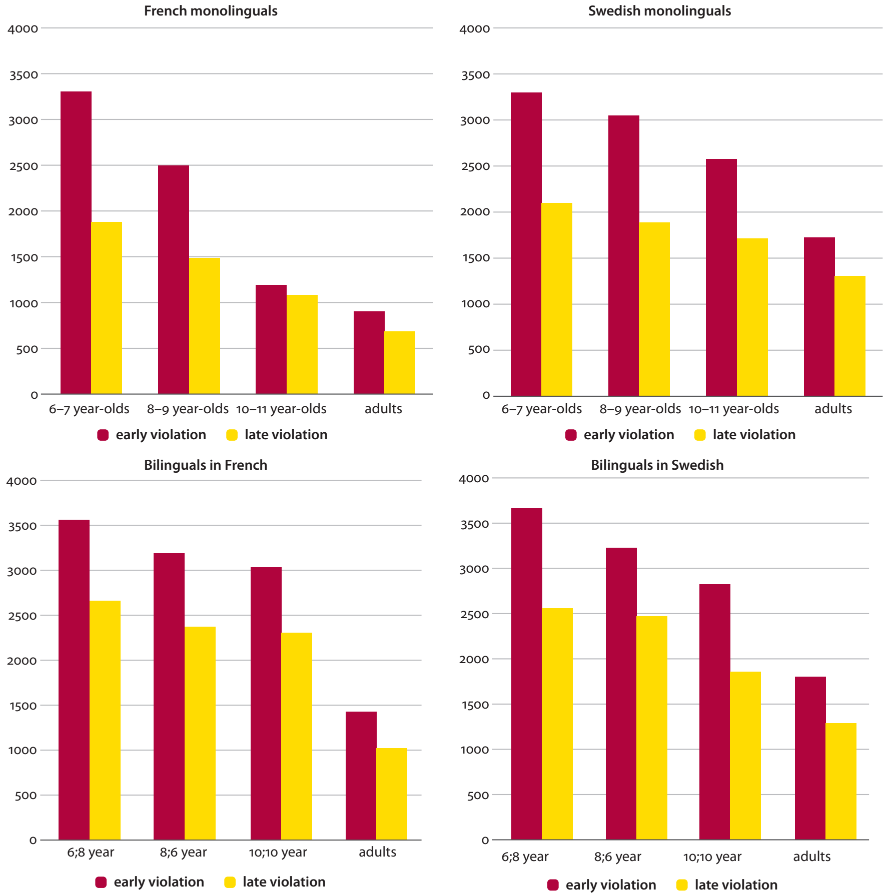

Figure 2. Mean detection times (ms) in monolinguals and bilinguals as a function of violation position and age

Swedish

The same patterns were observed in Swedish: late violations were detected more rapidly than early ones ($F1(1,37) = 69.31$, $p < .001$ and $F2(1,156) = 211.81$, $p < .001$) and this was observed in every age group: at age 6–7 ($F1(1,8) = 78.38$, $p < .001$ and $F2(1,39) = 173.93$, $p < .001$), at age 8–9 ($F1(1,8) = 8.98$, $p < .01$ and $F2(1,39) = 70.29$, $p < .001$), at age 10–11 ($F1(1,12) = 24.66$, $p = .0003$ and $F2(1,39) = 57.16$, $p < .001$), or among adults ($F1(1,9) = 6{,}0$ $p = .03$ and $F2(1,39) = 16.52$, $p < .001$). These results confirm our previous results on Swedish monolinguals (Kail et al. 2012).

6.2.2 *Structural information: Violation Span (intraphrasal vs. interphrasal)*

On the basis of previous monolingual data in several languages (cf., above), we predicted that intraphrasal violations would be more rapidly detected than interphrasal ones in French/Swedish bilinguals. The results are shown in Figure 3.

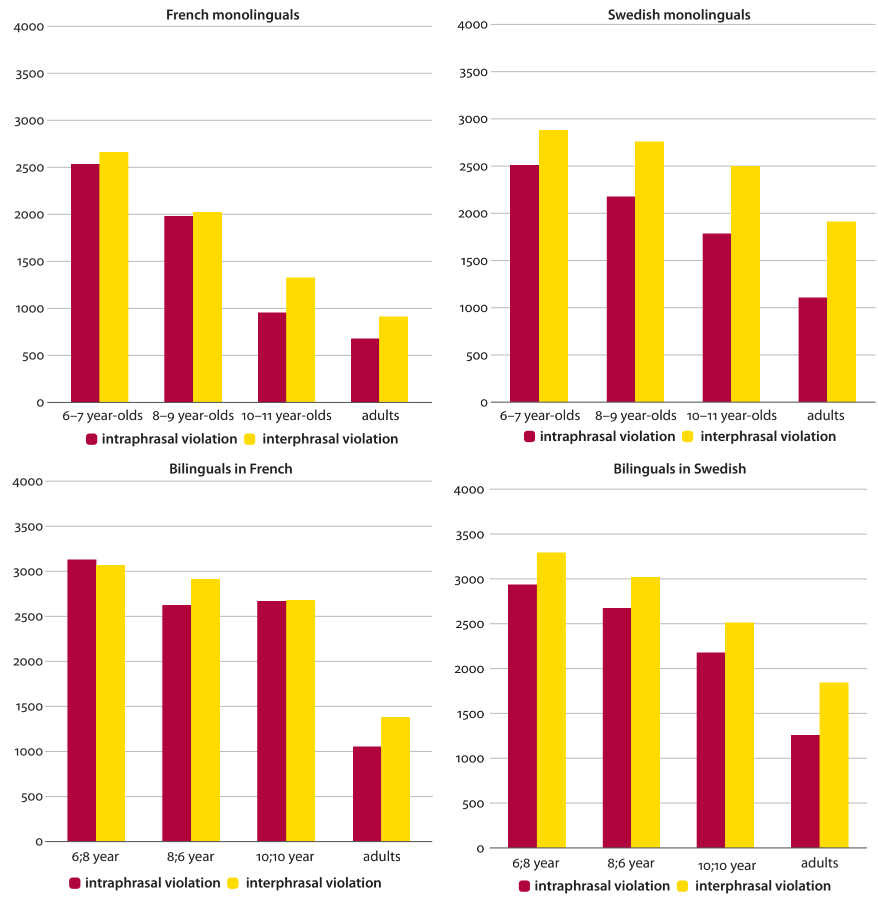

Figure 3. Mean detection times (ms) in monolinguals and bilinguals as a function of violation span and age

French

In French, the overall analysis supported this prediction ($F1(1,37) = 3.69$, $p = .05$ and $F2(1,156) = 7.61$, $p = .006$) but in the three children's groups, no significant effect of violation span was obtained. However, there was a significant effect among the adults, such that intraphrasal violations were detected considerably more rapidly than interphrasal ones ($F1(1,9) = 8.28$, $p = .01$ and $F2(1,39) = 3.38$, $p = .05$). This result differs from what was found with French monolinguals, who showed an significant effect both in the 10-11-year-olds and the adult group.

Swedish

In Swedish, bilinguals also detected intraphrasal violations more rapidly than interphrasal ones (F1 $(1,37) = 22.45$, $p < .001$ and $F2(1,156) = 41.52$, $p < .001$). This was confirmed at every individual age: at age 6–7 ($F1(1,8) = 5.05$, $p < .05$ and $F2(1,39) = 42.25$, $p < .001$), at age 8–9 although the tendency does not reach significance, at age 10–11 ($F1(1,12) = 24.66$, $p < .001$ and $F2(1,156) = 57.16$, $p < .001$), and among the adults ($F1(1,9) = 6.58$, $p = .02$ and $F2(1,39) = 6.47$, $p = .01$). Thus, monolingual and bilingual participants processed Swedish in a similar way.

6.2.3 *Violation Type (agreement vs. word order)*

Recall that the predictions for this factor were language-specific. In French, previous results indicated that agreement violations were more rapidly detected than word order ones. In contrast, in Swedish, no difference was observed between these two main linguistic features of the language. The results are shown in Figure 4.

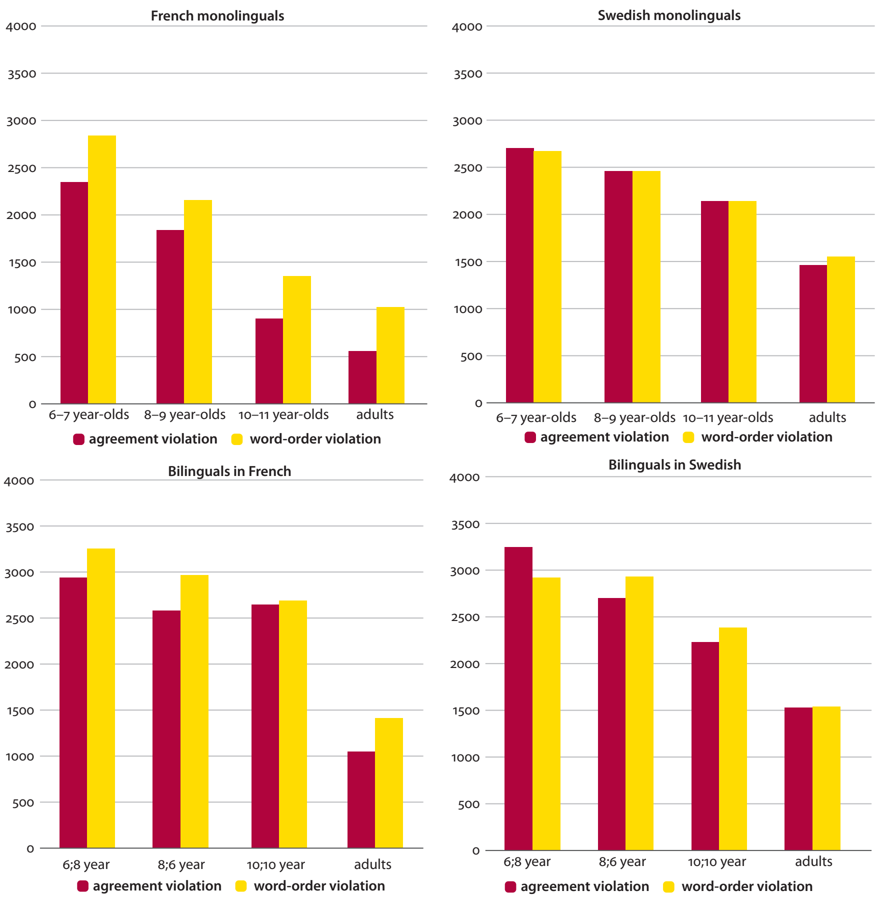

Figure 4. Mean detection times (ms) in monolinguals and bilinguals as a function of violation type and age

French
In French, the overall analysis supported the prediction ($F1(1,37) = 7.40$, $p = .009$ and $F2(1,156) = 7.20$, $p = .008$), but the tendency did not reach significance among the children's groups. Only the adult group confirmed the results from our monolingual analysis, where agreement violations were more rapidly detected than word order ones ($F1(1,9) = 5.94$, $p = .03$ and $F2(1,39) = 19.79$, $p = .0001$).

Swedish
In Swedish, as expected, agreement violations were not detected more rapidly in any group, in accordance with the monolingual data.

In sum, cue cost patterns were similar, with the exception that the bilingual children did not detect agreement violations more rapidly than word order violations in French at any age level, as opposed to the French monolinguals. In order to give a complete view of the main factors of cue cost in French-Swedish bilinguals we have to mention two important interactions found at all age levels and in both languages. Although the interactions are different in French and Swedish, such systematic interactions were not found in the monolingual data.

6.3 Interactions of factors specific to bilinguals

6.3.1 *Interaction of Violation Position and Violation Type in French*
The overall interaction between violation position and type was significant ($F1(1,37) = 13.91$, $p = .0007$ and $F2(1,156) = 59.37$, $p < .0001$). When the violations occurred early in the sentence there was no significant difference between agreement and word order, whereas for late violations, agreement violations were detected more rapidly than word order violations. This interaction was significant at every age level except for the adults: age 6–7: 2286 ms *vs.* 3007 ms ($F1(1,8) = 35.75$ $p = .0004$ and $F2(1,39) = 11.52$, $p = .001$); age 8–9: 1942 ms *vs.* 2786 ms ($F1(1,8) = 13.79$ $p < .005$ and $F2(1,39) = 32.88$, $p < .0001$); age 10–11: 2077 ms vs. 2515 ms ($F1(1,12) = 4.81$, $p<0.05$ and $F2(1,39) = 50.21$, $p < .0001$).

6.3.2 *Interaction of Violation Position and Violation Span in Swedish*
The violation position by span interaction was globally significant ($F1(1,37) = 22.39$, $p < .001$ and $F2(1,156) = 86.93$, $p < .001$), as well as significant at every age level, except in adults. When violations occurred early in the sentence, there was no significant difference between intra and interphrasal violations, while for late violations, intraphrasal violations were detected more rapidly than interphrasal ones: age 6–7: 2221 ms *vs.* 3089 ms ($F1(1,8) = 15;83$ $p = .004$ and $F2(1,39) = 58.89$, $p < .001$); age 8–9: 2084 ms *vs.* 2842 ms ($F1(1,8) = 7.93$, $p = .02$ and $F2(1,39) = 40.25$, $p < .0001$); age 10–11: 1477ms vs. 2229 ms ($F1(1,12) = 17.49$, $p = .001$ and $F2(1,39) = 40.97$, $p < .0001$).

We can summarize the interactions that were found in bilinguals as follows: in French, the more reliable the cue (agreement), the more efficient the context; in Swedish, the more available the cue (intraphrasal), the more efficient the context.

6.4 Specific cue cost hierarchies in bilinguals

A separate ANOVA was conducted in order to compare cue cost hierarchies in monolingual and bilingual processing. For every age group we have estimated percentages of variance as Ss_{effect}/Ss_{total}, the latter including all interactions. Results of these analyses are shown in Figure 5. In order to evaluate the specificities of bilingual processing, we give the corresponding monolingual graphs.

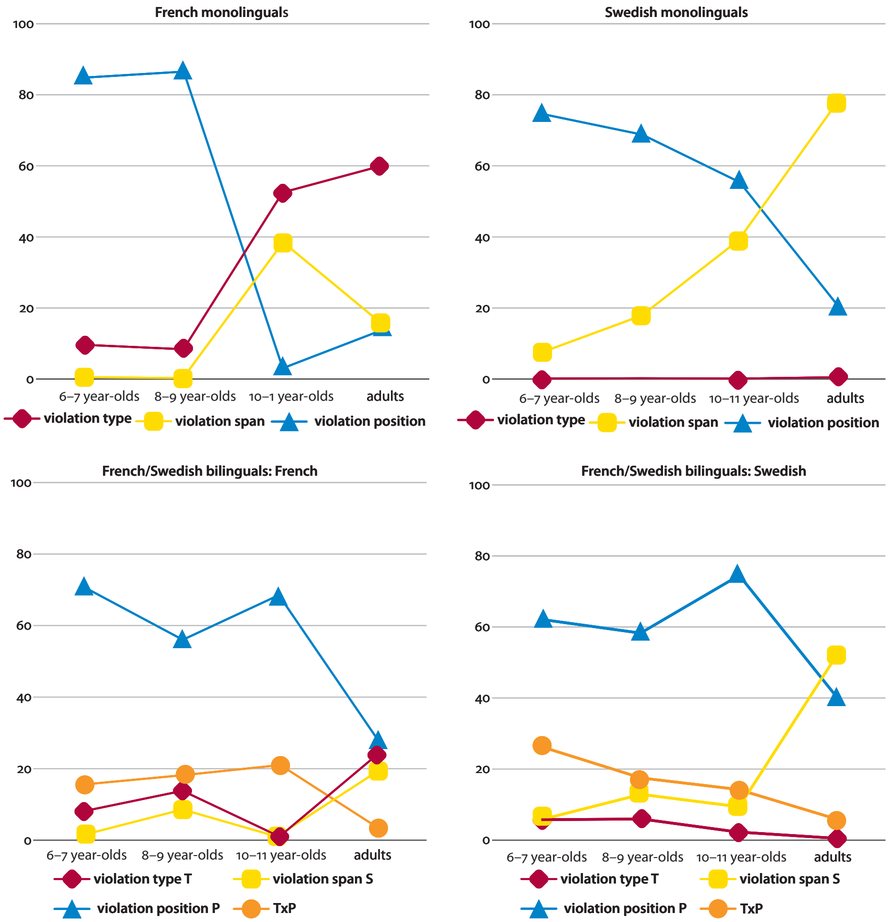

Figure 5. Detection times: percentages of variance resulting from main effects in each age group

In Swedish, the bilingual hierarchy of cue cost factors can be summarized as follows: the most important factor was the position of the violation, explaining 61% of variance at age 6–7, 58% at age 8–9, and 73% at age 10–11. This factor lost its importance in adults (39% of variance). We found the same pattern in Swedish monolinguals. The interaction "position by span" was the second most important factor explaining 26% of variance at age 6–7, 17% at age 8–9, and 13% at age 10–11, losing its significance in bilingual adults. This pattern was specific to bilinguals. The third factor was "violation span" which increased with age and became the most important one in adults, explaining 51% of variance. Violation type had no effect. This last developmental pattern was similar to the one found with Swedish monolinguals.

In French, the bilingual hierarchy of cue cost factors was as follows: the most important factor was the position of the violation, explaining 71% of variance at age 6–7, 56% of variance at age 8–9 and 69% at age 10–11, but it was of less importance in adults (28% of variance). This developmental pattern, also found in bilinguals in Swedish, was actually characteristic of monolinguals and bilinguals irrespective of the language. The second factor was the interaction of "position by type", explaining 15% of variance at age 6–7, 18% at age 8–9, and 20% at age 10–11, losing its significance in the adult group. This pattern was specific to bilinguals in French. The third factor was "violation type" which increased with age, explaining 23% of variance in adults.

To summarize, in Swedish, quite similar patterns were obtained in bilinguals and monolinguals (except for the "position by span" interaction in bilinguals). In French, bilinguals differed from monolinguals especially in the decreasing impact of the agreement/word order contrast, the most significant factor in the monolingual data.

7. Discussion and concluding remarks

In the overall analysis, detection times were longer for bilinguals than for monolinguals, as also reported by previous studies on bilingual sentence processing (see e.g., Frenck-Mestre 2002). Working within the Competition Model experimental framework, Kilborn (1989) showed that even fully competent bilinguals tend to process sentences more slowly than monolinguals.

What global performances tell us about bilinguals

Our previous studies on monolinguals have shown that Swedish speakers were significantly less accurate and slower than French speakers at every age level (Kail et al. 2012). In terms of overall performance, this gap between languages tends to disappear in French-Swedish bilinguals where we observed quite similar results in both languages.

One possible explanation is *dominance* (Heredia & Stewart 2002). In our sample of French-Swedish bilinguals, Swedish could often be considered the dominant language, according to detailed questionnaires.

However, in our cross-linguistic program on bilingual on-line sentence processing in children (aged 6–11) and adults, all exposed to their two languages from birth (simultaneous bilingualism), French was the shared language (French-English; French-Swedish; French-Portuguese). Whether French was the dominant language (French-English) or not (French-Swedish and French-Portuguese), the gap between French in monolinguals and in bilinguals was of comparable magnitude at all age levels (Kail 2012). This result indicates that dominance is not the only factor accounting for the differences between French monolinguals and bilinguals, irrespective of the language pairs.

From a developmental point of view, the bilinguals showed the most important decrease of their detection times between age 10–11 and adulthood in both of their languages. Such a profile was also obtained in our two other groups of simultaneous bilinguals (French-Portuguese, French-English; Kail 2012). In monolinguals, the developmental shift occurs earlier, at around 9 years old. According to Trueswell (2008), 9-year-old children become successful in their parsing revisions, an ability that can be attributed to the development of cognitive control and executive functions. In a sense, the bilingual delay seems to be in line with the idea that bilingualism is a unique situation in which competing languages could be a source of difficulty in attentional control during language processing (Bialystok 2005). One could assume that this unique situation explains why the developmental parsing process is somewhat delayed in bilinguals, where the difficulty of inhibiting one of the languages is more costly and takes more time.

Cue cost factors in bilinguals and monolinguals

Bilinguals tended to present the same patterns as their monolingual counterparts for cue cost general factors: in their two languages, late violations were more rapidly detected than early ones (contextual information) and intraphrasal violations were more rapidly detected than interphrasal ones (structural information). Similarly, in both languages, bilinguals presented the same pattern as monolinguals for language-specific factors: in Swedish, no difference between morphological and word order violations could be observed, whereas in French, agreement violations were detected more rapidly than word order ones. Thus, except for the fact that bilinguals were slower, the weight of each separate cue cost factor was roughly the same for bilinguals as for monolinguals. In this sense, our results support a large number of earlier studies which show a separate independent development in bilingual first language acquisition (Genesee 2002; De Houwer 2005).

The most important difference between bilinguals and monolinguals was found in the relative significance of interactions between factors, not observed in the monolinguals. These occurred at all age levels. These specific "bilingual" interactions, shown also in the French/English bilinguals of the program, could explain longer detection times, which, in turn, could be interpreted in terms of the cognitive cost implied by the need to "inhibit" (or "turn off") the non-relevant language.

However, it seems that delayed attentional control and executive functions do not give the whole picture, and that cross-linguistic components and language separation in bilinguals could also play a role. Our results highlight the need for operationalizing the role of typological distance between languages in simultaneous bilingual sentence processing. This topic remains largely unexplored in current research.

Acknowledgements

This research was carried out through the program *Ecole et Sciences Cognitives* with financial support by the French Ministry of Research.

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Appendix

Example of a Grammatical Sentence and the eight Corresponding Ungrammatical Sentences.

Grammatical Sentence

På	*lördagar*	*fyller*	*den*	*turkiska*	*grannfrun*	*kylskåpet*
On	Saturdays	fill-PRES	the	Turkish-DEF	neighbour-DEF	fridge-DEF,

efter	*att*	*ha*	*handlat*	*på*	*marknaden*
after	to	have	shopped	at	market-DEF

'On Saturdays, the Turkish neighbor fills the fridge after going shopping at the market.'

	Agreement violation t1		**Word order violation t2**	
	Intraphrasal violation s1	**Interphrasal violation s2**	**Intraphrasal violation s1**	**Interphrasal violation s2**
Early violation p1	1	3	5	7
Late violation p2	2	4	6	8

The Eight Corresponding Ungrammatical Sentences in Swedish (Kail et al. 2012)

1. t1s1p1 *På lördagar fyller det turkiska grannfru**n** kylskåpet efter att ha handlat på marknaden*

2. t1s1p2 *På lördagar efter att ha handlat på marknaden fyller det turkiska grannfru**n** kylskåpet*

3. t1s2p1 *På lördagar fyll**a** den turkiska grannfrun kylskåpet efter att ha handlat på marknaden*

4. t1s2p2 *På lördagar efter att ha handlat på marknaden fyll**a** den turkiska grannfrun kylskåpet*

5. t2s1p1 *På lördagar fyller den grannfrun **turkiska** kylskåpet efter att ha handlat påmarknaden*

6. t2s1p2 *På lördagar efter att ha handlat på marknaden fyller den grannfrun **turkiska** kylskåpet*

7. t2s2p1 *På lördagar **den turkiska grannfrun fyller** kylskåpet efter att ha handlat på marknaden*

8. t2s2p2 *På lördagar efter att ha handlat på marknaden **den turkiska grannfrun fyller** kylskåpet*

The Eight Corresponding Ungrammatical Sentences in French (Kail 2004)

1. t1s1p1 *Chaque semaine, le voisine remplit le frigo après avoir fait les courses au marché.*
2. t1s1p2 *Chaque semaine, après avoir fait les courses au marché le voisine remplit le frigo*
3. t1s2p1 *Chaque semaine, la voisine rempl**issent** le frigo après avoir fait les courses au marché.*
4. t1s2p2 *Chaque semaine, après avoir fait les courses au marché, la voisine rempl**issent** le frigo.*
5. t2s1p1 *Chaque semaine, voisine **la** remplit le frigo après avoir fait les courses au marché.*
6. t2s1p2 *Chaque semaine, après avoir fait les courses au marché voisine **la** remplit le frigo.*
7. t2s2p1 *Chaque semaine, **remplit la voisine** le frigo après avoir fait les courses au marché.*
8. t2s2p2 *Chaque semaine, après avoir fait les courses au marché **remplit la voisine** le frigo.*

Sentence No.:

1, 2, 3, 4 – Agreement violation (t1)
1 and 2 – gender agreement
3 and 4 – verb agreement
5, 6, 7, 8 – Word order violation (t2)
5 and 6 – N + adj
7 and 8 – SV

1, 3, 5, 7 – Early violation (p1)
2, 4, 6, 8 – Late violation (p2)

1, 2, 5, 6 – Intraphrasal violation (s1)
1 and 2 – agreement
5 and 6 – word order
3, 4, 7, 8 – Interphrasal violation (s2)
3 and 4 – agreement
7 and 8 – word order

CHAPTER 16

The blossoming of negation in gesture, sign and oral productions

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Negation constructions in longitudinal adult-child data are an excellent source for the study of multimodality in language acquisition. First negative constructions seem to take over from early forms of rejection and avoidance, but tracing the transitions between actions and gestures, and between gestures and signed or spoken expressions in young children is quite complex. We focus on multimodal analysis of negation in the productions of five children between the ages of 0;10 and 3;6 interacting with their parents in various linguistic environments (monolingual French, monolingual English, monolingual LSF, bilingual French/LSF, bilingual French/Italian). We present the individual multimodal path of each child, illustrate the continuum between actions, gestures and signed/spoken constructions and analyze the common trend that leads children into symbolic communication through multi-semiotic means of expression.

Keywords: negation, multimodality, gestures, sign language, language acquisition

Introduction

By comparing five children acquiring one or two languages in one or two modalities, the goal of this paper is to highlight the importance of taking into consideration all semiotic means of expression when we analyze interactions in developmental studies, with a focus on forms of negation expressed through visual means.

Stern and Stern (1928) had already noticed how early "no" and its equivalents were used in language acquisition, and there has been a whole lineage of valuable

DOI 10.1075/tilar.22.17mor

scientific literature on that topic. However, actions and gestures interpreted as negative in dialogue have not thoroughly been included in developmental research on negation. Tracing the transitions or complementarities between actions, gestures, and verbalized/signed expressions in very young children, and apprehending the function of each modality can be quite complex. In this paper, we propose to conduct comparative analysis in children who are surrounded by speech or by sign in order to take into account the multimodal aspect of negation in dialogue and to better grasp the possible transitions and continuities between actions, gestures and words or signs.

This paper will focus on multimodal analysis of negation in the longitudinal data of five children interacting with their parents in monolingual French, monolingual English, monolingual LSF, bilingual French/LSF, bilingual Italian/French. We chose to focus on unimodal monolinguals, bilinguals, and a bimodal bilingual child in order to analyze the use of gestures of negation in those different linguistic situations. Gestures have been found to be more frequent in bilingual situations (Nicoladis 2007; Benazzo & Morgenstern 2014), and it could be even more interesting in the case of bilingual bimodal children (Kanto et al. 2015) since gestures could be addressed both to speaking and signing adults. We will first present the research issues, within an overview of the literature. We will then introduce our data and coding. The results of our analysis for each child will be followed by our concluding comments.

1. Literature review and research issues

1.1 Negation and language acquisition

All human beings (Horn 2001, xiii) use negation as a pragmatic tool for a whole set of functions, including refusal, denial, prohibition, and even affirmation in anaphoric negation (Wode 1977; Bloom 1991). The study of negation is especially fruitful in the context of language acquisition. Children learn how to use negation as a tool to express their needs, their desires, and ultimately, their will, which is part of establishing their own identity (Morgenstern 2006: 10).

The study of children's acquisition of negation calls for a system of categorization based on the forms produced and the functions these fulfill in children's utterances. The first studies on the topic consisted of structural descriptions of negative markers used by children (cf. Bellugi 1967). Soon thereafter, McNeill and McNeill (1968) turned the focus of analysis to the semantic content of these negative types. Bloom (1970) proposed a succinct model for the semantic values of negative markers, a model which was expanded by Choi (1988).

These models, although thorough in describing children's development of negation in terms of the relation between syntax and semantics, did not incorporate socio-pragmatic factors undeniably present and central in children's interactions. The functions of negation are numerous and subsequent researchers have tried to organize them into typologies in order to account for their emergence and development. In their 1968 typology, McNeill & McNeill classified children's spoken productions into categories dealing with the syntactic and semantic value of the negation. Their three categories were existence/truth, external/internal, and entailment/nonentailment. Volterra and Antinucci's study (1979) was the first to propose a pragmatic typology of the acquisition of negation. It was divided into four categories and the authors convincingly demonstrated that children are able to understand the notion of polarity around 1;6. Later, Choi (1988) and more recently Cameron-Faulkner and colleagues (2007) conducted thorough multilevel corpus-driven analyses and created typologies that drew distinctions between negative functions (refusal, denial, failure, epistemic negation, non-existence, and negative assertion). In line with Volterra and Antinucci (1979), they classified the occurrences according to syntactic, semantic, and pragmatic parameters.

These studies on children's negative spoken productions have shown that *no* is the most consistently used word throughout the single word utterance period (Pea 1980: 170) and that the first negative functions children express are rejection, refusal and protest (Spitz 1957; Bloom 1970; Clark 1978; Vaidyanathan 1991; Dodane & Massini-Cagliari 2010). Children are shown to use spoken productions for negation around 1;07 (Tomasello 2003: 228–229). Other studies analyzed children's actions and gestures used before they speak and have shown that children express negation long before 1;07. Spitz (1957) observed that first negative constructions emerge thanks to early actions of rejection and avoidance. Guidetti (2005) demonstrated that gestures of negation are among the first symbolic gestures used by children.

The necessity for the advent of functional categories in children's use of negation was first approached from a purely syntactic perspective, and later from a syntactic/semantic perspective, before being considered through a more integrative model which includes pre-verbal categories and takes gesture into account. Gesture is a cornerstone in the development of negation, and should not be neglected. Clark and Clark (1977) report that the first expressions of negation are gestural, possibly combined with one word (op.cit.: 348).

1.2 The action-gesture-word relation

According to Darwin (1872), habitual gestures, such as the headshake, have become associated with the movement of certain muscles. Darwin argues that the association between the intention behind the movement and the movement itself is so strongly imprinted in the mind that it becomes natural to perform that gesture with its corresponding intention. Mimetic schemas for imitable actions, shared representations of objects that can be manipulated, ground the acquisition of children's first gestures and first words or signs (Zlatev et al. 2005). In addition, evidence from brain and behavioral studies shows that language use engages motor representations and that through complex imitation, manual-gestural communication in social interaction leads to spoken language (Arbib 2012). Despite the links drawn between actions, gestures and words, the literature has focused mostly on words and (less frequently) on gestures.

Some researchers claim that there is an initial period when children produce communicative symbolic gestures independent of speech. In this initial stage, gestures are unaccompanied by speech sounds (cf. Bates et al. 1979; Butcher & Goldin-Meadow 2000). However, gestures are not a sole modality of expression for long – as soon as children can break into the verbal realm, they learn to coordinate the two modalities within a single utterance. This shift from the gestural to the verbal does not necessarily attest to the child's preference for one modality over the other, but more likely takes place because of the abundance of verbal information in the child's input (Bates et al. 1979) and how adults reformulate children's actions and gestures into speech in their own conversational turns (Morgenstern & Beaupoil 2015).

Other studies on the gesture-word relation have highlighted that symbolic gestures tend to develop in tandem with early words, which could mean that they are a manifestation of the same cognitive development (Kita & Özyürek 2003). For a number of children, gestures seem to represent an alternative means of expression until the verbal means for the same function are available (Acredolo & Goodwyn 1988). In the same vein, it has been observed that cross-modal combinations (1 word + 1 gesture) allow the child to overcome what the authors call "linguistic limitations" in the transition to the two-word stage (see Capirci et al. 1996 on Italian children aged 1;04 – 1;08).

In the continuity of these studies on the use of the gestural modality as complement or in the place of the spoken modality, Guidetti (2005) demonstrates that, aside from pointing, gestures of agreement and refusal are the first symbolic gestures used by children, although the verbal modality for such functions takes precedence already by 2;00.

1.3 Gestures of negation and signs

The study of the expression of negation via gesture is gaining ground, as is shown in Kendon's (2002) study of the headshake, or Calbris (2005) and Harrison's (2010) studies of manual gestures of negation. Of particular interest in these studies are the semantic values associated with adult gestures. However, in children's first uses of gesture, the forms are not this finely articulated – a horizontal movement of the hand will not be as clear-cut as the adult version – perhaps because these are cultural acquisitions that serve as intensifiers in speech or as an expression of attitudes about what is said, or as a form of meta-language (as Kendon 2002 argues). It is only once the foundations of speech have been acquired that children can supplement their expressions with the specific co-verbal gestures described in the analysis of adult negations such as the palm down horizontal sweeping gestures (Harrison 2010). The child's frequent and stubborn refusals are often accompanied by body movements and actions that cannot be analyzed easily with the tools developed by authors specialized in adult interaction and very specific to co-verbal gestures.

The first symbolic intentional gesture expressing negation with more controlled movements and without any contact with an object is the headshake (Beaupoil-Hourdel 2015). The headshake, like all movements recognized as "gestures", is an excursionary movement, wherein the body returns to its initial position after the gesture is completed (Kendon 2004: 149). This distinguishes headshakes from head turns, which are not considered gestures, but rather gesticulations (following Kendon's Continuum, Kendon 1988; McNeill 1992).

The headshake is one of the most widely recognized head gestures. It is an emblematic gesture – a gesture that has "a direct verbal translation or dictionary definition, usually consisting of a word or two or perhaps a phrase" (Kendon 2004: 96).

Other gestures are also used by children to express negation, but these occur less frequently in the data. There are a few instances of the shrug, which has been called an "emblem" (Ekman & Friesen 1969) or a "quotable gesture" (Kendon 2004: 335) with a stable, conventionalized meaning that can be reformulated by a spoken phrase within a given culture. The shrug is defined not only as an instance of lifted shoulders but more broadly as a "compound enactment" (Streeck 2009: 189) which can combine palm-up flips, lifted shoulders, and a lateral head tilt. We have a few occurrences of shoulder shrugs and/or open arms palms up open hands that indicate lack of knowledge or absence. In British and American Sign Languages, shrugs and palm ups are not classified as signs (Sutton-Spence & Woll 1999 for BSL; Shaw 2013 for ASL) but as a gesture. We observed the same use in our LSF data and have adopted the same classification. We have also coded some instances of index waves, which are conventional gestures of negation in French and Italian and are incorporated in LSF as signs of negation. They were counted as Shared Gesture Sign (SGS). According to Emmorey (2002: 184), only the headshake is used by both hearing and deaf children to mean "no" during their first year. As the form of the headshake used as a gesture in isolation during the first year is similar to the sign used in ASL (and LSF), one hypothesis is that it should, therefore, be used in signed productions as soon as children enter signed syntax. However, Anderson & Reilly (1997) found that the deaf children in their study first used index waves around 18 months in their signed productions. Headshakes are only produced sporadically and in isolation at first and then added to the manual sign of negation between 1;07

and 3;04. In adult LSF, the headshake and index wave are very often used together in negative productions. Limousin (2011) found that Charlotte, the deaf little girl analyzed in this paper, used headshakes and index waves as early as 1;00 but always in isolation and never at the same time. At 2;00, she started combining these with predicates, she used negative verbs with incorporated negations expressed in the direction of the movement (NE-PAS-AIMER 'don't like', NE-PAS-VOULOIR 'not want', NE-PAS-SAVOIR 'not know'), and she also combined headshakes and index waves in synchrony as in adult language.

The 'No' headshake and the shrug combined with palm up (signaling 'all gone' (disappearance), 'I don't know' or 'there is no X') are conventional gestures, first, since their meaning is culturally specific and they must be learned as such by children in the same types of situations as words or signs, but also because they are produced without contact with objects and are thus 'decontextualized'.

1.4 First expressions of negation: The role of actions

Volterra et al. (2004: 9) suggest that vocal and gestural symbols emerge around the same time. Groundbreaking work has been done, notably by Pea (1980), whose aim was to describe the transition period from nonverbal to verbal negation. He was also one of the few researchers to treat both on equal terms. However, the earliest manifestations of negation are not "gestural", or representational and symbolic, but more accurately described as body movements that derive from natural expressions and will become re-organized as culturally specific gestures later on (Morgenstern & Beaupoil 2015). These forms of negation have largely been ignored in the modern psycholinguistic approach. There is a need to clarify the difference between children's actions, interpreted as negative and reformulated in their speech turns by their interlocutor, and symbolic gestures which are used by the child's surrounding cultural and linguistic community to convey negative meaning.

In this study, we are particularly interested in children's non-conventional body movements expressing negation, which we call "actions", that are interpreted in dialogue by their addressees as negations. Those actions interpreted as negative are non-conventional body movements that are primarily non communicative and are used either to act on an object or on a person, or to move away, kick away, or avoid.

The aim of this paper is to trace children's pathways from actions interpreted as negations in context to multimodal expression of negation in full bloom. Despite semiotic and linguistic factors of variation such as the expressive modality (spoken or signed) or the environment (monolingual or bilingual), we will try to point to possible common trends in children's entry into the use of negation.

2. Data[1] and method

2.1 Data

We will focus on multimodal analysis of negation in the productions of five children – Madeleine (monolingual French), Ellie (monolingual British) Antoine (bilingual French/Italian), Charlotte (Limousin 2011), a deaf signing child with input in French Sign language (LSF langue des signes française), and Illana (Tuller et al. 2007), a hearing bilingual bimodal child in contact with French and LSF. Longitudinal data were collected from four of the children between the ages of 0;10 and 3;00, and for one from 1;5 to 3;6. The children were filmed during interaction with their parents in various linguistic environments. Four children were filmed once a month for one hour including Illana who was mostly filmed in a bilingual, bimodal environment. Antoine (Benazzo & Morgenstern 2014) was filmed once a month with his French father and once a month with his Italian mother and recordings started six months later than for the other children. We used the videos and the transcriptions when they were available.[2] The entire data is spontaneous; we added no experimental design. A specific coding system was developed, combining the use of CLAN and ELAN with the video data and the transcriptions in order to make micro and macro analysis of the functions of the various forms of negation according to context in dialogue.

For this study we restricted the data to a one hour session every six months (two sessions for Antoine, one in each language), between the ages of 1 and 3 years for the five children, (except for Antoine for whom sessions started at 1;6). Consequently, we were able to code 30 hours of data.

Table 1. Recordings and negative productions of the five children

	Negative productions	Hours of video
Ellie	256	5
Madeleine	202	5
Charlotte	117	5
Illana	216	5
Antoine	174	10
Total	**965**	**30**

1. The data used in this study is part of the Projet ANR CoLaJE <http://colaje.scicog.fr>, a project funded by the French National Agency, see Morgenstern 2009 and Morgenstern & Parisse 2012.

2. The data in sign language was not entirely glossed but was tagged for negations.

2.2 Method

We followed a three-step coding process:

1. Recordings and transcriptions were analyzed in CLAN (spoken data) and ELAN (signed and spoken data) to find all forms of negation. They were all listed in a shared document and circulated among the members of the *Negation Project*[3] who coded the data.
2. Coding was done in excel grids in order to make micro and macro analysis of the type of modality functions of the various forms of negation according to context in dialogue.
3. Detailed analysis was conducted for certain extracts in ELAN for gestures or their timing with vocal productions; in our follow-up study we will try to correlate forms and functions with prosodic contours using PRAAT and phonological content using PHON.

Coding was done collectively for 20% of the data by the authors, a dynamic coding guide was devised and shared, and any issues raised by each coder were solved collectively during our regular meetings. The only forms included in the quantitative and qualitative analysis were those that could be interpreted in the dialogic context as being negations. Headshakes that were not interpreted as instances of negations but as movements of the head from right to left with no specific negative meaning, for example, were not counted. We used our own interpretation in context and the adults' previous and subsequent turns in order to code the data.

The negative functions (refusal, rejection, absence, denial, negative assertion, epistemic negation, and prohibition) were coded according to three types of forms:

a. Actions such as pushing away an object.

(1) Ellie 1;2
Mother: Do you want some milk?
Ellie: pushes the glass of milk away
Mother: No? OK.

b. Symbolic conventional gestures (headshake for refusal, shoulder shrug and extended arms and palms up for epistemic negation and for absence);
c. Speech or sign in each language included, for example, in French: *non*, *pas*, *y a plus*, *rien*; in Italian: *no*, *non*, *più*, *niente*; in English: *no*, *don't*, *not anymore*, *nothing*; in LSF: IL-N-Y-A-PAS 'none' or NE-PAS-VOULOIR 'don't want'.

3. All the authors of this paper were part of the Negation Project. The forms coded were based on our literature review and then enriched thanks to Beaupoil-Hourdel's PhD dissertation (2015), and the various studies on negation published by the members of the project (Benazzo & Morgenstern 2014; Beaupoil-Hourdel et al. 2015; Morgenstern & Beaupoil 2015; Morgenstern et al. 2015).

We thus made a distinction between actions and gestures, but the difference between the two categories is not always easy to draw when it comes to young children. We coded the child's behavior as an action when the movement produced by the child was a reaction to the environment rather than being intentional and conventionalized, as in the following example:

(2) Ellie, 1;10 with MOT (mother) and GDM (grandmother)
*MOT[4]: How many are there Ellie?
*GDM: Shall we count?
*CHI: 0.[5]
%act: CHI moves forward and looks at the book GDM is holding.
*GDM: one +…
*CHI: **0.**
%act: **CHI touches the book and tries to take it.**
*GDM: Two (.) oh no!
*CHI: **0.**
%act: **CHI takes the book in her hands and closes it.**

In the example above, Ellie is engaged in a shared book reading activity with her grandmother. The grandmother suggests they count the number of horses on the page and the child's actions show her intention not to get involved in this activity. Her actions have a negative meaning for the addressee and we coded them as a refusal and then as a protest. She uses her body to express her refusal to start the activity but her postures and movements are not part of the systematic conventional system used by her cultural community to express disagreement. Therefore, we coded these occurrences as actions and not as gestures.

In Example (3), however, Ellie does not use actions to convey her negations but the gestural modality in the shape of a headshake. Kendon (2002) has shown that this gesture is culturally understood as negative and the cultures in which the children in this study have been brought up have all conventionalized that gesture. In the corpus, we considered that the child and the mother produced a gesture when the movement was (1) intentionally communicative, (2) culturally understood as expressing a negation, and eventually (3) understood in context by the interlocutor as expressing a negation.

4. The CHAT (McWhinney 2000; <http://childes.psy.cmu.edu>) transcription system includes main tiers indicated by * and a three letter name for the speaker (MOT: mother; CHI: child and GDM: grand-mother) and secondary tiers indicated by %act describing the actions.

5. 0. is a convention from the CHAT format that indicates that the participant does not utter a word but makes an action or a gesture that is coded in the following lines. Actions are signaled by %act and gestures by %gpx.

(3) Ellie, 2;00 with MOT (mother), MAR and LAU (her aunts).
*MOT: Telephone!
%sit[6]: the telephone is ringing.
*CHI: Telephone!
%act: CHI looks at her aunt Marianne.
*MAR[7]: It's the telephone!
*LAU: +<[8] telephone oh yeah!
*MAR: 0.
%gpx: points to the child's bowl of porridge.
*CHI: **No.**
%gpx: **headshake.**
*MAR: Shall we eat the porridge?
*CHI: xxx[9].
*MAR: Some of your porridge.
%xpnt: points to the child's bowl of porridge.
*CHI: **0.**
%gpx: **headshake.**

In Example (2) the child's negations are unimodal because she only uses actions to negate, whereas in (3) she uses multimodal means of expression as well. In the first negative utterance combining < no + headshake > simultaneously, both the gesture and the spoken production are negative, we thus coded this multi-channel utterance as a combination of modalities: speech and gesture. When the child uses several modalities but with only one that expresses negation, we coded which modality conveys negation and we added what accompanies the negative message in another category.

The children have a complex system at their disposal that includes symbolic and non-symbolic means of expressing negation. They can use the visual modality with actions, symbolic gestures, and signs, or the auditory modality with vocal productions, onomatopoeia and speech. The only child who uses all those resources including both speech and sign is Illana, who was brought up bilingual French/LSF. As far as the two signing children are concerned, we did not think it was relevant to categorize certain forms of negation as either conventional gestures or signs. Headshakes and index waves, for example, are both used as conventional gestures by hearing and signing adults but they are incorporated as signs in LSF grammar. We thus included them in a category we called Shared Gesture/Sign (SGS).

6. We used %sit in the transcriptions to mark descriptions of the situational context.

7. MAR is MARIANNE and LAU is LAURA, Ellie's aunts.

8. This convention is used to signal that two participants are speaking or making an action at the same time. It is a marker for overlapping utterances.

9. This convention is used whenever the coder cannot understand what a participant says.

Table 2. Coding sample

Session	**Timing**	**Loc**	**Previous context**	**Verbal prod.**	**Action**	**Gesture**	**Subs. context**	**Function**	**Modality**	**Structure**	**Place in dialogue**
2;00,23 fr[1]	33′25	CHI	Nanny offers dessert	manon[2]	Pushes dessert away	Head shake	Nanny looks for other dessert	rejection	Action+ Gesture+ Verbal	isolated	resps
2;00,23 fr	35′30	CHI	Nanny asks if he is going to watch *the Aristocrats*			Head shake	Obs asks if he is going to watch another movie	refusal	Gesture	isolated	resps

[1] *Codes used Fr: French; CHI: Child; Obs: observer; resps: response*
[2] *manon* is a mixture of French and Italian (*ma* in Italian means 'but', *non* in French means 'no').

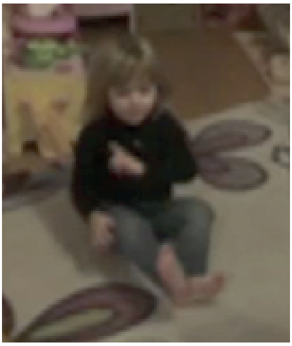

Illustration 1. Shared Gesture/Sign of negation:
Charlotte (top, Deaf child) and Ellie (bottom, hearing child) at 2;00 making an IndexWave

3. Results per child

In this study, we focus our analysis on the use of the visual-gestural and auditory-vocal modalities and will now present the results of our coding of actions, gestures, speech and sign (and combinations of modalities) for each child. The figures illustrate the percentages of each type of forms out of the total number of occurrences per session, the tables show the number of tokens per session.

3.1 Ellie's longitudinal data (monolingual English)

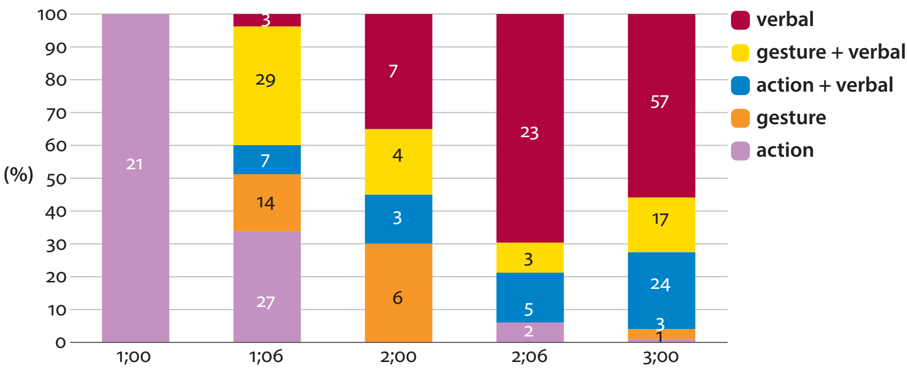

Figure 1. Percentage of actions, gestures, and speech and number of occurrences per category in Ellie's data

At the beginning of data collection (1;0), action seems to be sufficient for the child to express negation. Beaupoil et al. (2015) have shown that the child begins to use gestures and enters a symbolic mode of expression at 1;2. But, as early as 1;6, she is already using an important proportion of symbolic means of expression, predominantly with gestures (over 30% gesture in isolation and 35% combinations of speech and gesture). After 1;6, speech is the predominant modality either in isolation (over 35%) or combined with gestures (20%) or actions (15%). At 2;6, there is a decrease in the use of gestures (less than 10% and always in combination with speech). However, the use of gestures makes a comeback at 3;00 in combination with speech (almost 20% of all negative productions) and in isolation. Overall, the child uses actions in 35% and gesture in almost 30% of her productions of negation. Even though 71% of the child's productions involve speech, just 35% of them are only verbal, 36% of the productions of negation coded for this study are combinations of speech and either an action or a gesture.

Speech becomes predominant and Ellie's spoken negative utterances are more and more complex. We observe that her spoken productions for negation are constantly getting more elaborate. At 3;00 the child's negative utterances have an MLU (mean length of utterance) a little below 3, which is high for an average as there is a great number of occurrences of *no* in isolation. At 1;00, she only uses the grammatical marker *no*. At 2;00, she can produce the frozen expressions *all gone* or *couldn't do it*. At 3;00, she is producing more elaborate utterances such as *he can't push the baby*, *no, Pepper, you mustn't move my toys* (speaking to her cat), or *I don't like cheese, Mummy*, and uses all functions of negation (refusal, epistemic negation, negative assertions). Thus, in only three years, she has developed a good mastery of her mother tongue. Even though speech becomes predominant around 2;00, an analysis of negations restricted to speech would ignore a great proportion of Ellie's productions and the role of the visual-gestural modality in her pathway. The comeback of the visual modality in the role of co-verbal actions and gestures at 3;00 also seems to indicate that once Ellie has acquired the verbal means to express negation, she can still resort to actions and gestures to complement her speech.

3.2 Madeleine's longitudinal data (monolingual French)

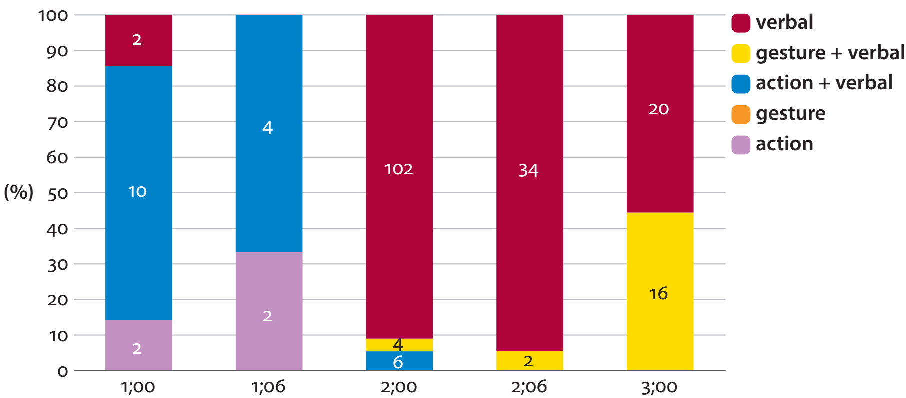

Figure 2. Percentage of actions, gestures, and speech, and number of occurrences per category in Madeleine's data

Madeleine's pathway is quite different from Ellie's, as she does not use gestures during an intermediary period to enter the symbolic expression of negation. She is already producing speech at the beginning of data collection (at 1;0), but mostly in combination with actions interpreted as negative by her addressee and the coder (pushing away toys, turning away from her mother, avoiding spoonfuls of food). At

2;00, her speech in isolation is highly predominant (over 90% of her productions). However, co-verbal gestures start emerging and are part of 45% of her productions at 3;00. Gestures seem to be used by Madeleine once she has a finer mastery of speech. As she has been extensively studied in the *CoLaJE project*, we know that Madeleine's mastery of speech is quite precocious (Morgenstern & Parisse 2012) and that as of 2;03 she has acquired the French phonological system (Yamaguchi 2012), she uses quite a variety of grammatical tenses (Parisse & Morgenstern 2012), produces three argument clauses, prepositions and connectives (Sekali 2012), she refers to herself in the first person (Caët 2013), starts using complex sentences (Sekali 2012) and can self-repair her utterances (Morgenstern et al. 2013).

At 1;00, Madeleine uses the grammatical marker *non* in isolation. The phonological realization of her productions of *non* is not yet complete as she pronounces them /næ/. At 2;00, she expresses various functions of negation using a variety of syntactic forms as in *télé éteinte fait rien* ('TV shut do nothing'), *non pas les brocolis* ('non, not the broccoli'), or *pas fini mon lait* ('not finished my milk'). Contrary to Ellie at the same age, Madeleine does not use chunks or frozen verbal expressions to convey her negations. At 3;00, Madeleine's negations have a complex syntactic structure such as *moi je l'avais ramassé mais maintenant je sais plus où il est* ('I picked it up but now I don't know where it is anymore').

3.3 Charlotte's longitudinal data (monolingual LSF)

Zeshan (2006) introduces negation as one of the "very suitable candidates for sign languages typology" (p. 28) since the expression of negation is present in all sign languages as well as home-signs analyzed so far and can be studied at the lexical, morphological and syntactic levels. She also highlights that "the relation between signing and gesturing with both manual and non-manual aspects is important […] in negation" (p. 29–30). Indeed, the numerous lexical and morphosyntactic forms

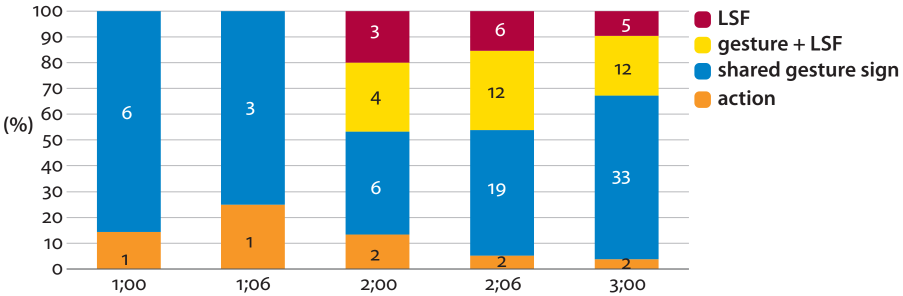

Figure 3. Percentage of actions, shared gestures/signs, and core-LSF and number of occurrences per category in Charlotte's data

involved in the sign languages studied so far are tightly linked to the signers' gesture systems in the signing community the signers live in. The coding for Charlotte's data is, therefore, different from the coding in the hearing children's data, since a number of LSF signs used to express negations are shared with the gestural repertoire used by of both signers and speakers in the French community. We coded them in the SGS category. This includes mostly index waves and headshakes for negations. Charlotte benefits from input through a single modality, the visual modality; actions, gestures and signs, as well as visual input derived from the vocal modality – mouthing.[10] LSF (in white in the graph) refers to the core LSF lexicon that hearing people would not use as gestures: the manual lexical signs NON 'no', IL-N-Y-A-PAS 'none', and the predicative signs incorporating negation such as NE-PAS-VOULOIR 'don't want' or NE-PAS-AIMER 'don't like'. SGS forms such as the waving of the index finger or the headshake are quite frequent in the adult input. We therefore observe a larger number of SGS productions (in black) throughout the data than of signs that are not SGS. Specific LSF core lexicon (such as NE-PAS-VOULOIR 'don't want' or IL-N-Y-PLUS 'no more') is only used as of 2;00 and predominantly combined with other gestures in the same production (between 20% and 30% of overall productions combine SGS signing and a typical LSF sign after 2;00).

Charlotte's LSF productions during that period are richer and progressively becoming more complex (Limousin 2011). At the beginning of the data Charlotte mostly expresses rejection like the other children studied in our project through what we categorized as actions. She also expresses refusal with the headshake and her index finger. During that period, all her actions and gestures/signs are produced in isolation. As she gets older, Charlotte produces those same forms but in combination with facial expressions in 2 or 3-sign utterances such as frowns and wrinkled nose. At 1;6 she starts using negative predicates as well, for example, PT1 NE-PAS-VOULOIR ('I don't want') and PT1 NE-PAS-SAVOIR ('I don't know'). Between 2- and 3-years-old, her signed productions become more sophisticated, as in NE-PAS-SAVOIR ('don't know') SPORT GRIMPER ('climb') and include up to four signs stringed together as in Neg-index PT1 VOULOIR ('want') PT(food) PT1 PT(food) when she is 3;00.

10. We have categorized Charlotte as being monolingual in contrast to Illana, but LSF is a language in close contact to French. Its lexicon and structure incorporate forms that derive from this contact, especially mouthing.

3.4 Illana's longitudinal data (bilingual bimodal LSF/French)

Illana is a hearing child growing up in a bilingual, bimodal environment. She has all semiotic means to express negation at her disposal, but SGSs plays a predominant role in her productions, especially when her deaf father is present during the recordings.

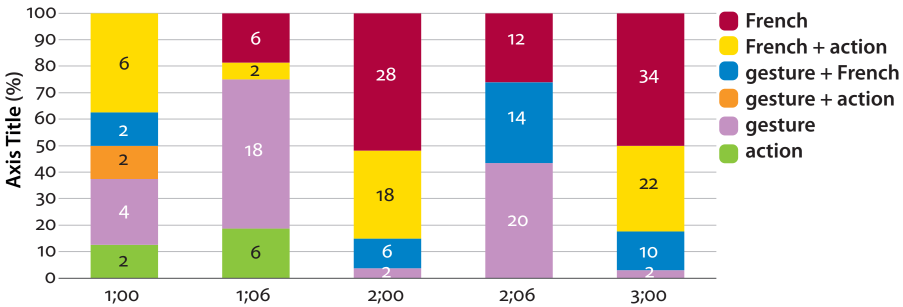

Figure 4. Percentage of actions, shared-gestures/signs, LSF and French and their combinations and number of occurrences per category in Illana's data

Illana did not produce any specific LSF lexical signs of negation during the 5 sessions chosen for this paper. We have noted that she does use the sign for NONE twice at 2;05, and a few instances of negative predicates such as NOT WANT in other sessions. However, her input is predominantly in French during the sessions, and at 2;00 and 3;00, her deaf father is not present during the recordings; consequently, forms in French take up 50% of her productions. In other words, she uses LS much less when her father is not present, which shows that she can accommodate with her audience, as shown by other CODA children (Kanto et al. 2015). She signs quite fluidly by the end of the data when her father is present (see Tuller et al. 2007, Blondel 2009 for a more detailed description of her signing) and she uses SGS forms proportionally more often than the other children. These make up 37% of her productions across the entire data set (combined or in isolation). When her father is present, isolated French occurs in only 20% to 25% of her productions and her use of the visual modality amounts to 73% of productions. The visual forms do not decrease in favor of the vocal forms since Illana continues to use headshakes, index finger negations and various symbolic gestures (Morgenstern et al. 2016).

In the following examples Illana, aged 2;07, answers her father while addressing both her father and mother. They play cards with animal pictures, and the child mixes vocal and labial French with negative symbolic gestures.

(4) FAT CROCODILE ('crocodile')
CHI Neg-index / ñan t(r)ompé c'est pas … c'est un crocrodile ('no, you are wrong this is not… it's a crocrodile')

(5) FAT SE-TROMPER ILLANA ('you're wrong Illana')
CHI palm-down gesture/ nan crocrocrodile ! ('let's give up, no, a crocrocrodile')

(6) FAT BALEINE ('whale')
CHI nan/Headshake baleine ('no, this is not whale')

(7) *her father takes one card*
CHI call gesture/nan c'est à pa(pa), c'est à maman ('hey, this is not your turn, this is Mummy's')

The majority of her productions are accessible to all her interlocutors, hearing and deaf. As she gets older, she seems to resort more and more to the combination of vocal productions with symbolic gestures. She uses several of the bimodal semiotic resources at her disposal to express her negations. French (in its multimodal nature) is her strong language (and could be compared to Antoine's use of French), and therefore she is predominantly a bimodal child who makes use of the visual modality to adjust to her bilingual bimodal environment.

3.5 Antoine's pathway (bilingual French/Italian)

Graph 5 gives an overview of the forms Antoine used over time to express negation, in accordance with his age (from 1;05 to 3;6) and to the language of the session (French when he interacts with his father and Italian with his mother).

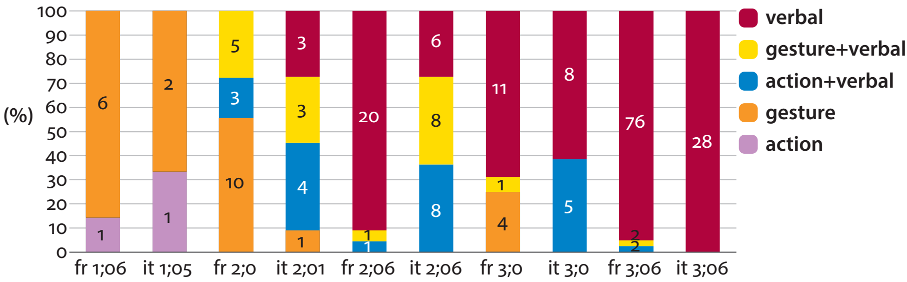

Figure 5. Percentage of actions, gestures, and speech and number of occurrences per category in Antoine's data

We note that there is a long transitional period from the visual to the spoken modality between 2;00 and 2;6 when cross modal combinations are quite frequent, before the spoken modality becomes dominant. Antoine's negation gestures are not qualitatively different in French and Italian (mostly headshakes) and his gestural behavior does not seem to be overall linked to an "Italian bias" towards gestures. We also observe a high number of spoken negations at 2;06 during the French session (Antoine develops his dominant language first), while we find a sort of regression at the same period in the Italian session (his weak language). When interacting with Italian-speaking interlocutors, Antoine code switches to French or accompanies his Italian negative utterances with gestures as in Example (8). His verbal production in the Italian sequences contains several code-mixed constructions like the utterance *pas nonna*, with the French negative *pas* and the Italian word for grandmother, which is, moreover, accompanied by a headshake.

(8) Antoine 2;06 IT

MOT:	chi sei tu?	('who are you?')
CHI:	[e ma]!	('is me!')
MOT:	c'est moi	('it's me')
CHI:	xx la nonna!	('xx grand ma!')
MOT:	era il nonno si	('it was granddad yes')
CHI:	pas nonna	(Fr. 'not' + It. 'grandma')
	shakes his head	
MOT:	non la nonna no	(not grandma no)

At 3;06, Antoine is much more at ease in the verbal modality of his two languages, but his phonological system is still incomplete both in French and in Italian. In addition, he still produces a lot of code-mixing in his weaker language, as in Italian *la mia maestra è grondata* ('my teacher yelled at me') with nonce *grondata* borrowing French *gronder* ('scold') with Italian conjugation (the Italian past participle would be *sgridata* from the verb *sgridare*) or the mixed utterance *fatto di* (It.) *bêtises avec Carmen* (Fr.) ('I was naughty with Carmen').

Gestures are practically no longer used to negate except when he is eating, but punctuating co-verbal gestures (such as "beat gestures", cf. McNeill 1992) start to emerge. This is in line with previous findings according to which beats develop with increasing MLU and varying stress patterns (Nicoladis, Mayberry & Genesee 1999; Mayberry & Nicoladis 2000). Towards the end of our collection period, speech in Italian and French has become his dominant modality.

However, as we have seen in the other hearing but monolingual children, the spoken modality already prevails, typically, between 20 and 24 months. Antoine's more intensive use of gestures of negation therefore seems to extend longer than the other hearing monolingual children previously studied, especially in the sessions with his Italian mother. Interestingly enough, there are very few co-verbal gestures of negation even at 3;6, unlike Ellie and Madeleine. Compared to Guidetti's study (2005) and to the monolingual children in our study, Antoine relies on the visual modality longer than other children raised in oral languages. His turning point into verbal modality is between 2;0 and 2;6, (depending on his use of his dominant or weak language), while verbal modality already prevails at 2;00 for the monolingual hearing children. It is also useful to underline that Antoine's linguistic production is very approximate phonetically and difficult to understand over a long period. This could be in line with the observations that bilingual children may be delayed in their phonological inventories (Oller & Jarmulowitz 2007). By 3;6, towards the end of the data collection period, his phonological system in French still lacks a number of phonemes, which is quite late compared to the children in the *Paris corpus* (Morgenstern et al. 2013). Gestures might have developed as a reinforcement function for efficient communication, allowing Antoine to overcome his linguistic limitations. However, his propensity to rely on gestures might also have been encouraged by an additional factor, namely input processing in a bilingual environment. Exposure to two languages implies dealing with linguistic forms in two codes vying for the same function. Even if there seems to be no specific delay in lexicon development when child production in both languages is considered, it takes some time for the bilingual child to elaborate equivalents in French and Italian. By contrast, the symbolic gestures analyzed in this study represent stable forms, shared in both the Italian and the French input, accessible to all his interlocutors whatever the situation might be, and therefore they might have been easier to adopt and difficult to abandon. As mentioned by Nicoladis (2007), we found no specific advantage for gestures to compensate for lack of vocabulary in his weaker language, Italian, as opposed to his dominant language, French. However, gestures seem to be a useful resource to give more pragmatic strength to his negations and might also be a convenient semiotic device to package his opposition (see Nicoladis 2007).

4. Discussion and conclusion

The analysis of each child's individual pathway into negation clearly demonstrates their differences, but there are common features. All the children in this study who have access to both the gestural-visual and auditory-vocal modalities use both (Morgenstern et al., 2010). However, they do not start expressing their rejections and refusals with conventional gestures shared with their cultural community, but with actions (pushing away an object, avoiding a spoonful of zucchini, wriggling away from their mother's arms) that are clearly interpreted by their interlocutors and integrated as if they were intentional communicative forms in the ongoing dialogue, often reformulated by the parents with spoken forms of negation.

The hearing children with no sign-language input first enter negation through actions, but then follows a period when they either use symbolic gestures (Ellie, Antoine and Illana) or speech (Madeleine). Those who get more or less rapidly involved in speech or sign seem to abandon gestures for a while, but gestures remain an excellent resource for the bilingual children, and also make a comeback with the use of co-verbal or co-sign gestures when speech or sign are already elaborated.

Charlotte, the deaf child, also expresses negation using body actions first, then uses symbolic gestures that are incorporated as signs in the linguistic system of LSF and are thus present in her input from the beginning (SGS). Illana, the bimodal child, uses progressively more complex combinations of forms simultaneously in both modalities, especially when her deaf father is present. She uses very few specific lexical signs for negations, as opposed to Charlotte; French is her strong language and although she does use signed utterances, they are less complex than her spoken utterances. However her SGS stay predominant and, along with salient facial expressions, are combined with speech.

Antoine and Illana, the bilingual children, have created efficient transitional systems during their developmental path both by combining modalities and mixing their two native languages. The need to acquire two languages at once might have an influence on the management of the visual-gestural modality, which is a stable resource to rely on in all types of linguistic environments Antoine and Illana experience. The visual modality is, of course, crucial for Illana when she wants to address her deaf father, but both bilingual children seem to rely on gestures during a transitional period when their weak languages (Italian for Antoine, LSF for Illana) are not yet fully mastered. Other studies of bilingual children would of course be needed in order to confirm whether bilingualism does correlate with a reinforcement of the use of gestures (see Benazzo & Morgenstern 2014 for a more complete study of Antoine's negations).

The children studied in this project, be they hearing or deaf, and regardless of the language or languages in their environment, make use of all the resources available to their bodies and in the input to express themselves in an environment that is favorable to language acquisition. They all have a shared a repertoire of gestures as they belong to very similar cultures, with headshakes, index waves, palm up, or sweeping palm down gestures.

Yet, they constantly use the multi-semiotic resources at their disposal and progressively enrich the complexity of their productions.

At the beginning of the data sets, they all seem to be more involved in non-conventional body movements to express rejection or avoidance, and will then use the conventional gestures that surround them, or signs. If they are non-signing children, their vocal productions (even screaming and crying) are going to develop into symbolic spoken productions. Interestingly enough, each child follows a

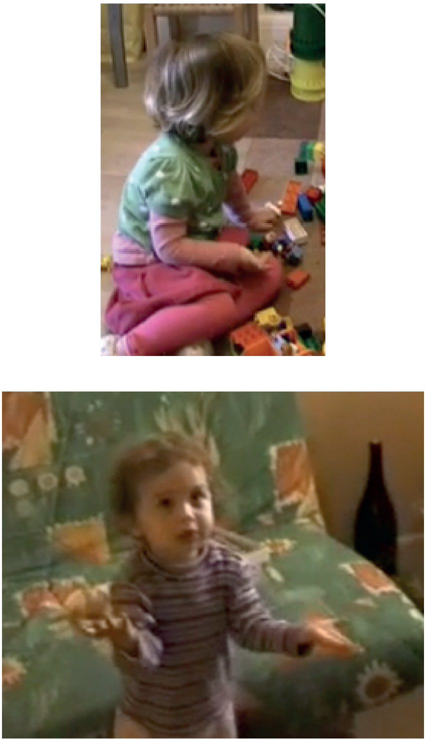

Illustration 2. Ellie and Illana making a palm up gesture (epistemic negation)

different pathway. Madeleine enters the verbal modality very early and co-verbal gestures are added as soon as her speech is established. Ellie uses more symbolic gestures before she masters speech. Detailed analysis of the forms used leads us to observe how all children are multimodal from the very beginning but also how the use of multimodality differs according to the stage they are in, in their cognitive, motor and linguistic development. The multimodal resources are first used in an integrative manner in the service of a global communicational intent and will then be subtly mastered. The productions are going to become more complex and each modality can then be used with specific different functions, which either reinforce or complement each other.

Acknowledgements

The authors would like to thank the anonymous reviewers for their constructive feedback and insightful comments, which have enormously helped to improve the paper, and the editors of this volume for their support during the revision process.

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CHAPTER 17

Motion expression in children's acquisition of French Sign Language

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Much research has examined the development of motion expression, but little is known about this domain in sign language. This study examines how signers (Deaf children aged 5–10 and adults) of French Sign Language (LSF) described clips showing voluntary motion events with variable Paths and Manners. Using mainly iconic structures, children frequently expressed both Path and Manner early on. However, responses varied with the structures used and increased with age for some event types (downward motion, boundary crossing). In addition, serial constructions increased, typically expressing two perspectives (observer and character). Finally, young children did not always provide relevant locative information (particularly with crossing events) but these cases decreased. In conclusion, iconicity partially invites signers to combine motion components, notwithstanding variation in structure and developmental changes observed with some event types.

Keywords: development of motion expression, classifier construction, constructed action, deaf children, French Sign Language (LSF), iconicity, serial construction, transfer

1. Introduction

Current research has been increasingly interested in the acquisition of spatial language. Variation across languages (e.g. Talmy 2000) has raised questions about the implications of language-specific properties (e.g. Choi & Hattrup 2012; Gennari, Sloman, Malt & Fitch 2002; Papafragou & Selimis 2010) and their role in language acquisition (e.g. Allen, Özyürek, Kita, Brown, Furman, Ishizuka & Fujii 2007; Choi & Bowerman 1991; Slobin 2004). Sign languages are of great interest in this respect because they rely on the visuo-gestural modality and therefore on iconicity (Cuxac & Sallandre 2007; Hoiting & Slobin 2007; Perniss & Özyürek 2008). Our aim is to examine whether these properties impact motion expression in children's

DOI 10.1075/tilar.22.18sal

acquisition of French Sign Language (hereafter LSF) under the assumption that they could encourage signers to express both Manner and Path when describing motion.

After a summary of available research (Section 2), we present a study examining motion expression in Deaf[1] signers (children aged 5–10, all from Deaf families, and adults), which is based on a methodology (Section 3) that was borrowed from a previous study of spoken English and French. We briefly summarize these previous results (Section 4), then focus on LSF data (Section 5). Analysis focuses on which motion components are expressed with different event types and with which linguistic structures. The discussion (Section 6) explores implications of the results for the acquisition of spatial language in LSF.

2. Space across languages

2.1 Spoken languages

Talmy (2000) proposes to group languages into several types differing in their lexicalization patterns. For example, *satellite-framed* languages (hereafter *S-languages*, e.g. English (1)) typically express the Manner of voluntary motion in the main verb and Path in satellites (particles) and other devices (e.g. prepositions). In contrast, *verb-framed* languages (*V-languages*) express Path in the main verb and downplay Manner expressed in the periphery (if at all), e.g. gerunds in (2).

(1) She is running, walking… across, into, up, away…

(2) Elle traverse, entre, monte, part… en courant, en marchant…
('She is crossing, entering, ascending, leaving… by running, walking…')

This typology has led to some debate (see Slobin 2004), suggesting, for example, that not all languages neatly match these types, proposing other terminologies (*Manner-* vs. *Path-oriented languages*), and more generally proposing to view languages in terms of a continuum defined by relative Manner or Path salience. A deeper issue under debate concerns the extent to which such language-specific features may filter speakers' attention and partly determine how they construe events.

2.2 Sign languages

Sign languages simultaneously use several manual and non-manual body parameters in discourse (hands, facial expression, eye gaze, mouth gesture, body posture) combined with a sophisticated use of the signing space (space in front of the

1. The capital (Deaf) indicates a linguistic/cultural group in contrast to an audiological condition.

signer). Iconicity plays an important role in sign language, as has been shown by many studies since research began in this field (Friedmann 1977; Klima & Bellugi 1979; Pizzuto, Pietrandrea & Simone 2007). It includes two major types, *imagistic* and *diagrammatic*. Imagistic iconicity is the most common type of iconicity in language, and the one on which this paper focuses. It implies a direct resemblance (albeit to varying degrees) between the sign and the referent. It is complemented by diagrammatic iconicity (Haiman 1985), a type of syntactic iconicity determining how signs are ordered in the utterance.

Focusing on imagistic iconicity, some authors (Cuxac 1999, 2000; Cuxac & Sallandre 2007; Russo 2004; Vermeerbergen 2006) have distinguished two types of units: conventional *lexical units* (hereafter LU) which show a weak and variable degree of iconicity, and a limited number of *highly iconic structures* characterized in the literature as *non-conventional units* or *productive signs* (Garcia & Sallandre 2014; Vermeerbergen 2006), which can represent more than 60% of units in narrative discourse (Antinoro Pizzuto, Rossini, Sallandre & Wilkinson 2008; Emmorey 2003). In addition to manual parameters, non-manual ones contribute to differentiating the types of units used. Among other non-manual parameters, eye gaze is particularly important: if eye-gaze is directed toward the interlocutor, it corresponds either to a lexical sign or to some types of pointing; if it is directed to another portion of space, then it generally corresponds to a highly iconic structure (Cuxac 2000; Garcia & Sallandre 2014; Pizzuto 2007; Pizzuto & Capobianco 2008).

Highly iconic structures are interesting cross-linguistically since they are structurally and functionally identical across sign languages (Antinoro Pizzuto et al. 2008; Sallandre, Di Renzo & Gavrilescu 2016). Such resemblance can be attributed to a process whereby signers' perceptual-practical experience has become iconic as a result of the grammaticalization of forms (Fusellier-Souza 2006; Garcia & Sallandre 2014). It has been proposed that highly iconic structures should be grouped together under the general heading of *transfers* (Cuxac 1999, 2000). The rationale for this terminology is that via neural imagery (Kosslyn 1980), these structures transfer extralinguistic experience inside the linguistic signing space.

The two most frequent types of transfers that have been identified in this framework are (see Illustrations 1 and 2):

a. *Personal transfers* (hereafter PT), wherein the signer embodies the Figure. PTs involve the whole body of the signer who reproduces actions carried out by an entity, usually a human or an animal, but which can also be inanimate. Signers' body movements, eye gaze, and facial expression all correspond to the transferred entity.
b. *Situational transfers* (ST) show the motion of a moving Figure (with the dominant hand) in relation to a stable locative entity (the non-dominant hand) which represents the Ground. In these cases, the signer's eye gaze is directed

towards the Figure represented by the dominant hand and follows its motion. STs can be further differentiated depending on whether or not they are accompanied by a locative landmark with the non-dominant hand (hereafter *locative* vs. *non-locative ST*).

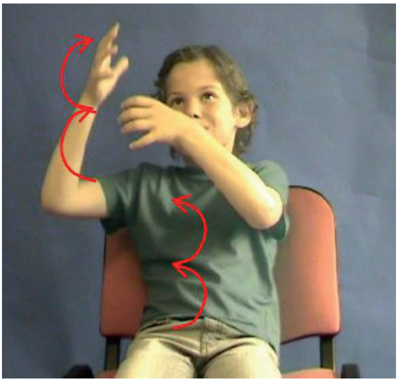

Illustration 1. Personal transfer (PT)
Ten-year-old embodying a monkey climbing up a tree. The child expresses Manner and Path by taking on an internal perspective

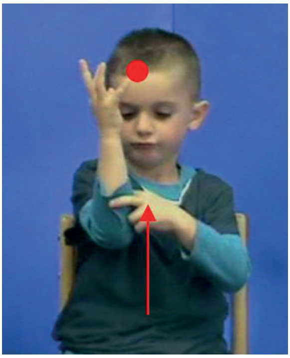

Illustration 2. Situational transfer (ST)
Five-year-old describing a bear climbing up a tree. The child expresses Manner and Path by taking on an external perspective

Situational transfers are often known as *classifier constructions* (Emmorey 2003) and personal transfers as *role shifts* or *constructed actions* (Cormier, Smith & Sevcikova, 2016; Metzger 1995), although many other terms have been employed (Schembri 2003; Slobin, Hoiting, Kuntze, Lindert, Weinberg, Pyers, Anthony, Biederman & Thumann 2003). Table 1 compares our terminology with the various terms found in sign language literature. The comparison shows not only the variety of available terminology, but also that these terms do not do justice to the iconic and context-dependent nature of these structures. Furthermore, the term *classifier* is frequently used to denote various aspects of motion events, including the entities involved and/or the event itself (*run up*), ignoring non-manual parameters which partly determine meaning. In the framework adopted here, a handshape denotes an entity displaying particular properties (e.g. thin vertical shape), but only takes on its full meaning in a particular context (e.g. as denoting a standing human, a telephone pole, a poplar tree). As noted by Slobin et al. (2003: 293):

> The "classifier" is a component of a construction that refers to a whole event. The various components function, in concert, to triangulate on an event, from a particular point of view. But the primary role of the property marking handshape is certainly not to classify. The fact that a referent property is used to evoke an entity in discourse does not mean that the entity is being presented as a member of a particular "class".

Table 1. Equivalences across terminologies

Present paper	Available literature
Lexical unit (LU)	Conventional sign, lexical sign, frozen sign
Transfer of size and form (TTF)	Specifier/Classifier of size and shape (SASS)
Situational transfer (ST)	Classifier, classifier predicate, classifier construction; polycomponential, polymorphemic, polysynthetic sign; spatial-locative predicates; depicting signs/verbs
Personal transfer (PT)	Role shift, constructed action, constructed dialogue
Double transfer (ST + PT)	Multiple references

These structures play a major role in the marking of perspectives, as illustrated by several sign languages (German, French, Italian, American, e.g. Antinoro Pizzuto et al. 2008; Perniss 2008; Sallandre & L'Huillier 2015). Thus, PTs allow signers to express the protagonist's internal perspective (through embodiment), while STs express the narrator's external perspective (no embodiment). Furthermore, transfers can be combined with one another, as well as with lexical units (LU) and pointings, resulting in twenty distinct categories (Sallandre 2007). For example, simultaneously combining a PT and a ST results in *Double transfer* (DT), also called *multiple reference* (Dudis 2004), as shown in Illustration 3.

Combining highly iconic structures may result in *serial constructions*.[2] Previous studies (Supalla 1990) show that representing motion events may involve using such

2. As is the case for serial verbs in spoken languages, serial constructions in sign language involve prosodic continuity between components, each of which can be used alone (to varying extent) as a verb-like element in other contexts. When combined, they can be accompanied by manual and non-manual markers, the scope of which covers both elements (Slobin & Hoiting 1994).

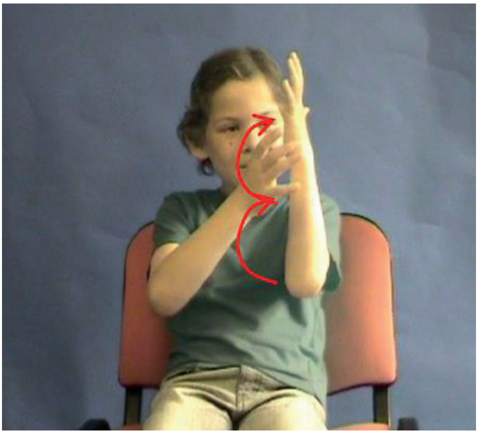

Illustration 3. Double transfer (DT)
Ten-year-old embodying a bear climbing up a tree (PT) while his non-dominant hand shows the trunk (locative landmark, part of the situational transfer)

constructions which comprise two successive elements (verb or reduced verb-like form). When these constructions include both PT and ST structures, they allow signers to present the same event from different perspectives (Risler 2013; Sallandre, Courtin, Fusellier-Souza & L'Huillier 2010; Schoder 2014). When they include two PTs or two STs, they denote different aspects of the same event (e.g. *he slides, he iceskates*). In this respect, serial constructions are relevant to several debates concerning, for example, the relative grammaticalization of sign languages (Özyürek, Furman & Goldin-Meadow 2014; Senghas, Kita & Özyürek 2004) or their typological status as either S-languages (e.g. Özyurek et al. 2014; Supalla 1990) or complex types of V-languages (Slobin & Hoiting 1994; Slobin 2004). These debates go beyond the scope of the present paper and partly revolve around difficulties in defining parts of speech in sign language (verbs, satellites, other devices, also see Talmy 2003, 2009).

2.3 Motion expression in first language acquisition

Spoken languages

Developmental studies in a number of spoken languages show the joint role of cognitive and linguistic factors during spatial language acquisition (Allen et al. 2007; Bowerman & Choi 2003; Choi & Bowerman 1991; Harr 2012; Hickmann, Hendriks & Champaud 2009; Hickmann, Taranne & Bonnet 2009; Hickmann & Hendriks 2010; Ji, Hendriks & Hickmann 2011; Slobin 2004). In all languages examined, children's motion expression shows an overall increase in joint expression of Manner and Path, reflecting their increasing ability to process and express multiple types of information. Variation of event types also shows that such responses are, overall, more frequent with upward motion, least frequent with downward motion, and variable with crossing events as a function of age. Second, at all ages, joint Manner+Path responses are much more frequent in S-languages such as English (Manner-oriented) than in a V-language such as French (Path-oriented), as predicted on the basis of typological properties. Thus, children's descriptions of motion events resemble what adults say in their language more than what same-aged children say in other (typologically distinct) languages, suggesting that language-specific factors play a role in spatial language development (see Section 4 below for more details).

Sign languages

Some studies (De Beuzeville 2004; Slobin et al. 2003; Smith & Cormier 2014; Tang, Sze & Lam 2007) suggest that classifier constructions are not mastered until eight years because of their complexity, both on the articulatory level (simultaneous manual and non-manual parameters) and on the cognitive level (decentering). Slobin et al. (2003: 291–292, for American Sign Language and Dutch Sign Language) also indicate that five-year-olds had difficulties changing perspectives (narrator vs. protagonist) in contrast to twelve-year-olds who showed a better mastery of non-manual parameters. They also show the early use of handshapes and Path descriptions, e.g. the equivalent of 'The plane flies down' at 2;8 ('Y' handshape in downward motion).

Zheng and Goldin-Meadow (2002) and Goldin-Meadow (2003: 172–174) compare Chinese- and English-speaking children as well as Deaf children (*homesigners*) in four age groups (3;7 to 4;11). Hearing children produced different motion descriptions depending on their language, whereas the descriptions of Deaf children were quite similar due to the visual-gestural modality.

In a another study, Sümer (2015) shows that Deaf children and adults frequently used classifier constructions in Turkish Sign Language and expressed Manner+Path more often than similar-aged speakers of spoken Turkish (V-language), who mostly focused on Path alone. In addition, although young signing and speaking children combined Manner and Path less often than adults, signing children did so earlier (from age 4 on) than hearing children acquiring Turkish (from age 7 on). Another interesting result is that young children (4–6 years) omitted Grounds more frequently than adults, a result that was observed in both languages, as well as in a number of other spoken languages (Hickmann 2003). However, young signing children did so more frequently than their speaking peers (see also Engberg-Pedersen 2003; Morgan, Herman, Barriere & Woll 2008; Slobin et al. 2003; Tang et al. 2007).

The present study examines motion expression by French Deaf adults and children (5–10 years). As background against which to interpret LSF data, Section 4 first presents the main results from one study (Hickmann, Taranne & Bonnet 2009) comparing English and French, from which the methodology was borrowed for the present study on LSF. Analysis of LSF data aim to address several questions. The first issue concerns the relative salience of Manner information in LSF. In particular, it was predicted that highly iconic structures would be frequent and should invite signers to combine this component with Path when describing motion. However, it was also expected that such responses would depend on the types of highly iconic structures used, since PT structures embody the moving Figure and therefore should highlight Manner more than ST structures. Third, responses combining Manner+Path were nonetheless expected to increase to some extent with age as a result of cognitive development. Finally, based on previous studies, it was expected that Manner+Path descriptions may vary with event types.

3. Methodology

3.1 Participants

Participants were 25 Deaf signers, seven adults and six children in each of three age groups (roughly half males and females): 5–6 years (mean 5;7 years, range 5;7–5;11 years); 7–8 years (mean 7;7 years, range 7;3–8;4 years), and 9–10 years (mean 9;7 years, range 8;10–10;8 years). All children had Deaf parents and learned LSF as their first language. Testing took place in schools (children) in Angers (one child) and Paris (other participants).[3]

3.2 Stimuli

Stimuli consisted of animated cartoons (8–12 seconds each) showing agents performing a *target* displacement (borrowed from Hickmann, Taranne & Bonnet 2009; see Appendix). Six showed motion along a vertical axis (hereafter six UP and six DOWN, e.g. a bear climbing up a tree, then climbing back down); six showed a boundary crossing (hereafter ACROSS, e.g. a baby crawling across a street). Half involved motion from left to right and half motion in the reverse direction. Manners (e.g. running, swimming), as well as Agents (animals, humans) varied across all cartoons.

3. The LSF data analyzed here are part of a doctoral thesis (Schoder 2017). They are extracted from a larger project including 82 signers (CREAGEST, Sallandre & L'Huillier 2011).

3.3 Procedure

Participants were seen individually by a Deaf experimenter and saw cartoons on a computer screen. After a training item, stimuli were presented in a fixed random order. After each cartoon, participants narrated what had happened to a fictitious addressee who would not have seen the cartoons. The entire sessions were recorded with two cameras (interaction between participant and experimenter, close-up of the participant).

3.4 Coding

Responses were coded in ELAN (Crasborn & Sloetjes 2008) following a procedure adapted from previous research on spoken languages. Analysis focused on utterances denoting target motion events. When several utterances denoted the same target, the one that provided the richest information was selected as the *main* target response and the others were coded as *potential* target responses, e.g. BEAR CLIMBS. UP [Manner+Path] is richer than BEAR ASCENDS [Path only].[4]

The coding of target responses further identified two types of expressed information: Path, i.e. vertical motion (UP/DOWN), boundary crossing (ACROSS), other (e.g. direction in TOWARDS); Manner, i.e. how motion was carried out (e.g. with what body part, how fast). Responses either combined Manner+Path or expressed only Manner (M) or only Path (P); a residual category included all other responses, e.g. neither Manner nor Path as in *he goes there* (which occurred in spoken languages) and cases of "No response" (LSF and spoken languages). Additional codes identified LOCATIVE information providing reference points for motion (grounds and other landmarks). Finally, the types of structures expressing Manner and/or Path information (see Section 2.2), including transfers (ST, PT, DT) and lexical units (LU).

The coding of Manner and Path took into account the use of several parameters, both manual and non-manual, which contribute to defining structures, such as:

a. *Path parameters*: direction of one or both mobile hand(s) (up, down, left, right); place of the non-dominant hand in relation to the mobile dominant hand contributing to the marking of landmarks; orientation of the signer's body; eye gaze following one or both hand(s) or fixing a point (or a zone) in the signing space.

4. Examples of Sign Language are presented in small caps. Relative richness applied to the great majority of cases. Other criteria were used for residual cases, e.g. when one predicate expressed Path only and the other Manner only, Path was considered as 'primary' (main target).

b. *Manner parameters*: movements of fingers in the mobile hand; in some cases the absence of finger movement might indicate a Manner of motion in which the body remains immobile (cf. *glisser* 'to slide'); motion of one or both hand(s); the handshape of one or both hand(s); the shape of the mobile hand(s) (e.g. undulation, zigzag); the speed of one or both mobile hand(s) (e.g. quick, slow); facial expression, mouth gestures.

4. Background: Previous results in spoken English and French

Previous results concerning spoken English and French (Hickmann, Taranne & Bonnet 2009)[5] serve as background for the LSF data presented in the next section. Analysis shows significant effects of age, language properties, and event types. A subset of results is shown in Figure 1 which displays the distribution of all main response types and other cases (2% in English, 5% in French, including rare omissions). Manner+Path responses increased with age in both languages. However, they were significantly more frequent in English, while Path-only responses were more frequent in French. Upward motion elicited the most Manner+Path responses overall, while other event types also elicited responses expressing only Path (DOWN) or only Manner (ACROSS).[6]

Responses are illustrated in (3)–(7). Young French children mostly produced Path-only responses as in (3), but also some Manner-only responses with crossing events as in (4), while Manner+Path responses increased with age (e.g. the adult in (5)). In contrast, English speakers most frequently combined Manner and Path at all ages (6), although children sometimes produced only Manner (7) or only Path (8).

(3) Elle a monté là […] elle est descendue. (3 years)
'She ascended there […] she descended.'

(4) Il a nagé dans la rivière. (3 years)
'He swam in the river.'

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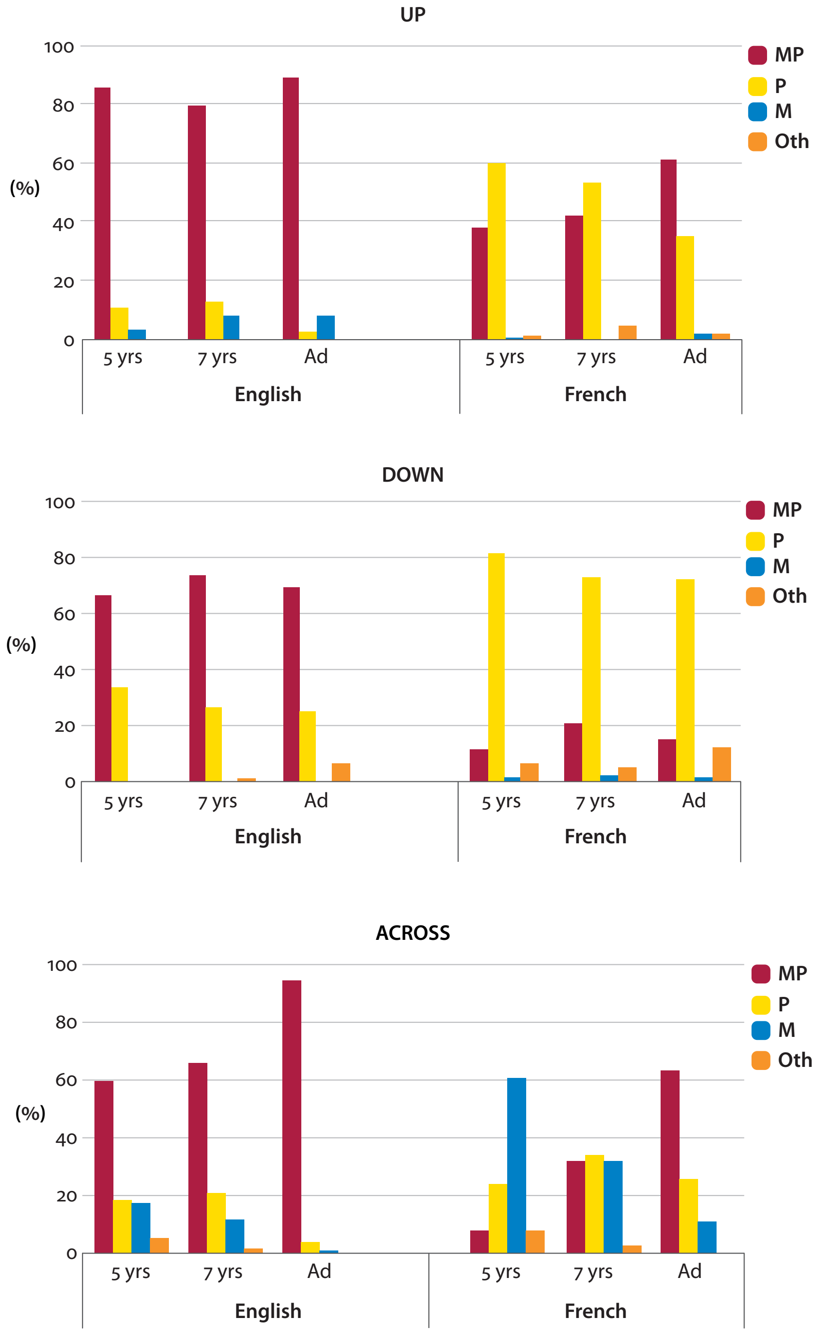
5. This study involved two experiments (one on vertical motion, the other on crossing events) with more age groups and a slightly different design. These methodological differences do not affect the conclusions, but do not allow a direct quantitative comparison with the present LSF data.

6. Although motion descriptions in French most frequently expressed Path only (e.g. *monter* 'to ascend', *descendre* 'to descend', *traverser* 'to cross'), one exception concerned the occasional use by older French speakers of a verb that happens to lexicalize both Manner and upward Path (*grimper* 'to climb.up').



*MP=Manner+Path, P=Path only, M=Manner only, Oth=Other (No response or inaudible)

Figure 1. Motion components as a function of age and events in French and English (synthesis of results adapted from Hickmann et al. 2009)*

(5) C'est un homme qui traverse une route en courant. (Ad)
'It's a man that crosses a road by running.'

(6) He swam across the river. (4 years)

(7) He was swimming in the river. (4 years)

(8) He went down. (3 years)

5. Results in LSF

All responses fell into the three main categories with the exception of a few cases of No response (NR) at 5–6 and 7–8 years (10 occurrences, of which 9 DOWN, 1 UP). We examine first the semantic components that were expressed in main target responses, then the types of structures that were used to express this information.

5.1 Expressed information

Overall, signers' responses most frequently expressed both Manner and Path (71% at 5–6 years, 76% at 7–8 years, 80% at 9–10 years, 90% among adults). However, as shown in Figure 2, some variation occurred as a function of event types and age.

First, most descriptions of UP/DOWN combined Manner+Path (see Illustrations 1 and 2 above) while few expressed only Path (5–11% among children, 1% among adults) or only Manner (1 occurrence). In contrast, ACROSS elicited a substantial number of Manner-only responses (31–47% among children, 17% among adults), suggesting that signers focused more on Manner with this event type.

Second, Manner+Path responses increased with age overall and this increase was most notable with two event types: DOWN (72% at 5–6 years, 77% at 7–8 years, 89% at 9–10 years, 95% among adults) and especially ACROSS (47% at 5–6 years, 53% at 7–8 years, 61% at 9–10 years, 74% among adults). In comparison, Manner+Path responses were very frequent with UP from early on, showing no real developmental progression (94% at 5–6 years, 97% at 7–8 years, 89% at 9–10 years, 100% among adults).

5.2 Structures used

Figure 3 shows the different types of structures that were used to express motion. Overall, signers most frequently expressed motion by means of locative ST (46%) and PT (37%). Adults produced more locative ST than PT with UP (57% vs. 40%, respectively) and DOWN (66% vs. 34%), while no such difference was observed with ACROSS (locative ST 43%, PT 40%). Children of all ages also produced more locative ST than

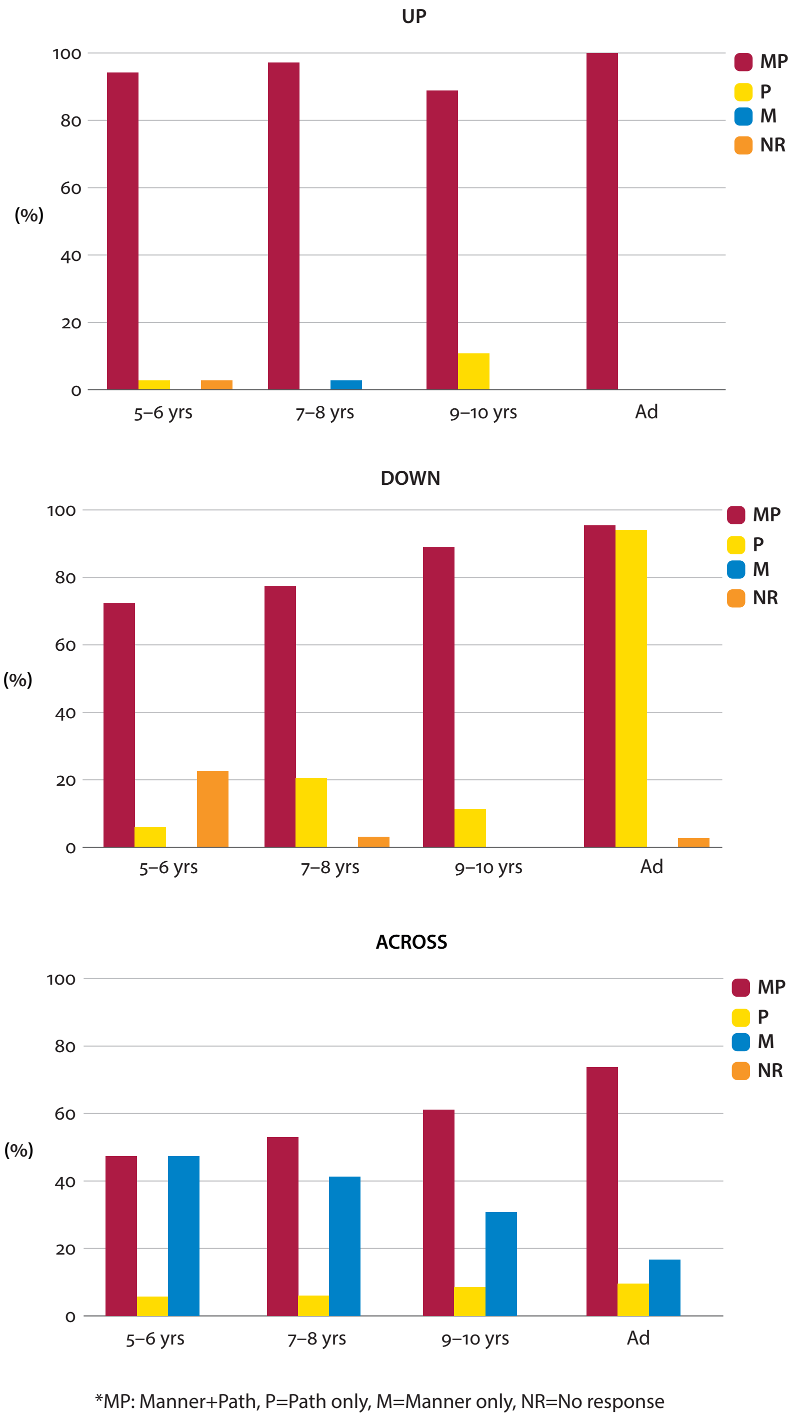
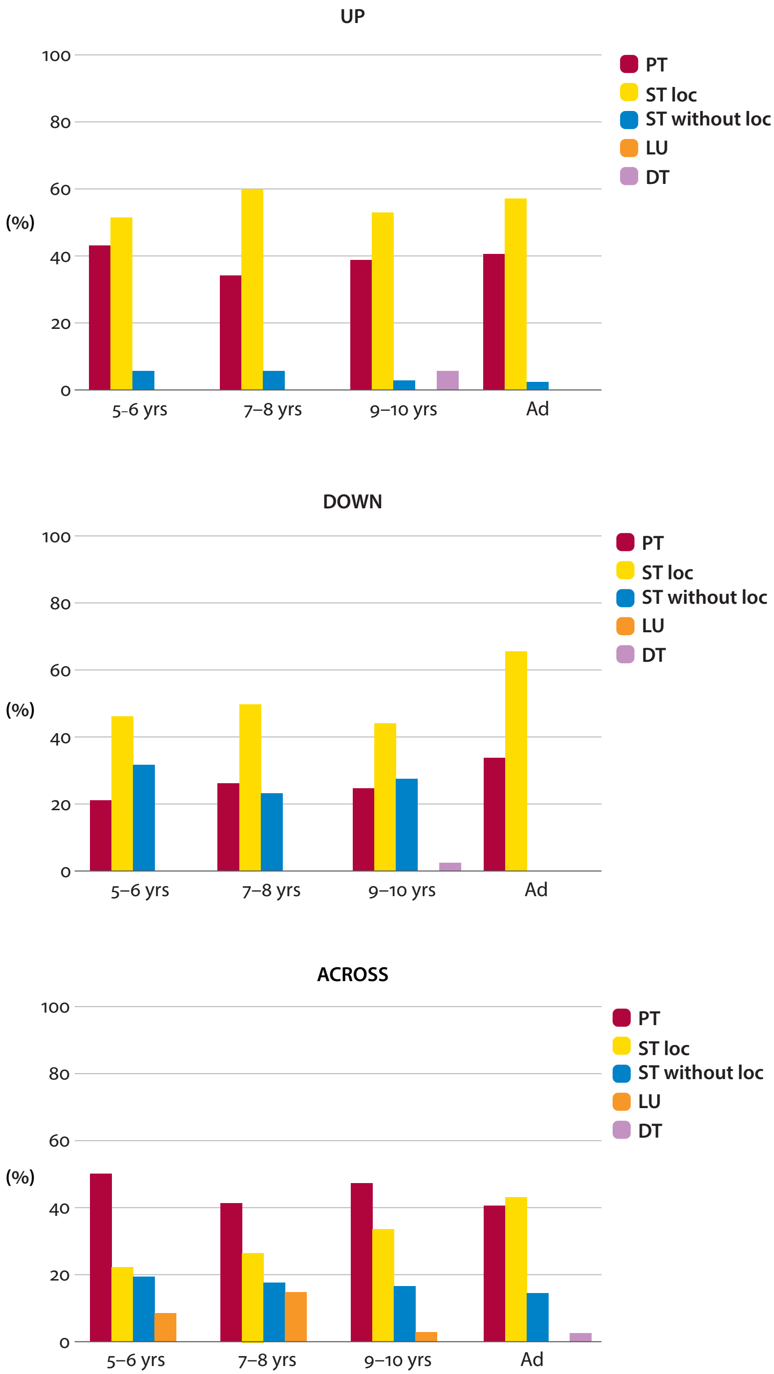


Figure 2. Motion components as a function of age and events in LSF*



*PT=Personal transfer, ST=Situational transfer, Loc=locative, LU=Lexical unit, DT=Double transfer

Figure 3. Types of structures used to express target motion events in LSF*

PT with UP (51–60% vs. 34–43%, respectively) and DOWN (44–50% vs. 21–26%), but with ACROSS they produced distinctly more PT (41–50%) than locative ST (22–33%). At all ages, children also used non-locative ST, particularly with DOWN (24–32%) and ACROSS (17–19%) but less frequently with UP (3–6%). These structures decreased with age until adult age (2% with UP, none with DOWN, 14% with ACROSS).

More fine-grained analysis examined the semantic content expressed by PT vs. ST structures. As shown in Figure 4, although both structure types expressed Manner+Path at all ages, such responses were overall more frequent with ST (91%) than with PT (69%), and this difference held across all ages (ST 86–95%; PT 57–85%). In addition, PT frequently expressed only Manner (overall 30%) and practically never only Path (1%). The production of Manner-only responses with PT was observed at all ages among children, although it decreased with age (41% at 5–6 years, 43%

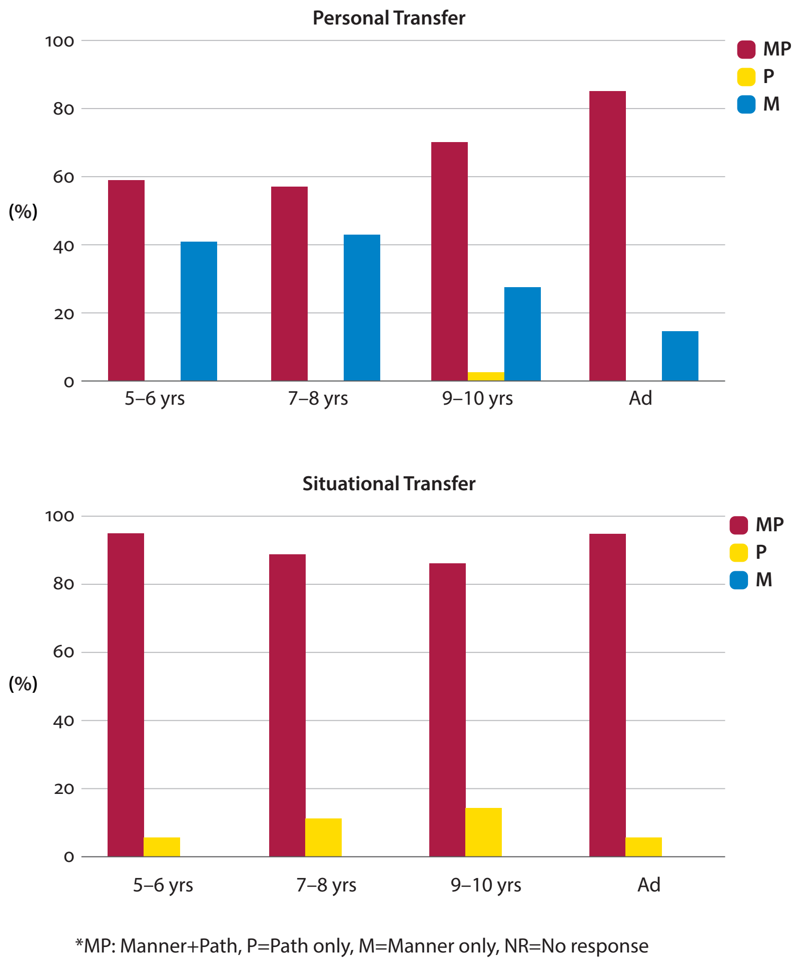
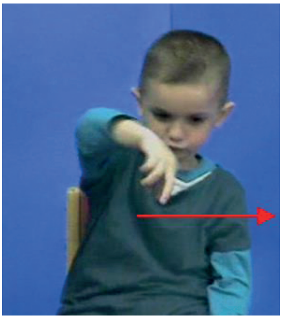


Figure 4. Semantic information expressed as a function of structure type in LSF*

at 7–8 years, 28% at 9–10 years; 15% among adults), while Manner+Path responses increased. In contrast, practically all ST structures expressed Manner+Path (overall 91%) and occasionally Path only (9%) but never Manner only. Thus, ST showed a predominance of Manner+Path responses and no developmental progression, while PT also frequently expressed Manner only, highlighting an internal perspective, indicating developmental change, particulary from 9–10 years on.

Motion was sometimes expressed in serial constructions comprising different successive predicates about the same event corresponding to main and potential target responses, comprising of highly iconic structures indicating two different (internal and external) perspectives on the same event (see Illustration 4). As shown in Table 2, these constructions increased from childhood (9–16%) to adulthood (34%), and mostly concerned UP and ACROSS events (overall 18% and 34%, respectively), rarely DOWN (4%).

a. BOY-SWIM



b. BOY-SWIM.ACROSS

Illustration 4. Serial constructions
Five-year-old expressing a boundary crossing by successively encoding (a) Manner in potential target responses embodying motion (with PT), then (b) Manner and Path in main target responses, shown by finger movements and the direction of mobile hand (with ST)

Table 2. Serial constructions as a function of age and event type*

	5–6 years	7–8 years	9–10 years	Adults	TOTAL
UP	(4/35) 11%	(3/35) 9%	(5/36) 14%	(14/42) 33%	(26/148) 18%
DOWN	(0/28) 0%	(0/34) 0%	(0/36) 0%	(6/41) 15%	(6/139) 4%
ACROSS	(5/36) 14%	(13/34) 38%	(10/36) 28%	(23/42) 55%	(51/148) 34%
TOTAL	**(9/99) 9%**	**(16/103) 16%**	**(15/108) 14%**	**(43/125) 34%**	**(83/435) 19%**

* Calculations are based on totals excluding irrelevant and no responses.

6. Discussion

This study examined motion expressions during the acquisition of LSF as a first language, with particular attention to three predictions: that LSF should invite signers of all ages to combine Manner with Path when describing motion, that this type of response might also increase with age, and that it could vary with event types. As expected, signers frequently produced Manner+Path responses at all ages, but three developmental changes also occurred: these responses increased substantially with age for some events (DOWN, ACROSS); serial constructions increased (particularly with UP and ACROSS); and non-locative ST, frequent among children (particularly with ACROSS), decreased to adulthood. We explore below how these results may shed light on the development of sign language in Deaf children within a larger cross-linguistic perspective.

6.1 Structure types and motion components

As predicted, signers frequently used highly iconic structures to express motion, but fewer lexical units than expected, suggesting that such structures play a role in LSF motion expression. Although all languages require some linear organization, sign languages also express space through signing space (Barberà 2014), unlike spoken languages (except through co-verbal gestures). As a result, sign languages maximize the amount of spatial information they can encode through the use of highly iconic structures that combine Manner (e.g. body parameters) with Path (e.g. trajectories and landmarks).

With respect to expressed motion components, LSF resembles the pattern found in English (S-language), which also invites speakers to combine Manner and Path, whereas French (V-language) invites them to focus on Path and to downplay Manner. However, a qualitative look at the data shows more Manner+Path responses for UP and DOWN in LSF (UP 89–100%; DOWN 72–95%) than in English

(UP 79–89%; DOWN 67–73%), while the reverse was true for ACROSS (47–74% in LSF vs. 59–95% in English). Further research directly comparing LSF with spoken languages should aim to determine whether these systematic trends correspond to significant language differences.

Although both PT and ST were frequently used at all ages and most often expressed Manner+Path, they differed in some respects. First, ST structures almost always expressed both Manner and Path, with occasional Path-only responses. In contrast, PT structures elicited not only Manner+Path responses but also a substantial number of Manner-only responses, especially among children aged 5–6 and 7–8 years. Second, the distribution of PT and ST structures (adding locative and non-locative ST) varied with item type. ST were clearly more frequent than PT with UP/DOWN events. In contrast, with boundary crossing, children used PT and ST roughly equally, although adults also used more ST than PT. PT structures highlighted Manner more than ST, inducing an internal perspective, particularly with boundary crossing. We turn to more details about the impact of event types.

6.2 Event types

Signers of all ages produced more Manner+Path responses for vertical motion (UP, DOWN) than for boundary crossing (ACROSS) which elicited a substantial number of responses expressing only Manner. This result held at all ages, including among adults. As illustrated above (Section 4), similar results were observed in spoken languages. It is possible that Path might be more salient than Manner with UP/DOWN because verticality is related to basic concepts such as gravity and/or standing body position. However, in both populations, upward motion elicited more Manner+Path responses than downward motion, which also elicited Path-only responses. One explanation could be that gravity, and therefore Path, might be more salient with downward motion because of its strong association with falling. Another plausible explanation could be that downward motion always occurred after the corresponding upward motion in our stimuli, which could have invited participants to presuppose Manner from prior discourse. If this latter account is correct, it would imply that children at all ages were sensitive to discourse presupositions which made it possible for them to assume Manner from context rather than to explicitly mention it again in discourse. Research in progress presently addresses this question by presenting participants with stimuli showing UP and DOWN events separately. Discourse skills might also explain why a few omissions occurred with *down* since downward motion was much less important for the plot compared to upward motion which led characters to reach their goal (e.g. getting food).

Boundary crossing was the only event type to elicit Manner-only responses in both populations. It is possible that these events presented more difficulties than UP/DOWN events because they could imply different spatial planes (left-to-right, front-to-back, behind-to-front). This feature is particularly important for signers because of their use of a three-dimensional signing space (see Barberà 2014; Sümer 2015). Thus, signers tended to spend some time giving information about the scene as background for the subsequent expression of the target event. For example, with one item showing a girl riding a bicycle across railroad tracks (see Item 8 in Appendix), signers often explicitly represented the tracks on one plane (left to right) and the target event on another plane (from behind to front). As a result, they expressed only Manner for the crossing event because Path could be implied by preceding information.

6.3 Development

Our analysis shows several findings with regards to LSF acquisition. LSF invites children to express both Manner and Path from early on. Consequently, their responses show relatively little developmental change in how much motion information is expressed. As summarized above (Section 4), this result is in line with the patterns observed in spoken English (early frequent Manner+Path responses), but not in spoken French, which shows frequent Path-only responses and fewer Manner+Path responses, which increase strikingly with age.

Second, serial constructions in LSF were more frequent with crossing events than with other event types at all ages and increased with age, particularly with crossing events (up to half of adult responses). These constructions typically involved expressing different motion components (e.g. Path followed by Manner), thereby contributing to the general predominance of Manner+Path responses. The fact that they increased with age shows the gradual development of the ability to combine structures to mark different perspectives on the same event.

Third, we observed effects of event types on sign language not previously reported in the literature. Although Manner+Path responses were overall highly frequent in LSF, they increased with age for some events (DOWN and especially ACROSS). Furthermore, fine-grained analysis revealed that ST were more frequent than PT with vertical motion, while crossing events showed more variation with age (more ST than PT among adults, roughly equivalent use of ST and PT among children). In addition, these highly iconic structures highlight different motion components, particularly because PT invite particular attention to Manner. In this respect, note that both ST and PT are frequent at all ages in our sample unlike previous studies on the acquisition of sign languages (Slobin et al. 2003; Smith &

Cormier 2014; Tang et al. 2007) which indicate the late mastery of these structures (after 7–8 years, particularly ST and DT). Although more research is necessary, our findings clearly suggest that the use of highly iconic structures is not exclusively dependent on age during development. Divergent results may be due to the particular features of LSF as compared to other sign languages that have been studied. Note also that these other studies combined different populations of learners, while the present study included only signers with a specific profile, coming from Deaf families and had a bilingual education since early childhood (exposure to LSF from birth, then to written French from three years on).

Fourth, despite frequent Manner+Path expression at all ages, some developmental changes suggest gradual progress with a more complete motion expression with increasing age. The number of expressed components increases with age, and non-locative ST decrease. Such a result is similar to Sümer's (2015) findings that young children tend to omit grounds in Turkish Sign Language. Note that locative ST are complex on the articulatory level in that they require combining the dominant hand (Figure) and the non-dominant hand (stable locative expression). In addition, learning to provide spatial landmarks is a relatively late development among hearing children indicating increasing competence in organizing discourse cohesion (e.g. Hickmann 2003). Other aspects of the data combine to show a more general development of discourse skills such as the fact that children produced fewer Manner+Path responses when describing downward motion compared to upward motion in all languages examined.

7. Concluding remarks

This exploratory study of children's motion expression in LSF suggests this language invites signers to frequently express both Manner and Path from early on, notwithstanding developmental changes with some event types that may be more complex and require more conceptual and/or linguistic maturity than others. The role of iconicity was shown to take different forms depending on the structures used to express motion components. It is likely that iconicity highlights Manner because of Figure embodiment resulting in motion expression that typically includes this component (encoding both Manner and Path or Manner alone). Further research is in progress to determine more precisely whether Manner expression might differ in more subtle ways in sign vs. spoken languages, e.g. in terms of the variety and specificity of details that can be expressed about this motion component. Further studies with more participants and more languages are clearly necessary to directly compare sign and spoken languages.

Acknowledgements

This research stems from two projects (CREAGEST and LANGACROSS), financed by the French national funding agency (ANR).

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Appendix. Stimuli

UP/DOWN items

1. A squirrel runs up a tree, into and out of a hole, then down and away.
2. A caterpillar crawls up a plant to eat a leaf, then down and away.
3. A bear climbs up a tree to get some honey, climbs down, and walks away.
4. A cat runs runs up a telephone pole to a birds' nest, drops an egg, jumps down and runs away.
5. A mouse climbs up a table to take a piece of cheese, slides down, and tiptoes away.
6. A monkey climbs up a banana tree to take a banana, then slides down and walks away.

ACROSS items

7. A man runs across a country road and runs away.
8. A girl rides a bicycle across railroad tracks, then rides away.
9. A baby crawls across a street and crawls away.
10. A boy swims across a river and walks away.
11. A boy slides across a frozen river and walks away.
12. A girl skates across a frozen lake and walks away.

CHAPTER 18

Early predictors of language development in Autism Spectrum Disorder

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Although deficits in language are no longer considered diagnostic of Autism Spectrum Disorder (ASD), delays in language are among the earliest concerns noted by parents. By the time children with ASD enter school, their language skills vary widely from intact linguistic ability to no spoken language, though in all cases, communication is impaired and atypical. This chapter first reviews the research on the earliest behavioral and neural predictors of language in ASD based on studies that have prospectively followed infants who are at familial risk for ASD because they have an older sibling with the disorders. In the second part of the chapter research on behavioral predictors of language development in toddlers and preschoolers with ASD is presented. The gaps in the current literature and the clinical implications are discussed in the final sections.

Keywords: Autism Spectrum language, high-risk infants, impaired communication, event-related potentials, toddlers

1. Language in Autism Spectrum Disorder

Autism spectrum disorder (ASD) is diagnosed on the basis of impairments in social communication and the presence of repetitive behaviors and narrowly focused interests that become evident during the second or third year of life (APA 2013). Social communication impairments encompass difficulties with social-emotional reciprocity, developing and maintaining interpersonal relationships, nonverbal communication, and conversational skills. Although in the recently released DSM 5 language impairment is no longer included as a primary symptom in ASD (APA 2013), and indeed some individuals with ASD have intact structural language skills, the majority of people with ASD have language deficits that go beyond discourse and pragmatics. A minority of children fail to acquire spoken language skills, remaining minimally verbal even when high quality intervention has been available;

DOI 10.1075/tilar.22.19tag

little is known about this group of individuals as they have not been the focus of much research (Tager-Flusberg & Kasari 2013). At least half of all children with ASD who acquire spoken language lag behind their peers in developing structural aspects of language including phonological processing skills, vocabulary and grammar (Kjelgaard & Tager-Flusberg 2001). These delays and continuing deficits mirror what is seen in children with specific language impairment (SLI), however, even in ASD these deficits in structural language are not just secondary effects of impairments in social communication (Norbury 2013).

Some researchers have argued that children with ASD and language impairment have co-morbid SLI (Tager-Flusberg & Joseph 2003; Tomblin 2011), though this hypothesis remains controversial (Taylor et al. 2013; Williams, Botting & Boucher 2008). Nevertheless, for both groups of children there are parallels in the specific areas of language that are most impaired and they share similar patterns of atypical structural characteristics and organization for language in the brain (Ellis Weismer 2013; Tager-Flusberg & Joseph 2003). There are also shared genetic etiologies associated with ASD and language disorders, which may be relevant for understanding the behavioral and neural overlap in these complex disorders (Toma et al. 2013). Nevertheless, there are also important differences between ASD and SLI. First, while ASD is sometimes associated with loss of language during the second year of life, this is never found in SLI (Pickles et al. 2009). Second, in the domain of language there is, as noted, enormous heterogeneity in language outcomes in ASD that is not found to the same extent in children with SLI. It is this heterogeneity that makes ASD so much more complex at both the theoretical and clinical levels. Unraveling this complexity from a developmental perspective is one of the key concerns for current research given what is known about the efficacy of early intervention in facilitating language acquisition in this population (Tonge et al. 2014).

What are the developmental origins of these widely varying language phenotypes in ASD? This is the question that is addressed in this chapter in which I explore the behavioral and neural predictors of language in ASD. In the first half of the chapter I focus on studies that have followed infants over the first three years of life in prospective longitudinal studies of children who are at high risk for developing ASD, including studies that my colleagues and I have conducted on the neural foundations for early language development. Investigations of this earliest period of development provide us with clues about the precursors of later language acquisition in this developmentally vulnerable population. In later parts of the chapter I summarize work that has followed toddlers diagnosed with ASD, with particular emphasis on behavioral predictors of the course of language development. The goal is to evaluate how early we can predict later language deficits in ASD and on identifying which factors are the most sensitive in forecasting such deficits.

1.1 Infants at risk for ASD

ASD is a complex and highly heritable disorder, as shown by research on twins and families (Sandin et al. 2014). Siblings of children already diagnosed with ASD are significantly more likely to meet criteria for the disorder compared to children in the general population where the risk is estimated to be between 1%–2% (Christensen, Baio, Braun et al., 2012). Current estimates for younger siblings range from 10% – 20%, with higher rates reported for clinically ascertained families (Messinger et al. 2015; Ozonoff et al. 2011; Sandin et al. 2014). Based on these risk recurrence rates for younger siblings, there has been a recent surge in research focusing on this group who can be followed from early in infancy, with the goals of identifying the earliest risk markers for ASD and tracing the developmental trajectories for those infants who are later diagnosed with ASD (Zwaigenbaum et al. 2007). In these studies, infants are recruited very early in life, usually by six months, and then followed longitudinally until a clinical diagnosis of ASD can be objectively confirmed, by age two or three. These high-risk infants are compared to a group of low risk infants who have an older typically developing sibling and no familial risk for ASD. One can also recruit families during the prenatal period, thus broadening the scope of risk factors to include prenatal exposures and relevant perinatal information (Newschaffer et al. 2012). It would be ideal to compare infants at risk for ASD to infants at risk for other neurodevelopmental disorders such as attention deficit hyperactivity disorder or specific language impairment to evaluate whether the risk factors identified for ASD extend to other disorders (Johnson, Gliga, Jones & Charman, 2015). To date, however, most published studies have limited comparisons of infants at risk for ASD to low risk controls.

There are now many research groups who have begun studying these so-called ‘infant siblings’ taking different approaches and employing a wide range of standardized and experimental measures that might serve to address the primary goals of this broad research agenda (for review, see Jones, Gliga, Bedford, Charman & Johnson 2014). Under the auspices of the organization *Autism Speaks*, these investigators have formed a consortium, the Baby Sibling Research Consortium (BSRC), to allow for greater collaboration, especially in pooling data collected using common behavioral measures. Findings from the BSRC provided the strongest evidence for the relatively high risk recurrence rates for ASD in younger siblings – almost one in five – who have been closely followed during infancy (Messinger et al. 2015; Ozonoff et al. 2011). In the BSRC sample, among the high risk siblings who did not develop ASD, about one in five had higher levels of autism-related behaviors or lower levels of developmental functioning, including language, cognitive, or motor development (Messinger et al. 2013). These behavioral differences observed in some siblings are evidence for the early emergence of the *broader autism phenotype* (see also Ozonoff et al. 2014), which refers to the presence of milder expression of autism-related traits, including language, in relatives who do not themselves have ASD (Sucksmith et al. 2011).

Studies of risk markers among infant siblings have demonstrated that during the first year of life there are few, if any, behavioral differences between high and low risk infants, even in those who are later diagnosed with ASD (Tager-Flusberg 2010). By 12 months, behavioral risk markers can be observed particularly during standardized evaluations of social, communicative and cognitive functioning. However, no single behavioral abnormality is strongly predictive of ASD outcomes (Zwaigenbaum et al. 2005). Instead, at this age only the presence of several different subtle co-occurring behavioral problems (e.g., visual tracking and disengagement; eye contact; social interest and smiling; orient to name; emotional reactivity) distinguish those infants who later are diagnosed with ASD from low risk controls in observational assessments carried out by trained experts. The second year of life is when ASD emerges more clearly. During this period, alterations in the developmental trajectories of key social communicative behaviors differentiate ASD outcome infants from low risk controls, including declines in frequency of eye contact and socially directed smiling and lack or slowed growth (relative to controls) in volubility, cognitive and language development (Landa et al. 2012; Ozonoff et al. 2010). Indeed, a hallmark feature of ASD appears to be *alterations* in early developmental trajectories not only in social communication, but also in other behavioral domains.

1.2 Development of language in infants at risk for ASD

It has long been known that delays in language are among the first and most significant concerns raised by parents whose children are later diagnosed with ASD (Tager-Flusberg et al. 2011; Talbott et al. 2015a). Studies confirm that lower language scores on standardized measures are evident for later diagnosed infant siblings at either 12 or 18 months (Landa & Garrett-Mayer 2006; Mitchell et al. 2006). Reduced rates and atypical patterns of vocal production may even be observed in some infants during the first year of life (Macari et al. 2012; Paul et al. 2010; Patten et al. 2014; Sheinkopf et al. 2012). These unusual features include high pitch but poorly phonated pain-related cries, lower rates of consonants in babbling and atypical intonation. Nevertheless, not all infant siblings later diagnosed with autism exhibit delays or deficits in language (e.g., Hudry et al. 2014; Talbott et al. 2015b), highlighting the variability in early structural language profiles that foreshadow the variability found among toddlers and older children with ASD. In contrast, impairments in communication are universal among children with ASD. One study followed a group of high risk infants from the age of 8 months and found that by 12 months there were already significant differences in early gestural communication, and particularly in the coordination between gesture and vocalization in those infants later diagnosed with ASD (Parladé & Iverson 2015), demonstrating the importance of exploring the functional aspects of language in these infants

1.3 Early behavioral differences in high risk infants

During the first year of life infants show marked preferences for particular speech patterns. Curtin and her colleagues investigated whether infants at risk for ASD show the same kind of preferences. For example, in one study they investigated five month old infants' preferences for particular syllabic stress patterns in infants growing up in English-speaking homes (Ference & Curtin 2013). The low risk control infants showed the expected preference for the strong-weak pattern that is characteristic of English, demonstrating that these infants attended to and preferred their native language lexical stress patterns. Moreover their degree of preference correlated with receptive vocabulary assessed at 12 months. In contrast, the high risk infants showed no preferences at five months and their attention to lexical stress was not related to later language outcomes. In another study Curtin and Vouloumanos (2013) found that at 12 months of age, while both high and low risk infants preferred speech over non-speech, there was more variability among the high risk infants. In a third study, the same researchers investigated preferences for infant-directed speech over adult-directed speech and for faces over abstract patterns (Droucker, Curtin & Vouloumanos 2013). Again, both groups showed the expected preference patterns but the differences between stimuli were smaller among the high risk infants. For this group only, the degree of preference was related to expressive language at 18 months. Together, these studies demonstrate that, during the first year of life, high risk infants show relatively weaker attention to and preference for foundational aspects of language and social information, which has subtle consequences on their development of language. Importantly, these findings are not only related to ASD outcomes but may be precursors to the broader autism phenotype.

A few studies have investigated auditory-visual integration in high risk infants. For example, Giraud and colleagues compared looking patterns in a McGurk paradigm in 9 month old high and low risk infants (Giraud et al. 2012). The infants were presented with two faces side-by- side saying /ba/ or /ga/. One face was congruent with the sound, one was incongruent. Low risk infants looked longer at the incongruent face when the sound could not be fused to form a McGurk percept. No differences in looking time were found among the high risk infants, indicating their relative difficulty in matching auditory and visual information related to speech. Shic and his colleagues also investigated looking behavior in younger, 6-month-old infants who were shown static faces, dynamic smiling, or speaking faces (Shic, Macari

& Chawarska, 2014). In this study reduced looking behavior to the face, especially in the speaking condition, was related to ASD outcomes suggesting that there may be early disturbances in processing social communication in high risk infants.

1.4 Behavioral predictors of language

Several studies have investigated behavioral precursors of language and ASD outcomes in high-risk infants. The most consistent and replicated finding is that the emergence of communicative gestures at around 12–18 months is delayed and more limited in infants later diagnosed with ASD (Chawarska et al. 2014; Leezenbaum et al. 2014; Mitchell et al. 2006; Talbott et al. 2015b). In particular, reduced or absent pointing to show interest is a significant predictor of ASD, underscoring the importance of monitoring early joint attention gestures in this population (LeBarton & Iverson 2016).

Several studies of motor development have found delays in high risk infants during the first year of life. For example, in a small group of high and low risk infants, delays in motor development were observed between three and six months of age, which were related to later language development at 18 months (Bhat, Galloway & Landa 2012). Other studies have also reported early delays in gross and fine motor skills among high risk infants (Leonard et al. 2014; Libertus et al. 2014; Nickel, Thatcher, Keller, Wozniak & Iverson, 2013). Delays in the emergence of fine motor skills during the second year of life were related to expressive language in high-risk infants, but were not specific to those infants who later developed ASD (LeBarton & Iverson 2013). Only one study investigated imitation skills in high risk infants. Delays in the ability to imitate manual and oral actions during an elicitation task between 12 and 24 months were found in high risk infants and were correlated with expressive language (Young et al. 2011). However, there were no differences between the infants later diagnosed with ASD and those who were not, suggesting that imitation delays are not specifically predictive of ASD outcomes. Taken together, these studies suggest that language and associated precursors may form part of the early emerging broader autism phenotype as they are found in a subgroup of high risk infants. These findings also underscore the interdependence of motor, gesture, and vocal development that is the foundation for language across all infants (Iverson 2010). Future studies need to consider whether broader measure of motor functioning, such as motor planning or anticipatory intentional actions, and spontaneous imitation in naturalistic contexts provide an even richer picture of early predictors of language and social functioning in high risk infants.

1.5 Neural foundations for speech in infant siblings

One of the goals of the collaborative infant sibling project between Boston University and Children's Hospital Boston, directed by Charles Nelson and me, is to investigate the early development of brain mechanisms underlying speech and language development in high risk infants. We explored the neural foundations for speech development during the first year of life when infants become attuned to the phonology of their native language and no longer discriminate speech sounds from other languages. This phenomenon of 'perceptual narrowing' which marks a key stage in early language development is associated not only with behavioral changes in response to phonemes, but also to brain reorganization that takes place in the context of social interaction (Kuhl 2010).

We employed a paradigm developed by Kuhl and her colleagues (Rivera-Glaxiola et al. 2005) using electrophysiological methods (EEG and event-related responses, ERPs) to probe the development of neural responses to speech in six, nine and twelve month old high and low risk infants (Seery et al. 2013). Infants were seated on their mothers' lap and kept calm and occupied with either a silent video or observing someone blow bubbles. They heard a series of speech sounds in random order: a repeated standard /da/ (played 80% of the time), a native contrast /ta/ (on 10% of trials) and a non-native contrast /ḍa/ (on 10% of trials), which is phonemic in languages such as Bengali. Our main findings were that there were no group differences in the development of perceptual narrowing: both high and low risk infants, regardless of their eventual outcomes, discriminated the non-native contrast from the standard at six and nine months (based on significant differences in the amplitude of the ERP elicited at around 150–300 milliseconds post-stimulus onset), but no longer discriminated these sounds at twelve months (Seery et al. 2013). In follow up analyses, we investigated group differences in the amplitude of this ERP, the so-called P150 to the repeated presentation of the standard /da/ (Seery et al. 2014). Overall, the high risk infants at nine months had significantly higher amplitudes to the standard compared to the low-risk infants. Moreover, for this group only, the amplitude of the P150 at nine months was significantly correlated with expressive language assessed at eighteen months. These findings may reflect enhanced attention that some of the high risk infants (including some with ASD outcomes) paid to the speech stimuli that supported their language development and may be an early maker of enhanced perception of speech found in older, highly verbal children with ASD (J Järvinen-Pasley, Wallace, Ramus, Happé & Heaton 2008).

Later components of the ERP response to speech sounds, the so-called late slow wave, are sensitive to hemispheric differences in speech processing in posterior brain regions. For the low risk control infants, we found significantly higher amplitude of the late slow wave in the left hemisphere compared to the right hemisphere response at nine and again twelve months. In contrast, no hemispheric differences were found at any age in the high risk infants, suggesting a failure to develop a left lateralized response to speech among high risk infants (Seery et al. 2013). This atypical lateralization was not related to later language, though the infants who developed ASD had significantly higher amplitude responses in the right hemisphere at twelve months.

In a final set of analyses of these speech data we investigated functional connectivity between frontal and posterior language regions in the infants at six and twelve months (Righi et al. 2014). In typical adults these regions are highly synchronized in their activation to speech and language stimuli, as they form part of an integrated neural network for processing language. For this analysis we measured functional connectivity using 'linear coherence' in the gamma frequency band of the EEG signal. Linear coherence is an index of how correlated the EEG signals are, which we measured between electrodes placed over frontal and temporal-parietal language regions in the left and right hemispheres. We found no group differences in linear coherence at six months, however at twelve months linear coherence was significantly higher in the low risk infants compared to the high risk infants. The group of infants who later developed ASD had the lowest levels of linear coherence suggesting relatively weak functional connectivity between frontal and posterior language regions responses to speech.

Taken together, the findings from our project point to several important differences between high and low risk infants in early brain development. As a group, the neural responses from high risk infants to repeated speech stimuli are higher in amplitude which may be an indication of more focused attention to speech. Importantly for this group, higher amplitudes at nine months predicted better language outcomes at eighteen months. We also found differences in the early development of brain lateralization for language. In contrast to the low risk control infants, high risk infants who do not develop ASD fail to acquire a left-lateralized response to speech even by twelve months; a more extreme right lateralized response was found in the infants who were diagnosed with ASD at 36 months. Finally, the high risk infants had lower functional connectivity at twelve months, but this too was not related to later language. Further research is needed to explore whether as these infants get older they develop a more typical profile (left lateralization; higher functional connectivity) which would suggest that the findings summarized here represent more of a delay than an atypical pattern of brain functioning.

1.6 Toddlers with ASD

Several research groups have studied the early development and behavioral predictors of language outcomes in young children with ASD. One of the most robust factors that predicts language levels in ASD is nonverbal cognitive ability (Tager-Flusberg et al. 2011), usually measured on the Mullen Scales for Early Learning (Mullen, 1995) using either the visual reception scale alone, or combined with the fine motor scale. For example, Anderson and colleagues followed a group of children with ASD from when they were first diagnosed at age two until the age of nine, at which point the children had a wide range of language abilities (Anderson et al. 2007). In their study visual reception scores were the best predictor of language outcomes. Other important factors that have been found in longitudinal studies of preschoolers include ASD severity, which has a negative impact on language acquisition, and joint attention skills (e.g., Charman et al. 2003; 2005; Ellis Weismer & Kover 2015). For minimally verbal children, the combination of nonverbal cognition (using the combined visual reception and fine motor scores on the Mullen) and symptom severity in the social domain were the strongest predictors of language change in the later preschool years (Thurm et al. 2015).

2. Predictors of language outcomes in toddlers with ASD

Several years ago, in collaboration with Alice Carter at the University of Massachusetts-Boston, we embarked on a large-scale study of 164 toddlers with ASD who we followed from the age of two (18–33 months at entry to the study) to age four, with annual evaluations of both the children and their parents. Diagnoses of ASD were confirmed using the Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview (ADI). Each year we assessed the children's receptive and expressive language using several measures: the language subscale of the Mullen Scales of Early Learning, the MacArthur-Bates Communicative Development Inventories (MCDI) and the Vineland Adaptive Behavior Scales. Scores on these measures were all highly inter-correlated (Luyster et al. 2008). When they began the study, the toddlers had widely varying language levels: their age equivalent scores on the Mullen, for example, ranged from 3 months to 45 months; standard scores ranged from a floor level (below 20) to 118. Thus, this cohort of toddlers represented the full range of language levels found among older children with ASD.

Drawing on the literature on early development of language in typically developing children and children with language disorders, we selected a set of factors that we hypothesized would be related to language ability in our toddlers with ASD. Our factors included chronological age, nonverbal cognitive ability (measured on the visual reception scale of the Mullen), initiate joint attention and response to joint attention (both measured using the Early Social Communication Scales; Mundy & Hogan 1996), elicited imitation of manual, oral-facial, and object actions (measured on the Rogers' battery; Rogers et al. 2003), functional/symbolic play (measured on the ADOS), communicative gestures (reported by parents on the MCDI), and fine and gross motor skills (measured on the Mullen and Vineland).

We created composite receptive and expressive language scores by combining the children's scores on the three language measures: Mullen, MCDI and Vineland. Not surprisingly, we found that *all* the factors were highly correlated with both receptive and expressive language (Luyster et al. 2008). We then used hierarchical regression models to identify which factors were the best predictors of concurrent receptive and expressive language. For receptive language, communicative gestures, nonverbal cognitive ability and response to joint attention all contributed unique variance, together accounting for 60% of the variance. For expressive language, gesture, nonverbal cognitive ability and imitation were the factors that were most significant, together accounting for 46% of the variance (Luyster et al. 2008).

One year later, at age three, we again assessed language using the same measures as the previous year for 109 toddlers on whom we were able to complete data collection. During this time, all the toddlers had been enrolled in high quality intensive early intervention, for an average of 20 hours per week. Most of the toddlers made significant gains in receptive and expressive language, which is consistent with what is known about the importance of early intervention for children with ASD (e.g., Dawson & Bernier 2013; Schreibman et al. 2015). Among our toddlers, even at age two, 10 children already had language scores at age level on the Mullen; another 70 made gains of 5 standard score points or more on the total language scale while 29 children (almost 30% of the children with low language) made no gains or had lower standard scores at follow up.

We investigated longitudinal predictors of the toddlers' combined receptive and expressive language scores using the same set of factors that had been collected when they were two and now adding in their language score from the previous year. In the regression model, we found that earlier language was the best predictor, accounting for 55% of the variance; age and communicative gestures each added unique variance, and together these factors explained 74% of the variance in language among three year-olds with ASD.

These findings suggest that very early language is itself an important predictor of language by age three. Nevertheless, within this cohort of toddlers with ASD some who had very low language at age two made very significant gains over the course of the following year, while others did not. This latter group remained minimally verbal, with Mullen scores still at the floor of the measure. We explored which factors distinguished between these groups. We selected from the toddlers who returned at age three, 50 children who at age two had very low (floor) levels of receptive and expressive language on the Mullen. This group was divided into two groups of 25 toddlers: the first made very significant language gains by age 3 (an increase of 20–30 standard score points on the Mullen), while the second group made no gains. We compared their scores on a range of measures collected at age two to identify which ones significantly discriminated between these groups. Those children who did not make gains in language and were still minimally verbal at age three had lower nonverbal cognitive ability, motor skills, imitation, and social adaptation scores on the Vineland. On a parent retrospective report measure of early milestones (Gernsbacher et al. 2008), 10 of the 25 parents of minimally verbal three year olds recalled that their children had significant delays in the onset of vocalization and babbling.

Many of our findings echo what has been reported in other studies of early language development in ASD. At the earliest ages, toddlers diagnosed with ASD vary widely in their language abilities and in their development across many behavioral domains. In our study we had the advantage of having robust measures of many different aspects of developmental functioning in a large cohort of rigorously diagnosed toddlers. All the factors that we assessed in our sample were significantly correlated with both receptive and expressive language. As in other studies that searched for the most significant predictors, nonverbal cognitive ability was an important concurrent and longitudinal predictor of language outcomes in ASD. In our study, gesture was a second strong independent predictor, although we note that many other studies in this area did not include measures of gesture. Perhaps gesture is so strongly linked to language because they share deep connections both at the conceptual level and with respect to neural underpinnings (Goldin-Meadow 2014; Iverson 2010). Moreover, from a developmental perspective, the emergence of gestural communication and first words are closely linked, at the temporal level both for the child (Bruner 1974; Capirci, Contaldo, Caselli & Volterra 2005; Tomasello 2003) and in relation to maternal input (Rowe & Goldin-Meadow 2009). Finally, gesture incorporates or overlaps with several of the other factors we included in our study including joint attention and motor skills. It is also an important component of social communication, which was found to predict language in several other studies of young children with ASD (e.g., Thurm et al. 2015; Ellis Weismer & Kover 2015).

3. Conclusions

A great deal of progress has been made in recent years in understanding the early course of language development in ASD. The research summarized here highlights the fact that the foundations for heterogeneity in language outcomes are laid down very early in development, even before the full onset of the behavioral symptoms that define ASD. Atypical behavioral and neural responses to speech and language are evident in infants at risk during the first year of life. Early vocal productions may be one the first signs of ASD that can be observed. Studies of toddlers diagnosed with ASD reveal the close connections between the acquisition of language and social communicative and cognitive development that already may predict later language outcomes. This work suggests that even though language itself is no longer a diagnostic feature of ASD (cf. APA 2013), it remains an important bellwether of ASD severity and long-term outcomes.

Despite the progress that has been made, there are still several key gaps in the research. First, it is still not known whether the early foundations that have been found for ASD are specific to this population or whether they extend to other disorders in which language is impaired that may or may not overlap with ASD. We need to investigate infants at risk for other neurodevelopmental disorders in order to figure out the specificity of the factors that were reported earlier in this chapter. We also do not know whether some of the atypical early behavioral and neural responses found in infant siblings would extend to other infants at risk for ASD, specifically infants who do not carry the inherited genetic or related familial risk factors. For example, would infants who are born prematurely, or who have other perinatal risk complications, or who fail ASD screening at 12 or 18 months, show the same atypical patterns in early language that have been found in infant siblings?

We know little about the later development in high risk infants of the neural foundations for language that we found during the first year of life. Does atypical lateralization and connectivity eventually resolve, at least for those infants who are not later diagnosed with ASD, or do they remain part of the broader autism phenotype? Only one published study has reported on neural responses to language in toddlers diagnosed with ASD. Kuhl and her colleagues found that atypical response to known and unknown words in toddlers with ASD was a significant predictor of language outcomes at age 6, even among children who were enrolled in a highly effective early intervention program (Kuhl et al. 2013). Their findings support the view that the foundations for language in ASD are laid down very early in development and that these neural responses may be potential biomarkers for language in ASD.

Finally, we need more research to follow up on infants at risk for ASD to capture predictors of the most adverse language outcomes. So far we have no data on infants who later remain minimally verbal. None of the ASD outcome infants in our study, for example, had very low or absent language by the age of three. Perhaps one reason why all our infants had relatively good language outcomes is because we referred them to early intervention at the earliest signs of ASD. Indeed, two recent studies have demonstrated the efficacy of providing intervention to symptomatic infants at risk, even before the full onset of ASD (Green et al. 2013; Rogers et al. 2014).

Thus, these lines of research are already leading to important clinical applications. Our goal is to capture the earliest emergence of ASD symptoms. It seems clear, based on the research summarized here, that focusing on the early development of language and communication will provide important clues about when and how ASD develops. Ultimately this work will lead to opportunities for offering targeted interventions that will keep infants on the developmental pathway to optimal language and social communicative outcomes.

Acknowledgements

Preparation of this chapter was supported by grants from NIH/NIDCD (RO1 DC 10290; RO1 DC 11339; P50 DC 13027).

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CHAPTER 19

Spoken and written narratives from French- and English-speaking children with Language Impairment

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Children with Language Impairment (LI) show significant delays in spoken language development with persistent problems in morphology. In this chapter, we compare spoken and written narratives from children with LI and their typically developing peers (TD) in French and English. We investigate the role of modality (spoken and written language), and the contribution of language-specific factors (French and English) to the LI phenotype. We found that both French and English LI groups exhibit problems with morphology; however, they use complex syntax strategically to bring coherence to their stories. Moreover, both LI and TD children are sensitive to the pragmatic and rhetorical conventions of their linguistic communities. Our findings increase our understanding of the nature of LI, and how language-specific features and culture might affect this profile.

Keywords: language impairment, narrative, French, English, spoken and written language, morphology, complex syntax, cross-linguistic comparison

1. Introduction

Children who are typically developing have mastered the majority of language structures in their native language by about age five (Slobin 1996), and from this point on, spoken language development includes increasing vocabulary, using a wider array of complex syntax and gaining skill in using these structures for

DOI 10.1075/tilar.22.20rei

divergent discourse goals. However, for children with Language Impairment (LI), early language emergence is often delayed, and acquiring their native language is slow and challenging. Those diagnosed with LI at age five often show subtle deficits in spoken language even into adolescence (Edmundsen & Bishop 1987). The profile of spoken language development in English speaking children with LI has been extensively studied (e.g., Bishop 1997; Conti-Ramsden & Botting 1999; Evans, Saffran & Robbe-Torres 2009; Leonard 1998; Rice, Wexler & Cleave 1995; Marchman, Wulfeck & Ellis Weismer 1999) and there is a developing literature on their writing as well (e.g., Dockrell, Lindsay, Connelly & Mackie 2007; Fey, Catts, Proctor-Williams, Tomblin & Zhang 2004; Gillam & Johnston 1992; Scott & Windsor 2000). As a group, studies consistently report that these children produce less speech/text and use less complex syntax than their TD peers, and they also tend to struggle with morphology.

In contrast to the extensive literature on language development in English speaking children with LI, there are few studies investigating language in children with LI who are learning French as their native tongue (Broc, Bernicot, Olive, Favart, Uzé & Reilly 2013; de Weck & Rosat 2003; Leonard 1998 stand as exceptions). Most of these studies focus on spoken language in preschoolers, and therefore do not consider differences in later-acquired linguistic structures such as complex syntax and some aspects of morphology. Particularly in the area of morphology, French offers an interesting contrast to English. Whereas the inflectional morphology of English is impoverished, French has a rich nominal and verb morphology. However, in spoken French some of these morphological contrasts (especially in the verb morphology) are silent; they are only apparent in written French. For example, the two utterances, *ils parlent vite*, [they speak quickly] and *il parle vite* [he speaks quickly] sound identical. The derivational morphology of French is also quite rich: approximately 75% of the French words known by an individual are morphologically complex (Rey-Debove 1984), whereas 60% of English words are complex (Nagy & Anderson 1984). Similarly, around 170 suffixes can be found in French, in contrast to the 50 found in English (Crystal 2003). Therefore, word formation in French relies more on derivation than on compounding as English does. According to Duncan, Casalis and Colé (2009) this difference presumably explains why French children have more morphological knowledge, and particularly morphological awareness, than English children.

In a recent chapter (Reilly, Bernicot, Olive, Favart, Wulfeck & Appelbaum 2014;), we looked at written narratives of children with Language Impairment and typically developing children (aged 7–16) who spoke either French (living in France) or American English as their first language. We found differences according to neurodevelopmental status, language and age. Specifically, the French speaking children (both TD and LI groups) made more morphological errors than their

English speaking counterparts. As noted above, however, French presents unique morphological particularities in that the French morphological system is not only highly complex, but its inflectional morphology is often silent. Thus, while previous results suggest that written morphology presents a particular challenge for French speaking school age children, it is not clear how this finding will manifest in spoken language. In this chapter we will investigate spoken narrative performance from this same group of school-age and adolescent children and compare it to our earlier findings from their written texts. This comparison will provide an opportunity to better understand the nature of Language Impairment, the role of modality (that is, spoken and written language), as well as the contribution of language-specific factors (French and English) to the LI phenotype. To provide context to our data, we first present a brief review of French and English morphology, and some thoughts on relations between spoken and written language.

As noted above, French, a Romance language, has a rich and complex inflectional morphological system in which nouns are marked for gender (masculine/feminine) and number (singular/plural), and the determiners and adjectives modifying those nouns also agree in number and gender (e.g., *la grande fille [the big girl]*; *le grand garçon [the big boy]; les grandes filles [the big girls], les grands garçons [the big boys]*). Modern English is indeed considered a less inflected language than French, which has more overt inflection, especially in verb conjugation. With verb forms, English has only three inflected forms for the past indicative and subjunctive (*worked*), the third-person-singular present indicative (*works*), the present participle (*working*), and an uninflected form (*work*). By contrast, in French, verbs are inflected for number, person, tense and voice. Specifically, three persons are identified in French (in the singular, I- *je*, II- *tu* ,III- *il/elle*, respectively *I*, *you* and *s/he* in English), and two numbers (singular and plural), which together correspond to six verbal forms. Four modes and different tenses that refer to past, present or future actions or events are further distinguished by different verb forms. For example, in *je regardais* [I was looking] the *-ai* plus the *-s* indicate the imperfect indicative at the first person singular, and in *ils regarderaient*, the *-ai* and *-ent* added to the infinitival form refer to the conditional present at the third plural form. It is worth noting that the verb inflections for marking different modes and tenses change the root word by suppressing the infinitive mark *-er* to the word *regarder* but require keeping this marker for the conditional present. It must also be noted that there are three groups of French verbs, each group inflected with specific rules and suffixes. In addition, the pronominal system is complex, marking person, number and case; object and reflexive clitics are preverbal. In contrast to the rich morphology of French, English, which is a Germanic language, has lost most of its inflectional morphology (although plural is still marked for nouns, and verbs have a third person singular -s in the present tense), and the many irregular verbs of English can be challenging. Rather than the complex system of verb endings of French, English uses the unmarked verb stem in tandem with modal verbs, e.g., *will, would* to express such tense distinctions. Also in contrast to French, in English the morphology is phonologically realized whereas in French some of the inflectional morphology is silent, especially in distinguishing third person singular and plural pronouns and verbs. This diminished phonological differentiation between some inflectional morphemes in French makes learning to write a particular challenge for French speaking children, and we predict the complex spoken morphology of French will also play a role.

Typically, infants are first exposed to their native language at about the fifth month of gestation when they can hear their mother's (and others') speech; comprehension of their first words is apparent about nine months after birth, production at 12, and first simple two word sentences emerge at about 20–24 months. Morphology develops, as does complex syntax, during the third year. With respect to writing, even before formal instruction begins, preschoolers can distinguish written language from drawing (Tolchinsky 2003). This demonstrates some rudimentary knowledge of writing conventions, but it is not until about age five that formal writing instruction begins, and by this age, children are relatively competent speakers of their native language. Written language is generally considered to be a graphic representation of the earlier developed spoken system, though with important differences. Spoken language is an almost immediate vehicle for thought, and unfolds in real time, whereas the writer has time to plan, execute, and revise. In spoken discourse, the interlocutors have perceptual access to the surrounding environment, but writing is de-contextualized; in fact, the writer may not even know his or her audience, and thus must provide sufficient context for comprehension. Different muscle systems are recruited for spoken and written discourse, as well as some overlapping and unique brain areas, such as the visual word form area. While much has been written about the relation of these two modalities in adults (e.g., Chafe 1994), the relationship is less well understood in children. Because of the significant discrepancy in the development of these two systems, the relations may well change over development and differ across languages and neurodevelopmental groups. In sum, we are interested in how language (French/English) and modality (spoken/written) influence the phenotype of language development and impairment, and how these relations change with age.

2. The narrative study

For this study, participants were asked to tell a story about a conflict or a time when someone had made them sad or angry. After completing the story, the English group was immediately given pencil and paper and asked to write down the story; the French group completed the two tasks in separate sessions.

In Reilly et al. (2014) we reported the results of the written stories; here we look at the oral narratives and compare them to our previous findings on the written texts.

The participants included 17 French speaking children and adolescents with LI and 31 age-matched TD, as well as 32[1] American English speakers with LI and 60 TD (all aged 7–16). To investigate developmental change, children were divided into two groups: ages 7–11 years and 12–16 years. In both language communities, children with Language Impairment were diagnosed by local speech language pathologists. The criteria for inclusion in the LI group included a significant language impairment in oral language in the absence of hearing impairment, frank neurologic deficits (seizure, CP, stroke), or significant social/emotional disorders. The child needed to have a non-verbal IQ score above 80, as well as score 1.5 or more standard deviations below the mean on a standardized language test of oral language (e.g., CELF-R).

As in our analyses of their written texts, we looked at a variety of linguistic indices in children's spoken narrative: the length of their narratives, the nature and rate of morphological errors, and finally, the use and types of complex syntax. Length was determined as the number of clauses, with a clause defined as a verb and its arguments. Morphological errors were both errors of commission and omission and included, for example, errors in number and gender agreement, subject-verb agreement, and verb tense. To evaluate morphological performance, the total number of errors was divided by the total number of clauses to yield a proportion of errors. To evaluate the frequency of complex syntax, the total number of complex sentences was divided by the total number of clauses to create a proportion of complex syntax. Complex sentences were defined as utterances including more than one verb, and multiclausal utterances within a sentence intonation contour; these included, for example, clefts, verb complements and relative clauses, as well as utterances with coordinate and subordinate connectors. Finally, to understand the diversity or richness of syntax, we created a measure of syntactic depth (cf., Reilly, Wasserman & Appelbaum 2012 for more detail). For this measure, different types of complex sentences were differentially weighted according to complexity based on acquisition studies. For example, coordinate and verb complement sentences which appear before age 3 received 1 point for each occurrence, whereas each subject relative clause which is a later acquisition received 4 points (Appendix A depicts the

1. Two of the children with LI who produced spoken narratives could not write stories.

coding system). The total was divided by the total number of complex sentences in the story. Syntactic depth assesses the degree to which a child recruits such structures in his or her narrative. Coding was completed by a native speaker for each data set, followed by one coder (bilingual) reviewing the coding of both data sets.

3. Analysis and results

All the results reported below stem from the use of a three factor (population, language, age) non-orthogonal ANOVA with all orders of elimination considered (Appelbaum & Cramer 1974). Only (and all) statistically significant results are reported below. In the text the observed means are reported (rather than the fitted means).

3.1 Length

As measured by the total number of clauses produced, **length** is a reasonable measure of quantity of talk; consistently across studies, those with LI tend to produce less language as a group than their TD counterparts. In their written narratives, this was the case for the English, but not for the French speaking group, where there was no significant difference in length of written text between TD and LI groups (see Figure 1a). Considering the spoken texts, the LI groups spoke less than their TD peers in both language groups (Figure 1b) [$M_{li} = 13.7$, $M_{td} = 27.4$; $F_{(1, 132)} = 16.48$; $p < .001$] and adolescents had longer spoken stories than school aged children [$M_{adol} = 27.4$, $M_{school} = 19.1$; $F_{(1, 132)} = 5.59$, $p = .02$].

When we compare the results across modalities, the two groups show distinct profiles in terms of the difference between spoken and written production [$F_{(1, 134)} = 10.02$; $p = .002$]. The children in the TD group showed longer spoken than written narratives, with an average difference of 16.2 propositions between the two. The children in the LI group also demonstrated longer spoken than written narratives, but the average difference between the two modalities was only 7.42 propositions. There was no overall difference in length of spoken narratives between French and English speaking children, nor was there an interaction between Population and Language. Thus, in all cases, children are telling longer stories than they are writing. Several factors may contribute to this finding: first, writing is a newer skill and thus more challenging, especially for the younger children; and second, in writing, one has the time to reflect and plan. As such, the texts are more succinct than their spoken counterparts.

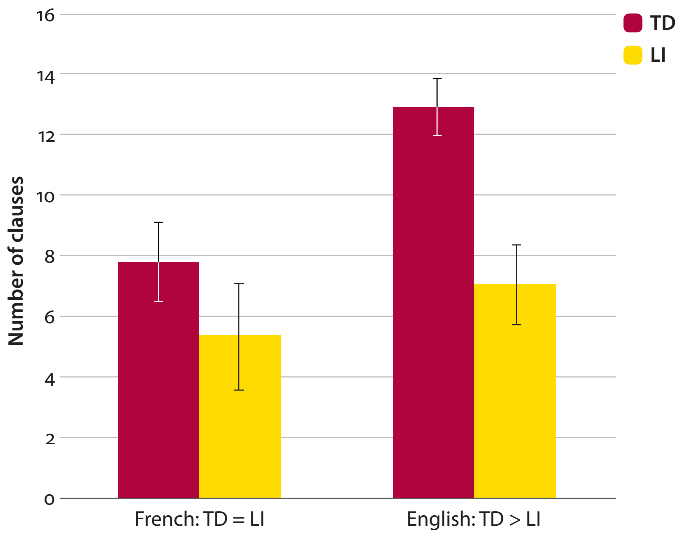

Figure 1a. Length in clauses for written narratives

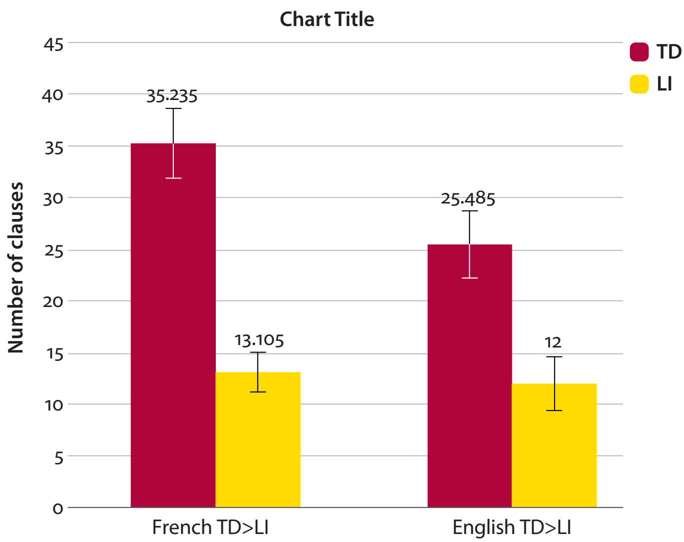

Figure 1b. Length in clauses for spoken narratives

3.2 Morphology

The vast majority of studies with children with LI have noted their struggles with spoken morphology (see Leonard 1998 for a review); however, as they get older, this group generally improves and makes fewer morphosyntactic errors in their spoken discourse (e.g., Reilly et al. 2004). When we looked at their written texts, we found that both English and French speaking children with LI made significantly more errors than their TD peers, and that the French groups (both TD and LI) made proportionally more errors than their English speaking counterparts (see Figure 2a), as was predicted based on the complex inflectional system of French. When we focused on their spoken narratives, we found that again the LI groups make more errors than controls [M_{li} = .30 and M_{td} = .049; $F_{(1, 132)}$ = 49.9, $p < .001$], and that the French speakers again make proportionally more errors than their English speaking counterparts [M_{Fren} = .22 and M_{Eng} = .09; $F_{(1, 132)}$ = 12.16, $p < .001$] (Figure 2b), with the French LI children showing the most morphological errors. Due to persistent problems with morphology in children with LI, we also split the groups by age (7–11 and 12–16 years) to look at development. We found that all groups perform better with age [$M_{Ado\ 1}$ = .08 and M_{School} = .17; $F_{(1, 132)}$ = 5.96, $p = .016$], but for those with LI, morphology continues to be a challenge, especially for the French children (see Figure 2c). However, it is important to note the high levels of variability, especially in the French LI group, and to recall the small sample size.

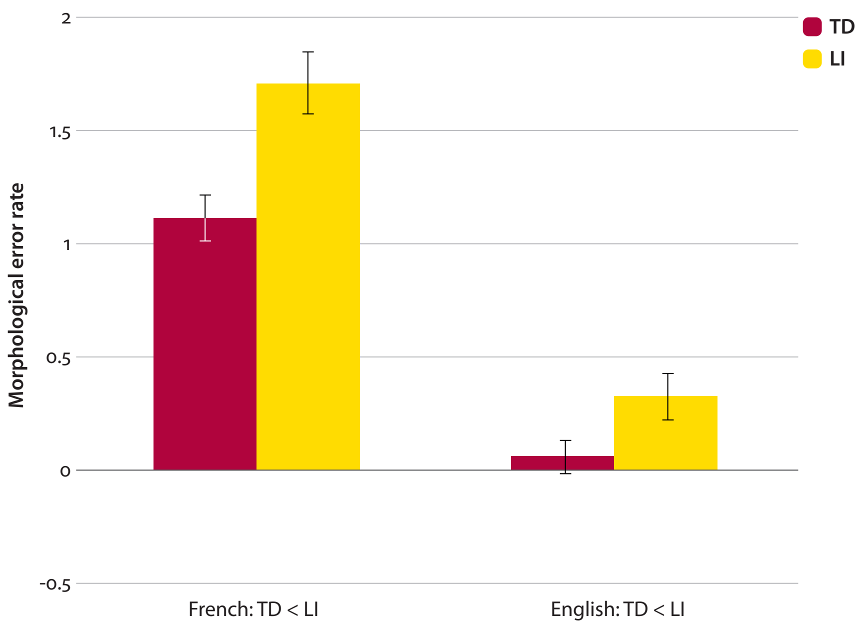

Figure 2a. Written texts: Morphological error rate

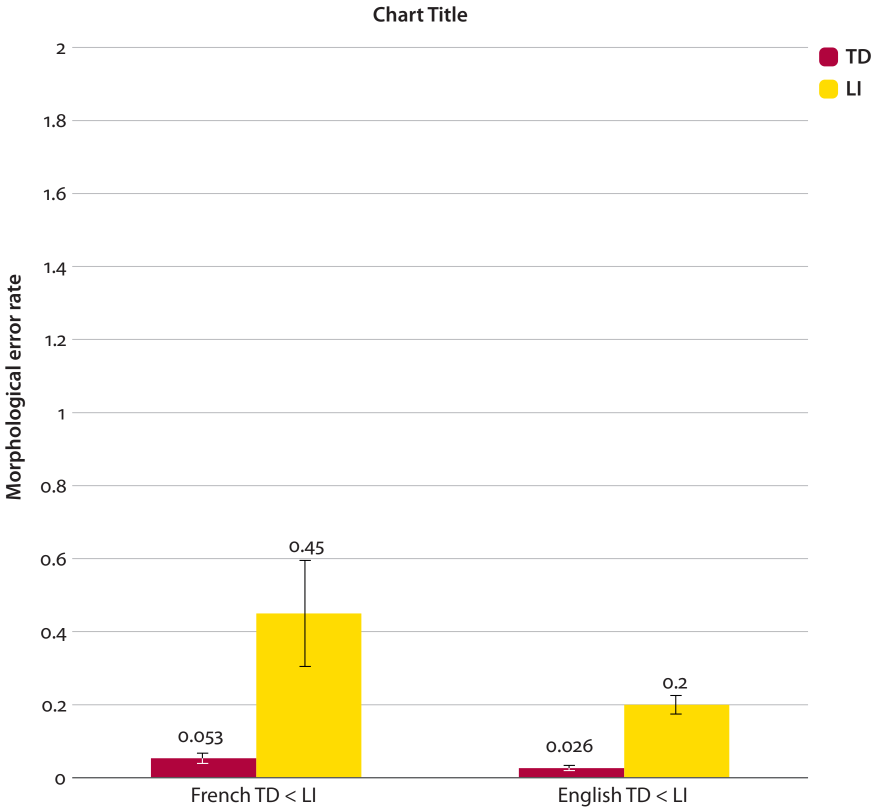

Figure 2b. Spoken stories: Morphological error rate

The differences in performance across the two modalities (spoken and written), especially in the French groups, are striking. First, it must be noted that Figures 2a and 2b/2c differ in scale, due to the high error rates in the written texts. With this in mind, it is nonetheless evident that both TD and LI French groups make proportionally more errors in written than in spoken French, as we had predicted. The difference in morphological error rates in written versus oral is .06 errors per proposition for English speakers and 1.11 for French speakers, $F_{(1, 134)} = 97.7$, $p < .001$. We suggest that this difference stems from the often silent inflectional morphology of French. In this same vein, for the English speaking groups, where the morphology (although impoverished) is articulated, the differences in error rate across modalities is small. In their written narratives, this was the case for the English speakers, but not for the French speaking group, where there was no significant difference in length of written text between TD and LI groups (see Figure 1a). The influence of a language's morphology and its acoustic availability appear to be major factors in the rate at which it is mastered.

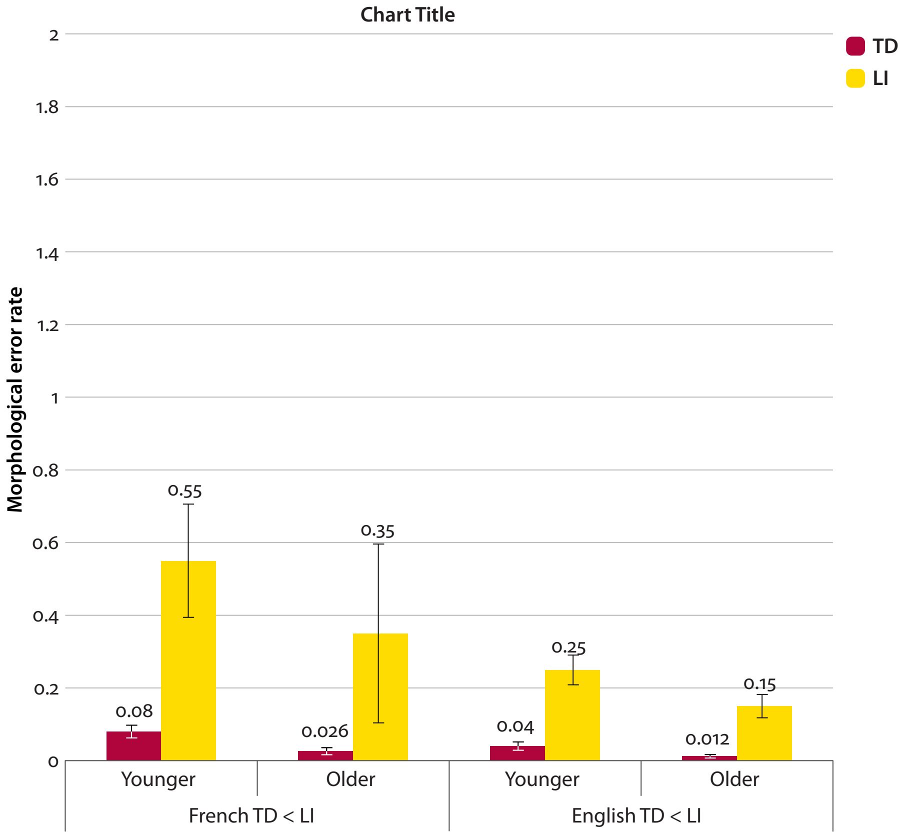

Figure 2c. Spoken stories: Morphological error rate by age groups

3.3 Complex syntax

The degree to which one uses complex versus simple sentences is a rhetorical choice, both personal and cultural. For example, "John goes to the store. He buys fish and potatoes. He goes home. He cooks dinner," is perfectly grammatical and comprehensible. However, complex syntax provides more information, as well as increases the density of the sentence. For example, "Before going home, John went to the market to buy fish and potatoes which he will cook for supper." Both versions are grammatical, but the first requires the listener to infer relations that are explicit in the second. In the written narratives, we found that the English writers included proportionally more complex syntax than the French, and that those with LI used proportionally less than the typically developing controls (Figure 3a). When we look at the results for their spoken narratives, we see that in this context as well, English speakers tend to use more complex syntax than the French groups [M_{Eng} = .82 and M_{Fren} = .67, F(1.132) = 10.53, p = .002] and the Typically Developing children use more complex syntax than those with LI [M_{td} = .82 and M_{li} = .68, $F_{(1, 132)}$ = 7.00, p = .009] (Figure 3b).

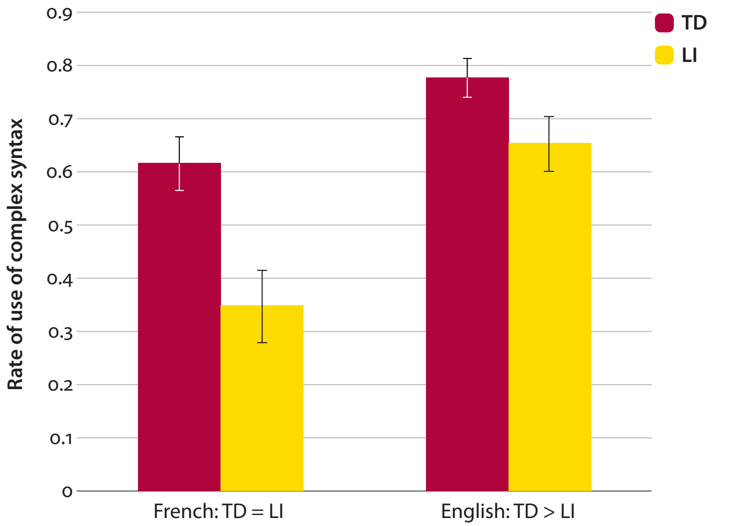

Figure 3a. Written texts: Rate of complex sentence use

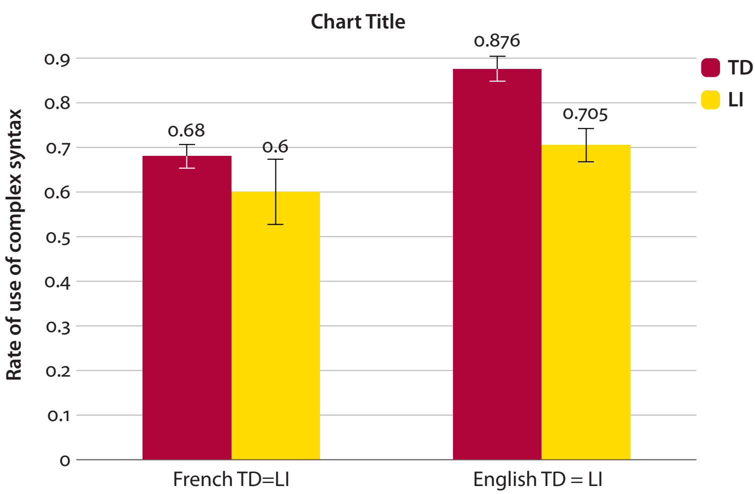

Figure 3b. Spoken narratives: Complex sentence rate

Findings with respect to differences in the use of complex syntax between the French and English speaking children and adolescents are not so surprising, as this tendency mirrors adult preferences. Nir and Berman (2010) found that French adults tend to prefer isotaxis, or simple over complex sentences in their discourse. In contrast, they found that English adult speakers show a preference for a greater use of hypotaxis or combining clauses. Our data for these school age children and adolescents reflect these same rhetorical tendencies in both their written and spoken stories. As such, both Typically Developing and Language Impaired children not only master the grammar of their language, but also acquire the rhetorical preferences of their language communities.

3.4 Syntactic depth

How frequently children use complex syntax serves as a first step in exploring connectivity, but in this coding scheme, a child can receive a rather high proportion, (i.e., use complex sentences frequently, but employ only a small repertoire of sentence types). To better understand the richness or diversity of their use of syntax, we created a weighted measure wherein more complex sentence types (e.g., subject relative clauses, concessive adverbials) were weighted higher than simpler types (e.g., verb complements and coordinate sentences, cf. Reilly et al. 2012 and Appendix A). In the written narratives (Figure 4a), we found statistically significant effects of all three main design features: Language [$M_{\text{Eng}} = 1.55$, $M_{\text{Fren}} = .61$; $F_{(1, 130)} = 107.8$, $p < .001$], Population [$M_{\text{td}} = 1.30$, $M_{\text{li}} = .07$; $F_{(1, 130)} = 4.53$, $p = .04$], and Age [$M_{\text{school}} = 1.08$, $M_{\text{adol}} = 1.08$; $F_{(1, 130)} = 6.53$, $p = .01$]. These significant marginal effects exist in the presence of a small Population x Age interaction which indicates that the effect of population on syntactic depth is slightly greater for younger than older participants. When examining the spoken narratives (Figure 4b) we find an effect of Language group alone [$M_{\text{Eng}} = 1.46$, $M_{\text{Fren}} = .51$; $F_{(1, 132)} = 294.33$, $p < .001$], such that the English speaking children and adolescents use more diverse syntax than their French speaking counterparts. The differences between syntactic depth of written versus spoken stories are seen only in the comparison of the two language groups where the difference is greater for the French group: for English, syntactic depth in written texts exceeds that of spoken by .14 units, while in French, the syntactic depth in spoken texts exceeds that of the written texts by 1.01 units [$F_{(1, 131)} = 170.87$, $p < .001$].

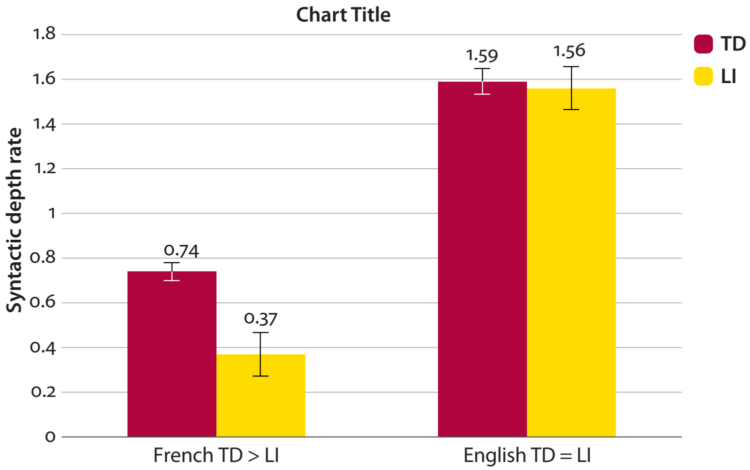

Figure 4a. Written narratives: Syntactic depth rate

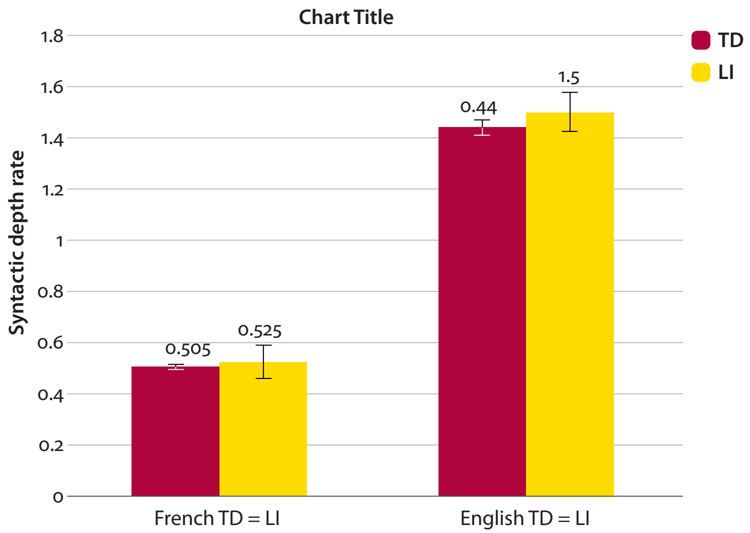

Figure 4b. Spoken narratives: Syntactic depth rate

4. Discussion

In line with the differing linguistic profiles for using complex sentences above, where English speakers show a preference for hypotaxis and the French for isotaxis in their writing, we see the same pattern in their written and spoken stories with respect to the diversity of sentence types they employ. Such consistency suggests that even school aged, French and English children (both typical and with LI) reflect the preferred rhetorical style of their language cultures. Perhaps the most striking of our findings with regard to syntactic depth, is that there is no difference between the TD and LI scores in the written stories of the English groups. This is not so for French, where the LI group trails behind their TD peers. However, in the spoken stories for both English and French, the LI group performs comparably to their TD counterparts in syntactic diversity.

The fact that children with Language Impairment continue to struggle with morphology, but can successfully recruit and employ complex syntax similarly to controls, raises interesting questions with respect to the nature of Language Impairment and the process of language acquisition itself. What is it about the morphology, even in English, that renders it difficult, whereas putting together clauses to create complex constructions appears to be more accessible? A variety of explanations have been posited for the persistent morphological difficulties of children with LI (e.g., Evans, Saffran & Robe-Torres 2009; Leonard 1998; Rice, Wexler & Cleave 1995; Ullman & Pierpont 2005), however, these studies do not account for the children's relatively proficient use of syntax in these stories. In fact, many experimental studies show that the LI group struggles with syntactic structures as well (e.g., Colozzo, Gillam, Wood, Schnell & Johnston 2011; Frizelle & Fletcher 2014). Additionally, studies on statistical learning (e.g., Evans, et al. 2009) have shown that children with LI are significantly slower to learn phonetic probabilities than their TD peers. However, it could be argued that the rhetorical preferences of French versus English speakers are also learned statistically, and for this pragmatic aspect of language use, the LI groups, both French and English, do rather well. In sum, our naturalistic results contrast with more experimental studies. It may well be that in contexts in which the children can choose the structures, as in the narratives, they demonstrate more advanced performance than when they must respond to specific experimental stimuli.

5. Language, modality, and Language Impairment

In this chapter we have discussed data from both written and spoken narratives from children with Language Impairment and Typically Developing children who speak either French or American English as their first language. Globally, children's spoken stories eclipsed their written stories in length. With respect to morphology, consistent with other studies, both French and English LI groups made more errors in spoken and written texts than their TD counterparts. However, the complex (and often silent) inflectional system of French was a critical factor: both French TD and LI, made more errors than their English counterparts, and had more difficulty with the written task than in the spoken task. Interestingly, this modality difference was not as apparent in the English groups, suggesting that the phonetic availability of morphology, or lack thereof, plays a significant role in its acquisition. Complex syntax links events in a narrative, and different language communities reflect divergent rhetorical styles in their use of syntax. Overall, the LI groups used less complex syntax than controls, especially in the written texts, but followed the rhetorical styles of their communities. Interestingly, considering the diversity of their complex syntax, the LI groups matched their typically developing peers in the spoken narratives.

Our youngest children were seven years old; they had been talking since infancy, but were beginner writers. They wrote very short stories. Although written stories from the older group were somewhat longer, they never matched the length of spoken stories. The challenge of writing was also apparent in morphology. Although all older groups made fewer errors than their younger counterparts, written errors were proportionally higher than spoken errors for all groups. Finally, for complex syntax, proportions for written texts were slightly below that of spoken texts. This was especially apparent for the younger LI groups, reflecting the challenge of the written modality for these children.

The role of language, i.e., French or English, in these results is especially prominent in the morphology findings and in the use and diversity of complex sentences. The morphological error rates were anticipated to be higher for the French groups (both TD and LI) due to the rich and complex inflectional morphology of French. Additionally, it was thought that written French would be even more challenging as multiple components of the inflectional system are silent. These hypotheses were confirmed, as was the prediction that the older French TD group would perform better than their younger counterparts. Unfortunately, the French LI group was much less advanced. As noted above, with respect to the use of syntax, both the Typically Developing children and those with Language Impairment reflect the rhetorical patterns or preferences of their cultures. In conclusion, Language Impairment is not an easily characterized phenomenon; as our results suggest, the modality, the structural aspects of the language acquired, and the pragmatic conventions of that language community play a significant role on the phenotype of Language Impairment.

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Appendix A. Complex sentence types and their weighted score

Sentence type	Score
Coordinate sentences (and, but) I went to the store], and [I bought some candy	1
Coordinate sentences (so) I hid the toy from my sister] so [I could keep it to myself	2
Verb complements He made me cry; They tried to pull me; I like playing with him; It seemed to me that the boy was mad at me; He thought [0-that] I wasn't coming	2
Object relative clauses I went to the store which was my favorite	3
Subject relative clauses The girl that I liked lived close to my house	4
Full passives I was hurt by that boy	4
Got and agentless passives I got hurt; I was beaten up	2
Causal adverbials I hit the boy because/since I was mad; I was so mad that I hit him	2
Temporal, locative conditional adverbials I went to bed after he left; He stayed where he was	3
Nominal adverbials or adverbial relative clauses I'm going to tell you about the time when I got by a baseball	3
Concessives Even though she didn't give me back my CD, I'm still her friend.	4
After that he kept on trying to talk to me as if we were still friends.	5

CHAPTER 20

Non-literal language comprehension

Brain damage and developmental perspectives

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Nonliteral language includes any utterance that produces an apparent need to go beyond what is literally stated, in order to comprehend the speaker's communicative intent and, consequently, to understand the meaning of these utterances in a given context. Impaired comprehension of indirect requests has been reported in adults with acquired brain lesions. There is little available knowledge on the development of pragmatic skills in children and adolescents with brain damage. Do children with brain damage differ from brain-damaged adults in request comprehension? To answer the question, this chapter adopts a developmental perspective, describing the results of studies with adults and children with acquired brain lesions.

Keywords: pragmatics, non-literal language, comprehension of requests, acquired brain lesions

1. Introduction

One of the key rules of pragmatic language theory is that recipients must attend to both the linguistic forms of utterances and the features of the interaction situation (Austin 1962; Searle 1969; Grice 1975; Searle & Vanderveken 1985; Verschueren, Östman & Blommaert 1995; Verschueren 1999). *Nonliteral language* refers to any utterance that generates an apparent need to go beyond what is literally stated, in order to grasp the speaker's communicative intent and thereby understand the meaning of that utterance in a given context. Nonliteral language commonly takes a variety of forms, including indirect requests, sarcasm and metaphor. Within the past twenty years or so, pragmatic theories and concepts have gained recognition in the field of *neuropragmatics*. Pragmatic theories which attempt to clarify the link

DOI 10.1075/tilar.22.21dar

between the formal structure of language and the extra-linguistic context may help to provide insight into the difficulties of patients with brain lesions (Bernicot & Dardier 2001; Dardier 2004; Dardier, Bernicot, Delanoë et al. 2011). The objective of this chapter is to provide a synthesis of studies regarding the understanding of indirect speech by people with brain lesions, from a developmental perspective.

There is little available knowledge on the development of pragmatic skills in brain-damaged children and adolescents. Indeed, the first researchers were exclusively interested in adult populations. These studies highlighted the deleterious consequences of right lesions (see Hannequin, Goulet & Joanette 1987; Myers 1998; McDonald 2000; Stemmer 2008; Monetta & Champagne-Lavau 2009 for a review) or frontal lesions (See Martin & McDonald 2003; Dardier, Bernicot, Delanoë et al. 2011 for a review) which occurred in adulthood.

The question addressed in this chapter is whether children with brain damage differ from brain-damaged adults in request comprehension. To answer it, we adopt a developmental perspective, describing the results of studies with adults and children with acquired brain lesions.

While mastery of the formal aspects of language is acquired gradually during the first five years, the development of pragmatic aspects, including the understanding of indirect language, continues during childhood. We can therefore question the impact of acquired brain injury after the age of five on the understanding of indirect language. Is there a similarity between patterns in the performance of young brain-damaged individuals and those described in the adult model? Furthermore, according to Bernicot, Laval, and Chaminaud (2007: 2115), "the topic of nonliteral language is a key issue in language development, one which underscores the interrelationships between linguistic, cognitive, and pragmatic skills". In order to provide new insights into the understanding of indirect language and the consequences of acquired lesions in the development of pragmatic aspects of language, the purpose of this chapter is to present the findings of several studies conducted with adults and children. This work also contributes to a better description of the pragmatic difficulties of people with right or frontal lesions. Indeed, difficulties in the understanding and use of language in context have a significant impact on people's daily lives and on their surroundings. Thus, a better understanding of the difficulties faced by people with brain lesions in the field of pragmatics of language can help to improve their social, educational and vocational adjustment. Studies in atypical populations can also have repercussions in applied research, shedding new light on the assessment of pragmatic skills and rehabilitation programs.

According to Speech Act Theory (Searle 1969; Searle & Vanderveken 1985), *requests* are directive speech acts defined as social acts by way of which a speaker attempts to get a listener to do something. In 1976, Ervin-Tripp identified various types of requests, including direct requests (*close the door*), conventional indirect requests (*can you close the door?*), which are commonly used as directives, and unconventional indirect requests, or hints (*It's cold in here*, meaning "Close the door"). To understand this type of allusive request for action, the listener has to draw a complex inference. We therefore need to understand how people with acquired brain lesions understand indirect requests.

2. Indirect request comprehension in adults with right-hemisphere damage and adults with traumatic brain injury

There are a number of similarities between the pragmatic disorders described in individuals with right-hemisphere damage (RHD), who have focal lesions, and those observed in individuals with severe traumatic brain injury (TBI), who generally have diffuse lesions (Martin & McDonald 2003), with both populations exhibiting a lack of comprehension of nonliteral language forms such as indirect requests.

RHD individuals have been shown to have difficulty understanding indirect requests (Foldi 1987; Weylman, Brownell, Roman et al. 1989). This difficulty only seems to concern nonconventional indirect requests, such as *The door is open*, meaning, "Please, close the door", as they correctly understand conventional indirect requests, such as "Could you close the door?" (Stemmer, Giroux & Joanette 1994; Vanhalle, Lemieux, Joubert et al. 2000; Champagne, Virbel, Nespoulous et al. 2003). They are also able to produce conventional indirect requests (Stemmer et al. 1994; Brownell & Stringfellow 1999). Champagne-Lavau and Joanette (2009) recently found that not all RHD individuals exhibit impaired understanding of nonconventional indirect requests. More specifically, the RHD patients in their study who did have difficulty were characterized by the co-occurrence of a lack of inhibition and a deficit in attributing mental states (e.g., intentions, beliefs, knowledge) to others. The ability to form representations of other people's mental states and to use these representations to understand, predict and judge their statements and behaviors is referred to as *Theory of Mind* (ToM; Premack & Woodruff 1978; Baron-Cohen, Leslie & Frith 1985). This result therefore confirms the theoretical claim that pragmatic interpretation is a mind-reading exercise involving inferences about the speaker's intention and beliefs (Grice 1969). Inhibition may play an important role in understanding nonconventional indirect requests, as literal, irrelevant meanings may, in some circumstances, be more readily accessed than other, perhaps more appropriate meanings (McDonald & Pearce 1996; Tompkins, Lehman, Baumgaertner et al. 1996; Champagne, Desautels & Joanette 2004).

People with TBI have diffuse damage with regular frontal lesions (Penn 1999). They have substantial social adaptation problems in their daily lives, as well as difficulty with the pragmatic aspects of language (Brooks 1984; Brooks, Campsie, Symington, Beattie & McKinlay 1986; Levin & Kraus 1994; Biddle, McCabe & Bliss 1996; Van Leer & Turkstra 1999; Martin & McDonald 2003). Neuropragmatic research has shown that adults with TBI understand conventional indirect requests (Bara, Tirassa & Zettin 1997; Angeleri, Bosco, Zettin et al. 2008), but very few studies have addressed their understanding of nonconventional indirect requests, or hints, which require complex inferences to be drawn (McDonald & Van Sommers 1993; McDonald & Pearce 1998). Furthermore, only a few studies have taken metapragmatic knowledge into account, that is, the ability to speak about the rules governing the social aspects of language use. In this context, the purpose of Dardier et al. (2011)'s study was to assess both the pragmatic and metapragmatic skills of TBI adults with frontal-lobe lesions (without aphasia or intellectual difficulties) and control participants (matched with the TBI adults on age, sex and educational level) in a comprehension task featuring both direct and indirect (conventional and nonconventional) requests. Regardless of the form of the request, results showed that the TBI participants produced just as many correct answers as the control participants. Request comprehension therefore seems to be particularly robust in adults with brain lesions. This result is consistent with Champagne-Lavau and Joanette (2009)'s view that there is a degree of heterogeneity and different patterns of performance in brain-damaged patients. By contrast, at a metapragmatic level, the same study highlighted the difficulty that TBI individuals have producing relevant explanations for such requests. The TBI participants often referred to their personal experiences, or associated a visual or textual story element with other irrelevant elements, whereas the controls made statements about elements that were consistent with the speakers' intentions and with the situation. On this point, as indicated by McDonald and Pearce (1998), people with TBI and frontal lesions often exhibit only a partial understanding of communication situations, which may explain the difficulties they encounter in daily communication. Dardier et al. (2011)'s research therefore highlighted the existence of various pragmatic and metapragmatic profiles among patients, and the need to consider this aspect when designing rehabilitation programs.

Although the pragmatic disorders of adults with acquired brain lesions have been quite well documented, there have been very few studies of these disorders in children and adolescents. The comprehension of indirect requests may be preserved in adults with TBI (with frontal lesions) or RHD, but what happens if frontal brain injury occurs during infancy? Infancy is a stage of rapid neural development and the brain is particularly vulnerable during this period (Hebb 1942; Ewing-Cobbs, Levin, Eisenberg et al. 1987). Some brain areas, such as the frontal lobes, which are involved in pragmatic interpretation, are characterized by delayed maturation, which is only completed in early adulthood (Toga, Thompson & Sowell 2006).

Frontal lesions lead to various communication disorders in brain-injured children, and impact their social outcome (Yeates, Swift, Taylor et al. 2004; Catroppa & Anderson 2009; McDonald, English, Randall et al. 2013). So do children and adolescents with frontal lesions have difficulty acquiring the ability to understand indirect requests and express metapragmatic knowledge?

3. Request comprehension in children and adolescents with frontal lesions

Acquired frontal lesions can also impair pragmatic skills. *Acquired brain injury* is brain injury caused by events occurring after birth (e.g., traumatic brain injury (TBI), ischemia, brain tumor, etc.), not including neurodegenerative diseases. The pragmatic disabilities of adults with acquired right or frontal lesions have been quite well documented. Far fewer studies, however, have been carried out on these disorders in children and adolescents (Bernicot & Dardier 2001; Dardier 2004). Children and adolescents with frontal lesions (resulting from TBI or a brain tumor) are generally free of aphasia, but are known to experience pragmatic difficulties (Bernicot & Dardier 2001; Chapman, Sparks, Levin et al. 2004). In language comprehension, they have difficulty differentiating truth from deception (Dennis, Purvis, Barnes et al. 2001), understanding sarcasm (Turkstra, McDonald & DePompei 2001), and handling nonliteral language such as metaphor or idioms (Towne & Entwistle 1993). From a developmental perspective, studies have shown that the ability of typical children to understand requests changes with age, depending on the linguistic form of the utterance and the contextual cues that are available (Bates 1976; Ervin-Tripp & Mitchell-Kernan 1977; Bernicot 1991; Ninio & Snow 1996; Bernicot et al. 2007). In typical development, by the age of five, children can understand hints if there are sufficient contextual cues (Bernicot & Legros 1987; Bernicot 1991). Language development beyond age five includes learning how to use the repertoire of linguistic forms, and the ability to understand nonconventional requests depends on the production context and the comprehension criterion used, that is, the action to be carried out (standard criterion) or the speaker's intention (Bernicot et al. 2007). Metapragmatic knowledge of requests (i.e., the ability to express metapragmatic knowledge), which involves relating the linguistic form of a speech act to the characteristics of the communicative situation, increases with age, and may emerge as early as 7–8 years (Bernicot 1991). Some studies have analyzed both the pragmatic and metapragmatic skills required for request comprehension in children and adolescents with acquired frontal lesions.

The purpose of the study by Dardier, Deleau, Delanoë, and Laurent-Vannier (2006) was to assess pragmatic and metapragmatic skills by means of a direct request (conventional and nonconventional) comprehension task in children and adolescents with acquired frontal lesions (mean age: 14.9 years), and compare their performances with those of controls. All the participants were not aphasic. They had a good grasp of the formal aspects of language. Their brain damage had occurred at least 3 years earlier, and when they were older than 5. At the pragmatic level, results showed that, as with adults (McDonald 1999; Dardier et al. 2011), the young participants with frontal lesions had no difficulty with either direct or conventional indirect requests, giving just as many correct answers as controls. The comprehension of this type of request, acquired in early childhood, can potentially be maintained in the event of brain injury sustained after age 5. By contrast, concerning the comprehension of hints, they had difficulty inferring the speaker's intention from contextual cues, producing fewer correct answers than controls for this type of request. According to McDonald and Van Sommers (1993) this result confirms that nonconventional indirect requests require complex inferences to be drawn. Data also suggest that people whose frontal brain lesions occurred during childhood (but after age 5), and who have no aphasic problems, continue to have difficulty understanding hints many years after the lesion. At the metapragmatic level, results indicated that the young participants with frontal lesions had difficulty explaining metapragmatic knowledge, that is, the relationship between the form of the utterance and the social context in which it is produced. Like their adult counterparts (Channon, Pellijeff & Rule 2005; Dardier et al. 2011), they made a great many inappropriate comments about the stories behind the requests, and used irrelevant cues to analyze the situation and the speaker's intention. They differed from controls in how they explained the use of language. While young individuals with frontal lesions may give the impression in daily life that they understand direct requests, this study showed that when they are questioned more closely on the contextual use of this language, their understanding proves to be only partial.

This result is in line with McDonald (1999)'s view that individuals with frontal lesions frequently exhibit a superficial understanding of the speaker's intention and of communication situations. The data yielded by this study show that brain injury acquired after the age 5 has a deleterious effect on pragmatic and metapragmatic comprehension in children and adolescents. Furthermore, as underlined by Anderson, Catroppa, Morse et al. (2005), contrary to traditional views of the plasticity of children's brains, they suggest that frontal lesions sustained in childhood have a profound impact on pragmatic development.

According to pragmatic theories, contextual cues play an important role in the understanding of requests (Bernicot 1991), but what is the role of context in the comprehension of requests in atypical development? And what contextual cues do children and adolescents with frontal lesions use to interpret conventional indirect requests? In typical development, interaction formats or routines (prototypical exemplars of social relations) are very important to the development of language (Bruner 1983; Bernicot 1994; Marcos & Bernicot 1997). So what is the role of routine or context prototypicality in understanding requests? To answer this question, Dardier, Delaye, and Laurent-Vannier (2003) assessed the ability of young patients with frontal lesions (mean age: 14.9 years) to analyze one specific category of speech acts, conventional indirect requests, in a standard comprehension task (judgment task). The authors examined whether variations in the preparatory condition (which expresses the possibility of satisfying the request; Searle & Vanderveken 1985) or the speaker's status influenced the comprehension of conventional indirect requests. They found that varying these contextual elements gave rise to prototypical and non-prototypical request situations. In the prototypical situations, the preparatory condition was satisfied, in that the listener could physically satisfy the request, and the speaker had a superior status (e.g., an adult with a child). In the non-prototypical situations, the preparatory condition was violated, in that the listener could not physically satisfy the request, and the hierarchy between speaker and listener was reversed, as the listener had a superior status (e.g., policeman with a car driver). The aim of this study was also to explore metapragmatic knowledge in children and adolescents with frontal lesions. As we have seen, metapragmatics is the conscious awareness of the conventions that regulate and organize discourse (Verschueren 1999). At the pragmatic level, the main results indicated that the patients with frontal lesions performed differently from controls in interpreting requests, producing fewer correct answers. These results suggest that individuals with frontal lesions have difficulty making use of the textual and contextual cues available to help them understand indirect requests. Additional analysis showed that both patients and controls had greater pragmatic difficulty analyzing the non-prototypical requests (i.e., unusual situations). This result can be interpreted in the light of interactionist theories of development, such as Bruner's theory on interaction format (Bruner 1983). Prototypical situations with interaction formats (i.e., usual situations), which are repetitive and predictable, were easier to understand than non-prototypical situations. Non-prototypical request situations require more complex inferential processes to be mobilized than prototypical situations do. At a metapragmatic level, the participants with frontal lesions produced fewer answers followed by relevant explanations, and tended to explain the situations either by focusing on one specific detail of the photographs, or by referring to their personal lives. Results also showed that metapragmatic skills, which are acquired later in childhood, seemed to be impaired in the children and adolescents with frontal lesions (occurrence after age 5), just as they are in their adult counterparts (Dardier et al. 2011). These data shed light on the comprehension of speech acts, and show how pragmatic skills can be maintained despite a metapragmatic impairment. Some individuals with frontal lesions are able to give correct answers in pragmatic tasks, but have greater difficulties in expressing their metapragmatic knowledge or else provide justifications based on a single critical piece of information. The data also reveal the absence of a link between pragmatic skills and metapragmatic knowledge. In line with the study by Bernicot et al. (2007), we therefore suggest that these two systems remain relatively independent during the process of language acquisition.

4. Conclusion

How can research on people with brain injuries contribute to the study of the pragmatic aspects of language acquisition? Request comprehension has been the subject of numerous studies in pragmatics, both in typical development and in neuropragmatics. Recent studies of adults, adolescents and children with frontal lesions show that these brain-injured populations have difficulties with understanding the types of utterances that require complex inference-making; they suffer from "failure of inferential reasoning". These studies also highlight dissociations between pragmatic and metapragmatic skills: some people with frontal lesions are able to determine whether or not the utterance is appropriate (pragmatic level), but they are unable to express the rules governing the use of this language (metapragmatic level). All of these pragmatic and metapragmatic difficulties interfere with the daily life of brain-damaged people; such impairments also affect social outcomes in children and adolescents. Consequently, it would be interesting to go deeper into this question by testing a larger population of children, adolescents and adults with frontal lesions, in order to establish how their pragmatic and metapragmatic skills might differ as a function of age. These studies also highlighted the need to conduct longitudinal studies to take the different possible developmental paths into account. These studies would enrich current models of pragmatic development and also produce additional data on its anatomical and functional organization. The consequences of acquired brain lesions in pragmatic development may not be immediately apparent in childhood. Indeed, in many cases pragmatic difficulties may not be recognized until the later stages after injury, when children begin to experiment with more complex use of language. Further research in nonliteral language comprehension is needed, with the aim of determining the extent to which frontal lesions suffered in early infancy might have more serious consequences than those acquired later during childhood. Additional studies, with larger samples of people with focal or diffuse brain injury are also needed, the aim being to identify possible links between the type of brain lesion (side, site, or size) and subsequent pragmatic developmental trajectories.

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Language index

Subject index

Developmental research has long focused on regularities in language acquisition, minimizing factors that might be responsible for variation. Although researchers are now increasingly concerned with one or another of these factors, this volume brings together research on three different sources of variation: language-specific properties, the nature of the input to children across contexts, and several aspects of the learners themselves. Chapters explore these sources of variation within an interdisciplinary and comparative approach allying theories and methodologies stemming from linguistics, psycholinguistics, developmental psychology, and neuroscience. The comparative perspective involves different languages, contexts of use, types of learners (first/second language acquisition, monolingual/bilingual learners, autism, language impairment), as well as vocal and visuo-gestural communicative modalities (co-verbal gestures, sign language acquisition). The volume points to the need to enhance interdisciplinary research using complementary methodologies to further examine sources of variation and to integrate variation into a more general developmental theory.

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ISBN 978 90 272 4412 3

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