Bilingual Cognition and Language

The state of the science across its subfields

STUDIES IN BILINGUALISM

54

EDITED BY
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Jason Rothman
and Ludovica Serratrice

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Volume 54

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Table of contents

CHAPTER 1

Studies in bilingualism

25 years in the making

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This year marks a quarter century since the founding of *Studies in Bilingualism (SiBIL)*; this book pays homage to *SiBIL*'s enduring legacy in the field. The mission and motivation with which *SiBIL* was founded have continued unabated; to provide a forum for the highest quality research examining all aspects of bilingualism. It would be fair to say that over the past 25 years in particular there has been a proverbial explosion in research on bilingualism, especially within various approaches to linguistics, psychology, cognitive science, health sciences and many more (now increasingly as a result) interrelated fields. This trend is nicely captured in the charts below, adapted from Kroll and Bialystok's (2013) meta-review in the *Journal of Cognitive Psychology*, which showcases the upswing in bilingual research in mainstream psychology, for example, and crucially its scientific impact between 1993 to 2012 alone. In Figure 1, the left chart (a) shows the steady increase in papers dealing with bilingualism in high impact, international journals whereas the right chart (b) documents the even sharper increase in citations to work on bilingualism in the same high caliber journals. In both charts, the trends are unmistakable; the study of bilingualism – from its social, educational and political functions to how bilingual acquisition development unravels over the course of the lifespan to how it potentially changes the structure of the brain and links to health benefits and fine-tuning of cognitive functions – is well represented and well regarded in mainstream humanities, social science and hard science circles.

Of particular note is the sharp increase between 2007 and 2008 in terms of papers published, most likely attributable to a critical mass in seminal work and discoveries emerging from several key labs around the world at roughly the same time period. An overwhelming plurality of work has consistently shown that both languages of a bilingual are always simultaneously activated, despite conscious intention or necessity to use more than one language. This ubiquitous activation

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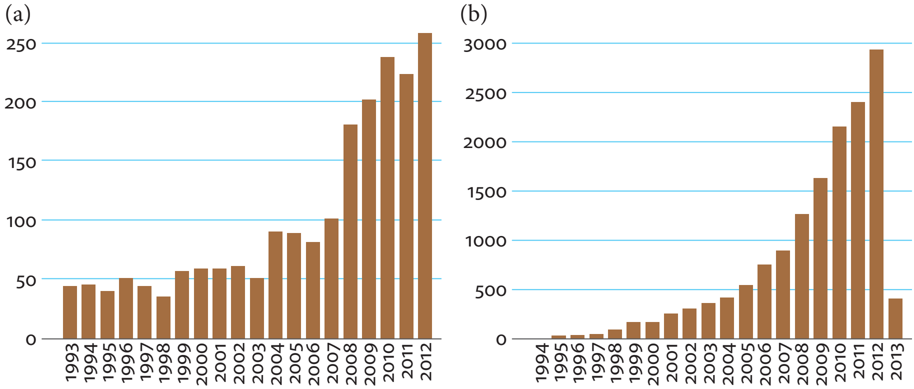

Figure 1.

creates a proverbial situation of mental juggling on the part of the bilingual; there is a delicate balance that the bilingual needs to strike. On the one hand, the utility of having both languages activated is not to be understated since the need to switch from one to the other can in principle arise at any given time. Just as an idling car makes for a much quicker getaway at a second's notice than a car that needs to be unlocked and turned over, having both systems relatively activated means that the bilingual can be most efficient at switching. After all, what if mom or dad call out of the blue in which case language X is the only appropriate language, even in the middle of a work day where language Y is the only acceptable one? On the other hand, keeping both languages activated is, cognitively speaking, not without costs. Having both languages (equally) activated draws on finite cognitive resources that could result in processing difficulties and a high degree of crosslinguistic influence in real time performance. The other side, therefore, of simultaneous activation is the increased burden on inhibitory control processes to suppress the contextually irrelevant language. As can be understood more deeply from examining Chapters 13 (Bialystok), 14 (Bobb and Kroll) and 15 (Del Maschio and Abutalebi) for further details in this volume, tension between activation and inhibition sustained over long periods of time (a true lifetime for very early bilinguals), underlie the likely mechanism, at least in part, through which bilingualism translates to potential changes in cognitive functions and structural neurological anatomy in the bilingual mind-brain (see Bialystok, 2009, 2016 for review). It is at the crossroads of these inherently interrelated research programs that the drastic upswing in mainstream psychology's interest in bilingualism took place peaking in 2007 and 2008.

One could go on and on describing with similar detail to the above the upswings and advancements in other subfields of bilingualism – formal linguistics, cognitive linguistics, sociolinguistics, language impairment studies, bilingual education, etc. – over the past 25 years or so; however, we leave such a task to the reader herself as she interacts with the very chapters that comprise this state-of-the-science(s) in bilingualism volume. What is most remarkable is the example that looking at the growth and increased rigor virtually all subfields of bilingual studies have experienced in the past few decades embodies in pointing out just how quickly tides can turn. It is hard to fathom that until the 1960s bilingualism was considered to be a "bad thing", minimally related to issues of social integration for immigrants as well as for general cognitive and linguistic development. In the extreme, it was claimed that bilingualism actually caused inequalities in learning and resulting intelligence. In Saer's (1923: 38) words, "***confusion*** [caused by bilingualism] has been carried over from the brain area concerned with language" to those connected with other functions (in his study tests of dextrality, rhythm and overall intelligence). To say nothing of the fact that Saer's work, which examined bilingualism in the Welsh context, offered no neurological measurement at all (even ones that would have been possible in 1923), let alone anything that would in modernity permit someone to claim so-called "confusion in brain areas" it seems to be oddly fit for purpose given the prevailing narrative of the specific context; a study looking at bilingualism in a so-called *subject-state* where its native language (Welsh) is different from the so-called *governing-state* (English) (italics refers to Saer's own words). Many studies between 1920 and 1960 in particular supported this general view, indicating that bilingualism correlated with lower IQ, cognitive deficiencies and even mental retardation.

Seminal work by Peal and Lambert (1962) effectively changed the course of direction, at least within science, of how bilingualism would become to be viewed and studied. Highlighting how previous studies did not control for deterministic intervening variables that obscured any meaningful conclusions about bilingualism, their own study in Montreal, Canada showed how a more nuanced consideration of factors and more constrained selection criteria for grouping various types of bilingual participants makes a huge difference in findings. Previously, bilinguals with various degrees of proficiency, from various socioeconomic statuses, across a range of language pairings, with diverse ages of onset and amounts of exposure were haphazardly grouped together – as if none of these variables mattered – and then compared against homogeneous monolingual controls of considerable socioeconomic advantage. Peal and Lambert's (1962) study showed that when deterministic variables were properly controlled, their highly proficient bilinguals were not only equal to, but indeed outperformed appropriately matched monolingual counterparts for measures of verbal and non-verbal intelligence. In the decades that have followed, an *a priori* deficit approach to understanding bilingualism has fallen out of fashion and for good reason: there is no credible evidence that bilingualism has any negative effects on any domains of development and beyond.

It is true that bilingualism has measurable effects and that differences between monolinguals and bilinguals exist; however, labelling these things as advantages or disadvantages – and many of us researchers are guilty of using these words – is ultimately a misnomer as the labels themselves relate to fluid concepts and are subject to evaluative perspective (see Bialystok this volume for discussion). For example, bilingual lexicons tend to be smaller in both languages, although when taken together the average bilingual has many more words than a typical monolingual. Is this an advantage or a disadvantage? It could be both depending on the question to which it is applied; however, in reality it is neither in the truest sense of the word. To be a real disadvantage, one would need to show that not having a larger vocabulary truly inhibits the bilingual from expressing herself in both languages she knows. To show it as an advantage, one would need to show how she performs better in both languages as a direct result. Since neither is the case, measuring relative vocabulary size is really nothing more than documenting an interesting difference; one that may indeed have important knock-on effects, but an advantage or disadvantage *per se* it is not.

The future of bilingualism studies will benefit from a greater understanding of the intended – and crucially the unintended – consequences of striving to balance good science, developing appropriate methodologies, the use of terminology and how it is applied, potentially precipitous claims and overzealous generalizations as much as we have learned from this in the past. Bilinguals are not confused, they are not incomplete, bilingual education is not meant to “fix” bilinguals, there is no question that the bilingual experience affects the mind and brain as much as there is no question that bilingualism is a social, biological and psychological construct. What is in question is what parts of the bilingual experience and their relative weights are in affecting the outcomes of bilingualism. Understanding this will help the field move forward to explaining the high levels of variation noted across bilingual individuals, groups of speakers, seemingly irreconcilable results from different labs and much more. Bilingualism is a dynamic process that exists on a continuum, one that affords the framing and asking of multifarious questions that studying monolingualism simply could not support. We are fortunate to exist as researchers at a time where the above is more or less accepted as fact.

In the remainder of this book, chapters by the most influential and seminal researchers within a given sub-area of bilingualism are brought together. Each chapter presents a state-of-the-art account of the research in various subfields of the study of bilingualism in the last 25 years. In an effort to pay homage to the influence each of these disciplines has had on linguistic and psychological theory and for ease of exposition, we present the chapters as outlined in the table of contents, that is, grouped together in related fields. Of course, given the time and space limitations, it is impossible to capture the entirety of the bilingualism research enterprise. Our aim, thus, is to give the reader both a broad view of bilingualism and its impact on our understanding of the mind-brain, language development and processing, the social and educational aspects of various types of bilingualism, as well as a concise review of more narrowly specified research interests in the field by presenting the chapters in units based on topics that are of current interest. When put together, these chapters provide the reader with the history, the present and an idea of the trajectory of the field of bilingualism in the years to come.

Theoretical approaches

This issue begins with a discussion of arguably the most prominent theoretical approaches to bilingual language development since the advent of the field and which have been at the forefront of relevant discussions over the last several decades, namely sociolinguistic, usage-based, and formal (i.e., generative) approaches.

In her chapter on using sociolinguistic approaches to examining bilingualism and language ideologies, Leonie Cornips offers a discussion centered around how a monolingual language ideology has shaped the categorization of world languages based on social, political and economical agendas and what the consequences of such an ideology have been on the experimental study of language. Specifically, she focuses on important developments in bilingual child acquisition and what power dynamics and language ideology reveal about how children and the language(s) they speak should be examined in light of methodological, conceptual and analytical considerations within a sociolinguistic framework. Sociolinguistics has, in this sense, contributed to the attentional shift from language ideologies towards an endeavor to capture and explain the flexible and fluid nature of specific language use and practices.

Of course, sociolinguistic approaches are not the only ones that consider the role of language use and other similar variables, such as frequency and salience to name a few. Usage-based theories regarding how cognitive representations of grammatical systems emerge offer another way of accounting for the intricate and distinct outcomes of language development based on its use among individuals and collectively within larger societies. Stefanie Wulff's and Nick Ellis's chapter provides a description of the constructs and working assumptions that characterize usage-based approaches to language learning, specifically focusing on cognitive underpinnings of these theories to second language acquisition. The authors argue that not all constructions are equally learnable by all learners and present a usage-based analysis of this phenomenon in terms of fundamental principles of associative learning (salience, contingency and redundancy). In doing so, they show that the learning of form-function mappings is problematic in naturalistic second language learning environments. The authors continue to describe how adult acquirers show effects of learned attention and blocking that limit learning and discuss how educational interventions may recruit learners' explicit, conscious processing capacities for noticing novel L2 constructions before subsequent implicit processing consolidates into the system.

While it is incontrovertible that language development depends to a great degree on the input one receives in conjunction with other factors considered within socio- and usage-based frameworks, the aim of formal approaches is to explain that which cannot be explained by frequency and which emerges potentially as a by-product of cognitive mechanisms specific to the domain of language. In the final chapter of this section, Lydia White offers a brief account of a formal linguistic approach to questions related to second language acquisition. This is followed by a detailed discussion of research on advanced proficiency and ultimate attainment in L2 acquisition that adopts a linguistic approach grounded in Universal Grammar (UG). In doing so, she presents the history of generative L2 research and how it has moved from the traditional UG principles and parameters approach, to a more detailed analysis of the properties of the interlanguage representations and the role of the L1 grammar and UG in shaping the acquisition of these representations, specifically focusing on how representations are accessed and used in real time processing.

Issues in child bilingualism

In order to have a global perspective on the development and ultimate attainment of language among bilinguals, research has paid particular attention to various types of bilinguals in different age groups. This series draws together an array of contemporary work being done on simultaneous and sequential bilingualism, acquisition, the role of input, and relevant corpora-based investigations. Elena Nicoladis, in her chapter on simultaneous child bilingualism, describes the language acquisition and development of simultaneous bilingual children in approximately the first five years of life. She discusses the pattern of exposure to each language in understanding children's dominance and proficiency in their two languages. She argues against the common assumption that bilingual children must be confused by their bilingualism by showing that they are actually able to differentiate their languages early in development, though there are differences in language processing and acquisition as compared to monolingual children. The chapter concludes with a discussion of the so-called bilingual advantage providing evidence for and against the argument that early bilingualism can lead to cognitive advantages over monolinguals (see also Bialystok this volume).

Determining how and why one particular type of bilinguals differs from others in terms of the contexts in which language is acquired is of crucial importance to understanding the intricacies of language development in general. In her examination of child second language (L2) acquisition, Vicky Chondrogianni provides an overview of research that compares different populations of L2 learners, specifically focusing on the development of phonology, vocabulary and morphosyntax of child L2 learners. Her chapter documents how child L2 development compares with child L1 development and adult L2 learners, what the role of the L1 in the acquisition process is, whether age effects are observed in L2 acquisition during childhood, and how input quality and quantity can shape the acquisition process. The chapter concludes that research, moving forward, must take into consideration the use of more experimental methods to better understand child L2 development as well as how the process is affected by child-internal and child-external factors over time such as age of acquisition, L2 proficiency, length of exposure and other cognitive measures.

Regardless of the theoretical paradigm that motivates one's research agenda on bilingualism, it is of course important to highlight the crucial role input plays in language development. Annick De Houwer's chapter evaluates potential links between language input and child bilingual language outcomes and discusses the relative importance and weight of input-related variables (see also Putnam, Kupisch, & Pascual y Cabo, this volume). In doing so, the author highlights the dynamic nature of bilingual language input and how this complicates the description of a bilingual's language input over time. Furthermore, De Houwer maintains that in order to gain a deeper understanding of a bilingual child's developing mind, research must consider a more holistic approach to examining input, which includes accounting for the relationship between environmental factors, such as the effect of specific sociocultural power relations in society and early bilingual development.

Similarly, Victoria Murphy provides an overview of the theoretical and empirical research on literacy development – literacy training being a type of input – of minority language learners in their majority language (e.g., reading accuracy, comprehension and writing). The author presents evidence for the two-level processes of the development of reading and writing skills in minority language learners. Minority language learners do not seem to struggle with the decoding aspects of reading. They do, however, have difficulties according to comprehension measures that arguably stem from underdeveloped vocabulary knowledge as compared to monolinguals. Similarly, the author shows that minority language learners tend not to have difficulties with lower-level processes of writing (i.e., transcription and spelling) but do manifest difficulties with higher-level features (i.e., organization of ideas). The chapter continues to discuss the effectiveness of various bilingual education programs. Murphy highlights the importance of theoretically motivated educational implications and interventions for home language proficiency and literacy skills that could help minority language learners bootstrap the translation of L1 skills to the L2 context.

While the majority of the work on child bilingualism is carried out experimentally in a laboratory setting, one cannot deny the usefulness of naturalistic data. Thus, authentic, interaction-based corpora research is increasingly common in bilingualism (the default case for decades in L1 monolingual research). Yip and Matthews show how corpora such as the CHILDES have revolutionized the study of bilingual language development by offering a state-of-the-art review of the bilingual corpora as well as some of the methods that have been used in creating and analyzing corpus data. Additionally, they present various analyses that the corpus data have made possible in the study of bilingual development. The chapter specifically focuses on cross-linguistic influence, language dominance and code-mixing by looking at the corpus data of Chinese-English bilingualism and other corpus-based studies documenting bilingual development. The authors conclude that as a consequence of increasingly more linguistically diverse language pairings being represented in corpora, we will have more opportunities to investigate the possible developmental trajectories and interactions between languages.

Issues in adult bilingualism

This section begins with a chapter by Sarah Bernolet and Robert Hartsuiker that examines three central claims for production models of syntax in adult L2 acquisition: (i) there is an abstraction process of L2 syntactic representations moving from item-specific to more abstract, (ii) more L2 representations are integrated with existing L1 representations with increasing proficiency, and (iii) co-activation of L1 syntactic rules during L2 syntactic processing and production occurs in early and late phases of L2 syntactic development. In accord with White's and Wulff and Ellis' (this volume) most general claims, albeit from a different point of departure, the authors conclude that L2 proficiency and L1 syntax play a role in different outcomes in syntactic representations in L2 learners, and highlight the need for longitudinal studies to refine our understanding of the process of late learning of L2 syntax.

The vast majority of bilingualism-related research has been biased towards the examination of linguistic influence (i.e. traffic) in the direction of L1 to L2. One unintended result from such a bias has been the marginalization of other important and related questions, namely whether the cognitive mechanisms that constrain L2 development are also pertinent to L1 maintenance. In this vein, Yılmaz and Schmid present a synthesis derived from the findings of previous studies on first language attrition in adult speakers in an attempt to explain the extent to which native language knowledge can become compromised, and how. They demonstrate how including these speakers in bilingualism investigations may help us explore the limits and possibilities of our language capacity and provide additional insight into controversial issues in second language acquisition research, such as maturational constraints and the nature of L2 knowledge in late learners.

Continuing along a related path, Putnam, Kupisch, and Pascual y Cabo provide an overview of research and theory in heritage speaker bilingualism. The authors discuss the appropriateness of classifying diverse groups and individuals under the same term of "heritage speakers". In doing so, they take a closer look at three different heritage speaker groups: (i) children, (ii) young adults, and (iii) elderly bilinguals who have all been referred to as heritage speakers in the literature. They provide evidence that despite some differences, the commonalities between these groups justifies the use of "heritage speakers" as a cohesive and overarching label. The chapter argues for a unified research program on the acquisition, development, and maintenance of the heritage grammar across the lifespan.

Bilingual cognition, neuroscience and impairment

There is currently a great deal of controversy surrounding the so-called bilingual advantage. The purpose of this final section of the present volume is to summarize the current research in this domain and set straight in a transparent manner that which may present an advantage for bilinguals and that which may not. The first chapter, by Ellen Bialystok, explains the issues surrounding claims that bilingualism may impact executive functioning. Adopting a historical approach, Bialystok explains bilingualism and its relation to nonverbal cognition as we understand the topic today, and what the data might implicate for all types of bilinguals. While independent research has revealed inconsistencies about the neurological impact of bilingualism, the evidence in favor of specific structural and cognitive consequences of it on the human brain remains persuasive. Thus, this chapter argues that research must continue to focus its attention on the explanation of the underlying basis for such consequences, rather than simply looking for positive or negative effects more generally.

In speaking of the cognitive consequences of bilingualism, Susan Bobb and Judith Kroll set out to link the impacts of the bilingual lexicon on broader cognitive functioning. In doing so, the authors provide compelling evidence for the hypothesis that a bilingual's experience in "juggling" co-activated lexicons might affect general cognition. While historically bilingualism research has often painted bilinguals in a negative light, especially as compared to monolinguals, modern research has shifted the attention towards examining the plasticity of the brain across the lifespan, and what effects bilingualism has on the brain's capacity to change with experience. Bilingualism is a complex experience leading to a variety of conclusions about its impact on human cognition, though in general the mental exercise of dealing with life-long co-activation of multiple linguistic systems has measureable implications on the brain's flexibility and cognitive well-being.

Nicola Del Maschio and Jubin Abutalebi's chapter examines the neural representations of certain aspects of language processing in bilinguals such as phonological, grammatical and lexico-semantic processing. It offers a review of the functional and structural neuroimaging evidence focusing on the representation, processing and control of two (or more) languages in bilinguals. The authors show from functional data that neural structure implicated in language processing and production are similar for L1 and L2. Differences between L1 and L2 are typically modulated by L2 proficiency and exposure. Moreover, they provide structural imaging evidence indicating that the bilingual experience results in neuroanatomical alterations and the brain structure is affected by the quantity and quality of second-language experience. Based on neuroimaging evidence and linking nicely to argumentation in Bobb and Kroll's and Bialystok's chapters, they also show that language control plays a critical role in the bilingual language system. The authors maintain that linguistic research and neuroscience of language should communicate better for improvements in both fields.

The last two chapters offer an overview of clinical studies that investigate issues in atypical bilingual individuals. Johanne Paradis and Krithika Govindarajan's chapter reviews theoretical and clinical studies of bilingualism in children with developmental disorders such as specific language impairment (SLI) and Autism Spectrum Disorders (ASD). The chapter focuses on simultaneous bilinguals as well as sequential bilinguals, including research on individuals for whom both languages are high status or majority languages, e.g., French and English in Canada as well as on bilinguals who are learning a minority heritage language, e.g. Spanish in the United States. The authors focus on the efficacy of intervention on language development within those populations and highlight that given the dearth of research to date in this area, more research needs to be done before any meaningful generalizations or conclusions can be made.

Finally, Swathi Kiran provides an overview of our current understanding of bilingual aphasia, focusing on four important themes in the research: (i) bilingual language processing is highly dynamic and bilingual aphasia represents a substantially more complex manifestation of such dynamicity; (ii) what the implications are for aphasia rehabilitation in a brain dealing with multiple linguistic systems and whether one can expect cross-language generalizations; (iii) what research on the effects of bilingualism on cognition reveal about bilingual aphasia; and finally

(iv) what effects specific neurological structural changes due to bilingualism have on the extent of language impairment and/or recovery in bilingual individuals with aphasia. In general, the author discusses the above issues in consideration of methodological challenges when studying bilingual people with aphasia, and how modern research provides evidence for some potential benefits and/or costs of bilingualism on patients with language-related brain damage.

As the overview so far has shown, the breadth and depth of coverage is impressive, and we are proud to present the reader with a volume that provides a comprehensive overview of the state of the art in the field of bilingualism in the 21st century. We are now looking forward to the exciting developments in a research area where we see enormous potential to uncovering the limits of the human language capacity.

We are especially pleased that this publication coincides with the 25th anniversary of the *Studies in Bilingualism* series. We are very grateful to the authors for their contributions, to the reviewers for their time and expertise, to Nadiia Denhovska for her work at the beginning of this project and especially to the publication team at Benjamins who not only made this volume possible, but who make every volume in SiBIL possible. Their dedication to the series over the past 25 years have made it one of the strongest and enduring series on bilingualism in our field.

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PART I

Theoretical accounts

CHAPTER 2

Bilingual child acquisition through the lens of sociolinguistic approaches

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This paper entails a perspective on bilingual child acquisition through the lens of sociolinguistic approaches. A discussion of the concepts of monolingual language ideology and power dynamics is undertaken in order to reveal their important consequences on studying bilingual child acquisition, in particular, which (parts of) *language(s)* and *children* are important to study with which kinds of *methodologies*, *concepts*, and *analyses*. This paper discusses ethnographic fieldwork as a methodology to dive deeper into the whole envelope of bilingual child use in situated interactions with parents/care-takers, teachers and other children at home and in the classroom. The emphasis on language ideologies and power dynamics has helped sociolinguistic enquiry to move away from existing monolingual bias in bilingual child acquisition research.

1. Introduction

This paper is an attempt to capture the general trends in bilingual child acquisition from a sociolinguistic perspective, and in sociolinguistic approaches to bi- and multilingualism at present.[1] Sociolinguistics emerged as a framework in the early sixties of the former century, stemming from the need to contextualize the study of language or in other words, to study both language (in) use and society.

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1. Research leading to this paper has benefitted from ongoing discussions on the "new speaker" theme as part of the EU COST Action IS1306 network entitled "New Speakers in a Multilingual Europe: Opportunities and Challenges" and it has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 613465. I would like to thank the following colleagues for their valuable feedback and insights on earlier versions of this paper: Frans Gregersen, Aafke Hulk, Vincent de Rooij. I also like to thank the two reviewers for their valuable comments.

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Sociolinguistics

> attempts to establish causal links between language and society, pursuing the complementary question of what language contributes to making community possible and how communities shape their languages by using them. (Coulmas, 1997: 2)

In order to study language use as a social phenomenon, sociolinguists make use of a wide range of theories and methodologies stemming from the intersection of linguistics (both applied and theoretical), anthropology, sociology and social psychology. Sociolinguistics is therefore a broad and open field. In fact, sociolinguistics constitutes a "meeting ground for linguists and social scientists" (Coulmas, 1997: 2) in which the focus can either be more on linguistic, anthropological or more on social theory.

Since sociolinguistics differs considerably with respect to the frameworks used, concepts, methodologies, and analyses of the data over time, and meanings attached to it, this paper can only be highly selective in its topic which is bilingual child acquisition through the lens of sociolinguistic approaches.[2] From its beginnings, sociolinguists have investigated bilingual (child and adult) individuals and multilingual societies and have delivered many insights about bilingual experiences which are crucial for acquisition research, in particular, the language socialization research (Ochs & Schieffelin, 2011). This type of research investigates the socializing functions of language by caregivers, and how children through language are able to display and understand behaviors appropriate to social situations (Ochs & Schieffelin, 1984: 276).

This paper is organized as follows. Section 1 section entails a brief history and introduction to the scope of the broad sociolinguistic field. In relation to bilingual child acquisition, relevant concepts in sociolinguistics such as language ideology and power dynamics will be discussed in Section 2. Section 3 presents two case-studies of sociolinguistic methodologies and their data-collections which yield an elaborate view on the whole envelope of bilingual child behavior and interactions. Section 4 describes how sociolinguistic enquiry is helping to move away from still existing monolingual language ideologies in bilingual child acquisition research. The conclusion in Section 5 summarizes the main topics in this paper.

2. Topics such as bimodal bilingualism, social media, language rights of minority speakers or multilingualism in educational context are absent. I refer the interested reader to the many recent Handbooks on Sociolinguistics, and in particular to Johnstone (2016) for a much more detailed and comprehensive overview of language theory in contemporary sociolinguistics.

2. The history and the many faces of sociolinguistics

The strand of sociolinguistics with a focus on internal structure of language (Cornips & Gregersen, 2016) is the one developed by William Labov in which variation is examined in observable language use and its patterns are analyzed quantitatively. This kind of enquiry reflects the insight that language variation correlates with or reflects broad social categories of groups of speakers like gender, age, ethnicity, class and place (region, nation-state) (cf. Labov, 1966, 1972). The most important (statistical) findings are that every individual shows linguistic variation across and within social contexts (intra-individual variation) and that individuals differ linguistically from each other (inter-individual variation). These patterns of language variation are not distributed randomly but are social regular and correlates with style of speech (formal or informal), and this socially and stylistically patterned variation is crucial in understanding the mechanisms of linguistic change and its direction (Labov, 1966, 1972).

The findings that social, stylistic and regional intra- and inter-individual variation serves as the input to which bilingual child acquirers and second language learners are exposed and that these types of variation are produced by them as well, is important for acquisition research (Cornips, 2014; Smith et al., 2007, 2009, 2013). It is a moot question how to disentangle which type of variation in the output is due to sociolinguistic variation or (both) due to the bilingual child's development acquiring a particular phenomenon, for example, the acquisition of grammatical gender of the Dutch definite determiner that may take some years.

Sociologically oriented studies are more concerned with the distribution of languages and their broader functions with a relative large-scale perspective such as language choice, diglossia and bilingualism, language planning and policies, and educational policies with the practical application of results as major goal (Swann, 2004: 196; Wodak et al., 2011: 3). In the work of Joshua Fishman and his followers, motivated linguistic choices and norms of language use of bilingual speakers are studied addressing the question: who speaks (or writes) what language (or language variety) to whom and when and to what end? (Fishman, 1997: 26) and in which domains such as family, kindergarten, school, work and playground influence bilingual behaviour (cf. Coupland & Jaworksi, 1997: 325). These domains intersect with other sources of variance like media and role relations (like interaction between father and child or teacher and pupil). Participants, physical setting, topic and function of discourse and style (intimacy-distance, formality-informality) employed all play a crucial role in language choice (Fishman, 2000) showing the complexities of the language input environment for the child's acquisition and adult second language learning.

Charles Ferguson introduced the key concept of *diglossia* which originally referred to speech communities where two or more varieties are used by some speakers under different conditions, depending on the specialization of their functions, for example a standard language in formal and prestigious and a dialect in informal, every day and low-prestigious activities (Ferguson, 2000: 66/68).

The anthropological/ethnographic strand in sociolinguistics examines how language is used strategically in interaction and negotiations between individuals (Swann, 2004: 205). The aim of interactional sociolinguistics is to understand how social structures and language use shape each other in daily life. Dell Hymes (1972) argued strongly for research into the communal and interactional context in which speech occurs since it appears to be crucial for what speakers can do and say and provides a more complete envelope of bilingual behavior. John Gumperz theorized how understanding is negotiated through *contextualization cues* such as intonation, turn-taking processes, and non-verbal gestures in speakers' interaction. These cues may be more opaque or transparent for the interlocutors which may lead to communication problems or not, respectively. Shared, and therefore more transparent contextualization conventions are assumed to be distributed along networks of interlocutors such as prolonged interactive experience in family, friendship, and occupational networks (cf. Gumperz, 1997: 45). Before bilingual children can say anything, they must learn to distinguish between languages that are spoken to them, and they must learn to make useful perceptual distinctions in each of them in order to understand what is said to them (De Houwer, 2017a: 19). Conversational interaction and non-verbal communication, such as pointing and gaze aid children in attending to and processing aspects of their 'language input environment' (ibid.).

Studies into *language socialization* focus on interaction as well to study the process whereby young children and others are socialized *through* the use of language and socialized *to* use language(s) meaningfully, appropriately and effectively (Ochs & Schieffelin, 1984). Schieffelin (2002: 153) argues that the process of language socialization starts at birth, because the ways in which caregivers and people do or do not speak to children is culturally organized. Language socialization constitutes the ecological study of real life acquisition. Its goal is "understanding how persons become competent members of their social groups, learning how to think, feel, how to conduct themselves in socially appropriate ways, and the role of language in this process" (Ochs & Schieffelin, 1984).

In language socialization as in interactional sociolinguistics, speakers are not considered as passive subjects from which 'static' information can be collected, but as agents, as subjects who give structure to the world and who make themselves who they are, also through their language use (Joseph, 2010: 9). Language is seen as a process, constructed in particular ways by shifting and multiple groupings of individuals and is crucial in social identity formation processes: how one defines oneself (self-description) and how someone is defined by others (by ascription) (Barth, 1969: 13). Identities are not inherited and passed on; they are collectively constructed as a result of social interaction, mediatization and communication. According to Pavlenko (2007: 226), subjectivities, agency, emotions and power are all involved in identity construction through language choice, learning and use. Therefore, the link between the social and situated context and the selection of languages and linguistic forms in uses has to be understood as very complex and multi-dimensional (Eckert, 2000) since choice, selection, elaboration and interpretation of all these linguistic 'means' can index membership to various groups within existing power dynamics which might be different on various levels (local, regional, national, transnational). Within these power dynamics, one language is perceived as more 'logical', 'cultured', 'useful', 'modern', 'civilized', 'educated', 'prestigious', 'beautiful' or more 'survivable' than another. This hierarchy has a profound effect on how a bilingual speaker whether child or adult, values her two or more languages. Adults' and children's selection of languages and linguistic forms out of an input is shaped in interaction with and by others, informed by language ideology in glove with this hierarchy. In this respect, the acquisition of two languages and language choice is always an emotional and contextualized process (Pavlenko, 2007) and never a social neutral activity. Every language user associates particular languages with specific kinds of speakers and practices within a social, political and economical hierarchy. The choice between languages is connected with ideas about and stereotypes of users.

More recently in the field of sociolinguistics, upgrowing children as agents are considered crucial in the linguistic construction of their own social identities. Children in their language socialization are particularly tuned into the indexical meanings of languages and forms which link those forms to the social identities of the interlocutors (Ochs & Schieffelin, 1995). Which linguistic choices the bilingual child or adult makes in her interactions with interlocutors will become socially meaningful, is dependent on the individual and wider societal, political and ideological context. There is more attention than ever in sociolinguistics on the emergence of new types of families or new types of living together (cf. Lanza, 2007) due to the circulation of people, both adults and children, with unexpected language choice patterns as a consequence. As Sheller and Urry (2006: 207) argued, as far back as 2006:

> All the world seems to be on the move. Asylum seekers, international students, terrorists, members of diasporas, holidaymakers, business people, sports stars, refugees, backpackers, commuters, the early retired, young mobile professionals, prostitutes, armed forces [adoptees and children/LC] – these and many others fill the world's airports, buses, ships and trains. The scale of travelling is immense.
> (2006: 208)

Children participate in these circulations volitionally or unvolitionally, not as passive subjects, but as agents who are capable of appropriating new languages and innovating grammars in interaction with their linguistic knowledge and resources, according to the context and tasks at hand.

3. Monolingual language ideology

Language ideology has become an important concept in sociolinguistics questioning the interpretation of linguistic forms and choices by community members, both adults and children and their projection of an iconic or emblematic relationship between these forms and speakers (Woolard, 2008: 448). Language ideology is defined by Irvine (1989: 255) as "the cultural system of ideas about social and linguistic relationships, together with their loading of moral and political interests".

The European nation-state formation at the end of the 19th century and its influential monolingual language ideology has profoundly influenced linguists' and non-linguists' thinking about bilingual speakers and multilingual societies (Auer & Wei, 2007: 1). This monolingual language ideology had its source in the 18th century Enlightenment and substantially in Herder's (1744–1803) ideology of the tripartite 'one nation, one culture, one language', which links nationhood naturally to a language and a people. Since then the ideology prevails that there are more or less fixed links between speaking one invariable, uniform language and a national identity sharing a more or less stable set of norms and values, both cultural and linguistic (cf. Blackledge & Pavlenko, 2001: 252; Kroskrity, 2010). Crucial to modern European nation-building was the formation of state institutions such as educational infrastructure that took care for the need of an official supposed homogeneous language through selecting, codifying, implementing and elaborating the 'right' language labelled a standard language (Haugen, 2003). Since language is a key ingredient in the ideology of a national unity and that nations are real (Joseph, 2010: 16), being part of a nation was equated with being a native speaker of 'its' distinguished language. From then onwards, the establishment of a new nation-state almost inevitably has entailed the 'invention' of a new standard language (Auer & Wei, 2007: 1–2), and hence, native speakers. This monolingual ideology has been expanded outside Europe and forced upon in colonial/Christian contexts (cf. Makoni & Pennycook, 2005).

Before the European nation-state formation, multilingualism was a daily and pervasive phenomenon. In the Low Countries of medieval times people spoke their local dialects, whereas Latin was the language of science, church and literature and French the language of the court and civil service (Sijs van der, 2004: 37). In the Dutch Republic of the 17th century, the active and passive knowledge of more than one language or dialect was part of daily life in all kinds of situations (Frijhoff, 2010: 8; Sijs van der, 2004: 31). After the European nation-state formation, multilingualism was and is a common societal and individual daily practice. However, the deep impact of the monolingual language ideology still results in the erasure of numerous languages in public and official activities of national governments worldwide (Extra & Gorter, 2001: 10–11) through ideas that multilingualism hampers 'efficiency' in running a state and the number of languages should be kept to a minimum in order to preserve a state's 'integrity' (Patrick, 2010). As a consequence, many languages find themselves excluded from a national state level, in particular within general educational contexts. Examples of languages spoken in France (all examples below are taken from Extra & Gorter, 2001: 10–11) are Breton and Corsican; for Germany: North Frisian and Sorbian; for Italy: Friulan and Sardinian; for the Netherlands: Frisian; for Portugal: Mirandes; for Spain: Galician and Aragonese; for Great Britain: Scottish Gaelic and Cornish. Examples of languages that are spoken in more nation-states in Europe are: Basque in Spain and France; Catalan and Occitan in Spain, France and Italy; Sami in Sweden and Finland and Limburgish in the Netherlands and Belgium. There are languages that are a minority language in one nation-state state but the dominant official one in another, as Albanian in Italy and Greece; Croatian in Italy and Austria; German in France, Italy, Belgium and Denmark; Slovenian in Austria and Italy; Danish in Germany; Dutch in France. Then, there are the so-called non-territorial languages like Romani and Yiddish and languages that are brought due to migration and have become part of the daily multilingual practices throughout Europe like Turkish, Polish, Berber, Urdu. This process of exclusion or marginalizing multilingual societies and bilingual speakers is not restricted to Europe but takes place worldwide as well.

Language ideologies also have serious consequences on how linguistics is practiced and how linguists conceive their object of research: which (parts of) *language(s)* and *speakers* are important to study with which kinds of *methodologies*, *concepts*, and *analyses*. A concept of indexicality is crucial to analyze how language users derive meaning in their tendency to associate particular languages as distinct linguistic identities and linguistic forms with specific kinds of speakers or contexts of speaking (cf. Woolard, 2008: 437). When informed by a monolingual language ideology, bilingual phenomena such as code-switching, may be considered as a signal of imperfect command of the standard language, particularly in educational contexts. The use of a non-dominant societal language in public may index resistance or impolite behavior, or the use of dialect may index backwardness and so forth.

Since linguists and linguistic analyses most often refer to standard languages – also typical for bilingual child acquisition studies – standard ideology is part and parcel in linguistic analysis (Milroy, 2001: 530). Auer & Wei (2007: 3) discuss the deep impact of the nation-state ideology in and outside linguistics, in which phenomena as multilingualism, language variation, language contact and language mixing are seen as a disturbance in the 'natural order'. The concepts of native speaker, monolingual speaker, monolingualism and hence non-native speaker, bilingual speaker and bilingualism and analyses like imperfect acquisition, fossilization, transfer and variation are all consequences, or rather, inventions of this purism debate implied in the European nation-state language ideology. A bilingual was considered as a speaker whose grammars are the equivalent of two monolingual states (Pavlenko, 2007) and language separation presupposes the existence of two separate systems. In a one language – one parent scenario for example it is assumed that children in bilingual families are exposed to two separate languages in use (cf. Meisel (ed.), 1994 among many others) and questionnaires are often used to 'measure' the division of labor amongst two languages (Carroll, 2017).[3] Similarly, a concept like language attrition refers to changes in one language i.e. the first acquired one (Schmid & Jarvis, 2015: 729) and as Auer (2007) argues, even code-switching research shows a monolingual bias.

3.1 Bilingual uses

Language ideologies held by speakers inform their in situ selection of languages and forms. An example of the latter is the interaction in Dutch and dialect between Pim, 5;8 years old, and his swimming instructor on a Saturday morning in the indoor swimming pool in a small village in Dutch Limburg (Fijnault, 2011), presented below. This interaction is an example of the concept of diglossia (see §1.1) since people in Limburg perceive and experience dialect and Dutch as two distinct linguistic identities (cf. Cornips, 2013).

The swimming instructor and Pim talk together in dialect when Pim stands on the side of the swimming pool. At one point, the instructor asks Pim in dialect:

(1) *Kumse het water in, anges kries ze ut koud*
'Come into the pool, otherwise you will be freezing'

The moment Pim jumps in the water, the instructor switches to the use of Dutch:

(2) *Pim, doe je handjes op je rug*
'Pim, put your hands-DIM on your back'

3. It is important to point out that the focus on the capability of separation of languages is and has been very crucial in the emancipation of children growing up bilingually and bidialectally as children who are ably to acquire successfully a standard language.

and in Dutch:

(3) *Benen sluiten, Pim*
‘Close legs, Pim’

Pim, being in the swimming pool, also answers in Dutch:

(4) *Ik heb water in mijn oogjes*
‘I got water in my eyes-DIM’

Here, language choice between dialect and Dutch is indexical of the kind of situated interaction and hierarchical relations. The choice to Dutch signals a formal setting in which instruction on how to swim takes place within a hierarchical relation between an instructor and her pupil. The formality of the situation is co-constructed by Pim in his choice of Dutch when being in the water. The use of dialect co-constructs an informal situation between locals: the adult and child just chat with each other while standing on the side of the swimming pool. Pim’s choice between Dutch and dialect shows that he is already socialized in when to use what language; in what context, with whom, in what kind of relationship and with appropriate social meaning.

The interaction between bidialectal Pim and his instructor shows separate language uses. But bilingual uses also blur “the line between language A and language B, and also between ‘langue’ and ‘parole’, between linguistic systems and their usage, between knowledge and practice” (Auer, 2007: 320). The question where one language stops and the other starts in bilingual talk is difficult to answer since it is not only a matter of structural distance from the perspective of the analyst, but also of the perception of the distance by the speaker (Auer, 2007). Ambiguous stretches of talk between language A and B are made to happen by speakers for interactional reasons. (5) is an example of Clyne (1980: 400) with such an ambiguous stretch, i.e. the near-homophonous dimorphs dialectal German /fɛr/ and Australian English /for/ (taken from Auer 2007: 322):

(5) wir nehmen unsre biecher **fär** **vier** (-) ***for*** ***four*** *periods*
we take our books for four
‘We take our books for four – for four periods’

In this example, the instantiations of ‘for’ and ‘four’ do not differ from their respective counterparts in monolingual talk but as Auer (2007: 323) argues, bilinguals do not usually speak like two-fold monolinguals. In contemporary sociolinguistics, the clear-cut alternation between monolingual and bilingual uses is problematic. For example, the Moroccan-Arabic/Dutch example in (6) taken from Boumans

(1998: 233) shows that (6) is not like monolingual Moroccan Arabic since the auxiliary in Moroccan-Arabic combines with the Dutch infinitive *voelen* 'feel':

Moroccan Arabic/Dutch

(6) ma ka-t-dir-ha- *voel-en*?
NEG ASP-2-do-3SG.F-NEG feel_{INF}
'So, don't you feel it'

Therefore, the sociolinguistic study of the monolingual language ideology has led to the questioning of the nature of the concept of language itself and, as a consequence, bilingualism which "can be understood as a wide variety of sets of sociolinguistic practices connected to the construction of social difference and of social inequality under specific historical conditions" (Heller, 2007: 3). The perspective on language as a social practice within power dynamics frames linguistic discourses of multilingualism as political and economic discourses (Stroud, 2007: 509, see §4) and has influenced concepts, methodologies and analyses in sociolinguistics (Blommaert, 2010). That is, rather than depicting 'a language' as a monolithic, fixed, countable and bound object, it is assumed that *a language* is (re)produced by language users through the process of *enregisterment* by which distinct forms of speech come to be socially recognized (or enregistered) as indexical of speaker attributes by (a group of) language users (Agha, 2003; Johnstone, in press). Through enregistering, a selection of specific linguistic forms becomes meaningful for the speaker as a distinctive or recognizable set of 'a language' (see §4).

4. Sociolinguistic methodologies

Sociolinguistics makes use of a wide range of methodologies to study bilingual children. What all these methodologies have in common is that they focus on language (in) use in order to grasp a more complete and accurate picture of how individuals actually speak in interactions across situated contexts and how they use language for their social identity constructions. Therefore, bilingual acquisition research that requires a monolingual control group is quite problematic from a sociolinguistic language (in) use perspective. How to decide from a sociolinguistic perspective which children have to be considered as monolingual or bilingual (2L1, L2)? Is a bilingual speaker someone who speaks two languages daily or monthly or who categorizes herself as bilingual or is also literate in the two or might understanding in two languages already be sufficient (Li Wei, 2000: 5)? Bilingual children use their languages in different situations with different people. Thus, although Pim and his swimming instructor use both languages separately during the instruction and informal chatting context in the swimming pool, they and other bidialectal speakers in Limburg reveal code-mixing in other contexts (Giesbers, 1989: 337). Similarly, bilingual children do not acquire a second (first) language in exactly the same contexts and with the same interlocutors as monolingual children (Li Wei, 2000: 17). Thus, monolingualism and bilingualism may represent extremes of a multidimensional spectrum in knowledge, usage, and behaviour (cf. Cornips, 2014; Luk & Bialystok, 2013; Luk, 2015; Li Wei, 2000: 5–7). Moreover, experimental methodology poses another challenge when it requires to categorizing children in cases when their home language is different than the dominant societal language. The researcher may group children who speak at home Moroccan Arabic or Mandarin in France and England, respectively as French/Moroccan or English/Mandarin by ascription, perhaps on the basis of assuming fixed links between language background and language behavior. Such categories, however, do not imply that the subjects ascribed to these categories i.e. French/Moroccan behave in a homogenous way with respect to their language (in) use. Their experiences throughout their lives, being children of migrant (grand)parents or not, their gender, education, social class and neighborhoods where they live and their religious and cultural associations may differ bringing about different linguistic identifications. Illustrative is an interview with the 30-year-old sociologist Farida who would be placed under the label Moroccan/Dutch bilingual speaker, but vehemently protests against the interviewer's question whether she considers herself Dutch, Moroccan, Dutch-Moroccan or Moroccan-Dutch:

> None of these things! …To be Moroccan…that doesn't mean much to me since I grew up here [the Netherlands/LC]. I came here at a very young age, so I had my socialization here, outside the group (…) To me, being Moroccan means being attached to Morocco. Which I am not. (Buitelaar, 1998: 43)

Therefore, in language socialization approaches, interactional sociolinguistics and linguistic anthropology, ethnographic fieldwork is preferred in order to be able to examine language (in) use as social activity in various contexts. It, thus, aims first-hand experience and exploration of a particular social, cultural or linguistic setting (Atkinson et al., 2001: 4; Zentella, 1997). Traditional methods are in-depth and long term observation of the spoken language-in-situ, that is, embodied practices of speaking and doing (of groupings) of individuals, participant observation and the making of audio or video-recordings and field notes. Moreover, in ethnographic fieldwork, the identity, beliefs, attitudes and values of the researcher (gender, social class, ethnicity, race) is considered extremely important as – in all types of linguistic fieldwork – it affects the aims and objectives of the research and the relationship with the children under study (see Li Wei, 2000a: 476 for more details). In general, ethnographic analyses include a reflection of the researcher's influence on the field she is examining.

Below I will discuss two types of sociolinguistic researches in more detail in their aims and methods.

4.1 The focus on the child's linguistic meaning-making practices in the classroom

The first case-study I present is the one by Karrebæk (2013) who conducted ethnographic fieldwork involving young children in an ethnically and linguistically diverse school in Copenhagen. The aim of her research was to examine the process of language socialization of children into existing power dynamics of the classroom and which values they attached to their two languages. She carried out fieldwork among a class of school-starters between 17 and 20 children, aged 5 through 6 between 2009 and 2012. She conducted participant observation, audio- and video-recordings in classes, during breaks, in afterschool centers and the children undertook self-recordings in the same settings. The collected data consists of approximately 300 hours of audio-recordings, 90 hours of video-recordings, and 20 interviews with teachers, the school principal and parents of children in grades 0 through 1. Karrebæk's (2013: 361) study revealed that children in grade 0 of which two-third had home-languages other than Danish, almost never oriented to other languages than (standard) Danish. She found only 23 situations in which minority languages were used in her almost 300 hours of recordings (covering both class-time and break-time). According to Karrebæk's analysis, how children socialize into the monolingual standard ideology is mediated by the teachers who don't speak about linguistic diversity with their pupils. As a result, they created a lack of visibility or erasure (Gal & Irvine, 1995) of multilingualism and thereby achieved the monolingual classroom as the ideal. The children participated in co-constructing the classroom as monolingual, that is, Danish only by not questioning the teacher about their linguistic diversity and by disciplining themselves. How this was done, was observed in an interaction between three girls Fadime (Turkish language background), Merve (Turkish language background), and Selina (Moroccan language background) when playing with wooden blocks. Merve and Selina starts competing as to who can build the tallest tower and Merve informs Fadime in Turkish that she has won: *Fatima ben kazandim* 'Fatima I have won'. Selina disciplines Merve in Danish by telling her "don't speak like *that* to her" in which *that* refers to the use of Turkish:

Extract (1)

Merve: Fatima (.) ben kazandim.
'Fatima, I have won'
(0.5)
Selina: la vær med og tal sådan til hende.
'don't speak like that to her'
Merve: jeg vundet.
'I won'

Karrebæk analyses these interactions in the classrooms as brought about by reflections of the "principal's orientation to middle-class values and a monolingual and mono-cultural habitus. (…). The children soon learned that a competent and obedient schoolchild was expected only to draw on linguistic features associated with standard Danish" (2013: 370). Her ethnographic fieldwork, thus, reveals that the indexical sensitivities of Danish versus Turkish may account for why and how children may produce the linguistic forms and language choices they do in specific contexts (like Pim's choices discussed earlier (§1.2)).

4.2 Focus on linguistic variation in bidialectal care-giver and child interactions

Smith and her colleagues conducted sociolinguistic fieldwork in home interactions in Buckie, a small fishing bidialectal town in Scotland (UK) (Smith et al., 2007, 2009, 2013).[4] The focus in this research was on linguistic variation addressing the question: when do children acquire the highly complex patterns of variation between dialect (local/traditional variants) and standard (Scottish) English variants, both linguistic (phonological, morphological and syntactic structured variation) and sociolinguistic, widely attested in adult speech? The interaction in (7) between Luke and his mother Molly shows that Molly uses two forms of the negative imperative i.e. *dinna* and *don't* (Smith et al., 2013: 286):

(7) (Luke) Take it off! (Molly) No *don't* no! *Dinna* now! Just leave that. Just hold on. No *dinna*! You'll break it. *Don't* do that! (Luke) How?

The local variant *dinna* is associated with working class speech and informal contexts. The sample of subjects was controlled in order to elicit local/traditional variants as *dinna* as much as possible. Therefore, the subjects were selected according

4. Other studies of in-depth observational studies of home interactions like Juan-Garau & Pérez-Vidal (2001), De Houwer (1990), Lanza (1997), Afshar (1997), Deuchar & Quay (2000) and Garlin (2008) are reported in De Houwer (2017b).

to the following criteria: (i) both parents were born and raised in Buckie; (ii) the mother was the main caregiver, i.e., the child spent no substantial time with extended family; and (iii) no child was in formal nursery education, to avoid effects of standardization (Smith et al., 2013: 287–289). They collected speech between children and their mothers i.e. 29 dyads (caregivers and their children aged 2;10 to 4;2) participated and their primary caregivers were provided with lightweight minidisc recorders (Sony MZ-R700) and lapel microphones (Sony ECM-T145) and requested to undertake a series of recorded sessions with their child, in a variety of situations. These included interactions between mealtimes, trips in the car, walks and lots and lots of play. The recordings amounted to ten hours for each pair; 290 hours in total. The transcribed corpus totals ca.700 000 words (see details in Smith et al., 2007; Smith et al., 2013: 287–289). The analysis was a quantitative one comparing (i) overall distributions between community, caregiver and child, (ii) across ages of children, (iii) between caregiver/child pairs, and (iv) comparisons across linguistic constraints. The results for negation show (but see Smith et al., 2013 for the other types of linguistic variables) that the caregivers in interaction with their children used considerably lower rates of the local form *dinna* when compared to adult to adult patterns of use. In turn, the children had lower rates than the caregivers. Furthermore, *dinna* is significant used more by the older than younger children. These results are explained by assuming that the caregivers exaggerate the use of the standard variant *don't* with younger children but once the children pass the age of acquisition, the caregivers revert to adult-like norms and hence local variants as *dinna* in their speech. Thus, although the caregivers of the younger children are in fact using both variants, the standard one may have more prominence in the speech of the caregiver and this is the form that the child will hear, and use, first.

In both two case-studies various role-relations (adult-to adult, adult/teacher/care-giver-to-child, child-to-child, §1 (Fishman, 2000)) across different situational contexts may be compared although research aims and questions may differ considerably. The data-collection yields a more elaborate view on the whole envelope of bilingual behavior than would be possible through an experimental, controlled setting. In fact, an experimental setting implies that eliciting linguistic forms (phonological, morphological or syntactic) in language X is the same kind of social activity for a child, as eliciting the same forms from language Y with similar indexical sensitivities, as well as for monolingual controls. However, bilingual children acquire and learn their second (first) language under different conditions for different purposes in different contexts.

All methods discussed above can be found in the various strands of sociolinguistic research: all types of interviews (open, (semi-)structured), a form of (participant) observation, audio- and video-recordings and self-recordings and the use of questionnaires are applied both in the various sorts of sociolinguistic fieldwork.

5. Beyond monolingual ideology: Fluidity, crossing and languaging

Contemporary sociolinguistics attempts to break down the Herderian view of the concept of a language as a discrete, bound, countable, fixed, invariant object since "languages do not exist as real entities in the world and neither do they emerge from or represent real environments; they are, by contrast, the inventions of social, cultural and political movements" (Makoni & Pennycook, 2005: 2, see also §2). Sociolinguistic enquiry has helped move ideologies away from this Herderian view by proposing that instead of working with languages, it may be more useful to investigate how groups of speakers organize '(sets of) linguistic resources […] in ways that make sense under specific social conditions' (Heller, 2007: 1; Jørgensen, 2008: 167). The idea of linguistic resources was already present in the *human linguistic pool* of Nette that contains linguistic items that are "any piece of structure that can be independently learned and therefore transmitted from one speaker to another (…)" (Nettle, 1999: 5, quoted by Mufwene). Inspired by the linguistic pool, Mufwene (2001) proposes the idea of a *feature pool* which is analogous to a biological gene pool. The feature pool consists of all the variants coming from all kinds of sources the learner is exposed to, including the social and systematic values that enable her to rank them and selects the options that are the most successful ones. The learner can also identify which variants are in (some) complementary distribution and which ones are not and appropriate alternative variants, as she is likely to interact in different networks and/or settings committed to differing variants. Since exposure takes place throughout someone's life, such a feature pool is inherently fluid and flexible. Wiese (2013) proposes to elaborate the notion of a feature pool as a *feature pond* that "supports a network of interdependent features, a rich ecology that brings forth interconnected linguistic patterns at different levels". Such a feature pond is flexible as well and allows certain feature choices over others, depending on the particular practices and contexts with different communicative situations, but not in a mechanistically determined way.

The concepts of a linguistic pool, feature pool and feature pond aims to handle language (in) use that otherwise cannot be accounted for within a monolingual ideology, because from that perspective it is too unexpected. For example, Cornips and de Rooij (2013) report on the use of Papiamentu by adolescent speakers of Surinamese descent that from an analyst's perspective, is completely surprising, because Papiamentu is not their 'heritage' language, whereas Sranan Tongo would be. Hence, their use of Papiamentu does not conform to the ethnic category or heritage to which these friends are normally assigned. This unexpected choice provides a window or recognizing identity as interactional and emergent: by the use of Papiamentu they actively produce new forms of identity by disrupting naturalized associations between a specific language and specific social categories (Bucholtz &

Hall, 2005: 593). Observational audio-recorded field work shows that every time when a young woman passes the group of friends, they switch to Papiamentu to address her. In these interactions, Papiamentu in use is indexical for seducing women (Cornips & de Rooij, 2013):

Extract (2)

Situation: Romano notices a girl across the street (italics: Papiamentu, underlined: English)

Romano: hey Nadia! roep haar even?
Romano: 'hey Nadia! just call her?'
Ronald and Vincent call the girl a few times.
Vincent: *menina*!
Vincent: 'girl!'
Ronald: *menina*!
Ronald: 'girl!'
Vincent: *gusta bo. unda bo ta bai.*
Vincent: 'I like you. where are you going'
Romano: hij praat echt Antilliaans. *unda bo ta bai.*
Romano: 'he really speaks Papiamentu. where are you going'
Ronald: <u>come and talk to me</u>. (they all laugh)
Vincent: *menina*!
Vincent: 'girl!'
Ronald: *dushi, hey dushi. unda bo ta bai.*
Ronald: 'sweetheart, hey sweetheart where are you going'
Vincent: *bai drumi, menina. bai! bai kasa.*
Vincent: 'go and get some sleep girl go away'
Ronald: *warda. mi ta bin. warda. mi ta bin.*
Vincent: 'get married. I'm coming. wait. I'm coming'
Vincent: *menina*! (they all laugh)
Vincent: 'girl!'
Vincent: *bini! bini!*
Vincent: 'come come'
Ronald: *gusta bo. hey dushi. mi ta bin. wardami. warda, mi ta bin.* (they all laugh)
Ronald: 'I like you. hey sweetheart I'm coming. wait for me wait, I'm coming'

From the perspective of a monolingual ideology, Papiamentu is used in a very restricted way with many repetitions. For example, *gusta bo* 'I like you' lacks the required subject (topic) *mi* as in *mi gusta bo*. However, the use of *gusta bo* as part of linguistic resources that the friends have in common makes sense for these speakers under these specific social conditions i.e. seducing women. Hence, linguistic resources do not only include linguistic forms like phonemes, morphemes, lexical units and structures, but anything that people use to communicate meaning (Blommaert & Backus, 2011: 7) or communicative competence (Gumperz, 1997). From a sociolinguistic interactional perspective, these friends do not use Papiamentu as a discrete language but features like *gusta bo* which are associated with "a language" as Papiamentu and the meaning(s) of its use is derived through their association with Antilleans and their contexts of speaking. It is a crucial point that these associations are fluid and negotiable, but that these practices exist within speakers' ideologies of fixed links between language and social categories, that is, for the speakers in Extract 2, the use of Papiamentu is linked with Antilleans in their own neighborhood (Cornips & de Rooij, 2013).

Other concepts that attempts to capture these fluid and flexible use of linguistic features disconnecting fixed links between language, ethnicity and place (nation-state) are *crossing* (Rampton, 1995, inspired by Hewitt, 1986), *polylanguaging* (Jørgensen, 2008), *metrolingualism* (Li Wei, 2011) and *translanguaging* (Otsuji & Pennycook, 2010; cf. Androutsopoulos, 2013 for a brief overview). Rampton defines crossing such as the use of Papiamentu by speakers of Suriname descent in Extract 2 as "code alternation by people who are not accepted members of the group associated with the second language that they are using (code switching into varieties that are not generally thought to belong to them)" (1995a: 485). Jørgensen (2008; Jørgensen et al., 2011; Jørgensen & Juffermans, 2011) attempts to capture language in use as a process and proposes to use the verb languaging for language practice or behavior. Languaging places the activity and the agents hence, languagers and their uses in focus, rather than the linguistic system (see Møller & Jørgensen, 2009). This speaker-orientedness included in all these concepts is needed in order to ensure that the use of unexpected linguistic features is informative only when it is socially meaningful for both the speaker and listener such that the listener can interpret the speakers' intentions. In the words of Auer, code-switching and transfer

> is defined as a relationship of contiguous juxtaposition of semiotic systems, such that the appropriate recipients of the resulting complex sign are in a position to interpret this juxtaposition as such. (Auer, 1995: 116)

Ultimately, the conventionalized use of combining linguistic features associated with different languages can be interpreted by interlocutors as belonging to one and the same set of linguistic features i.e. to one linguistic and hence, social identity. Flores and Lewis (2016), for instance, analyze an interaction between two students and one researcher in a local Latino kindergarten class of a dual language charter school. One of the students used *mira* (in Spanish 'see', 'look') in an otherwise full English utterance. On the basis of their observations, they argue that *mira* is not an example of code-switching in which *mira* means 'see/look' but that it was used in order to get attention. There was nothing in the observations that proved that the students understood this word to be a Spanish word (2016: 116). According to Auer, only if language uses are to be analyzed

> as a collection of discursive and linguistic practices used by speakers in a community and based on certain grammatical/lexical/phonological feature constellations, these constellations may reveal one speaking style (and therefore one 'code') [as in the case with *mira*/LC] or they may become amalgamated into a new system such as the so- called mixed or fused languages. (Auer, 2007: 337)

This depends on the extent of whether these speaking styles have become conventionalized or routinized, that is through the process of enregisterment (Agha, 2003).

6. Conclusion

This paper discussed bilingual child acquisition through the lens of recent sociolinguistic approaches which study language ideology and power dynamics. In this perspective, the paper discusses the monolingual (standard) language ideology as the result of the modern European nation-state formation since romanticism, until its strongest position at the end of the 19th century and which is still present nowadays. This monolingual ideology influenced and is influencing the way by which languages are ranked according to social, political and economical contexts; how many languages can/could not participate in education and, most importantly, how 'language' became/becomes reified as a language; which is, as a discrete, bound, countable and monolithic object.

This ideology still influences linguistic research profoundly in taking concepts 'for granted' like native speaker, monolingual speaker and analyses like imperfect acquisition, fossilization, accuracy, transfer and cross-linguistic influence. Sociolinguistic enquiry has helped move ideologies away from this view to introduce concepts like feature pool, feature pond, crossing and languaging, that all endeavors to catch the flexible and fluidity of language uses (practices).

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CHAPTER 3

Usage-based approaches to second language acquisition

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We present an overview of the cognitive underpinnings of usage-based approaches to second language acquisition (L2A). Not all constructions are equally learnable, even after years of (frequent) exposure. We present a usage-based analysis of this phenomenon in terms of fundamental principles of associative learning: Low salience, low contingency, and redundancy all lead to form-function mappings being less well learned. Compounding this, adult acquirers show effects of learned attention and blocking as a result of L1-tuned automatized processing of language. We also describe form-focused instruction studies that aim to recruit learners' explicit, conscious processing capacities for noticing novel L2 constructions before subsequent implicit processing consolidates it into the system. We conclude with further readings which discuss wider coverage of usage-based L2A.

1. Introduction

"Usage-based" is an umbrella label for a variety of approaches to second language acquisition (L2A) that minimally share these two assumptions:

1. The linguistic input learners receive is the primary source for their second language (L2) learning.
2. The cognitive mechanisms that learners employ in language learning are not exclusive to language learning, but are general cognitive mechanisms associated with learning of any kind.

In this chapter, we describe the constructs and working assumptions that characterize usage-based approaches to language learning, with a particular focus on the cognitive underpinnings of usage-based approaches (for a more detailed discussion of the important contributions of social and interactional factors in usage-based approaches, see, for example, Cadierno & Eskildsen, 2015). We start out by explaining

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constructions as the targets of language learning. Then we describe the processes of construction learning in terms of exemplar-based, rational, associative learning. But not all constructions are equally learnable by all learners: Naturalistic second language learners focus more in their language processing upon open-class words than on grammatical cues. We describe a usage-based analysis of this phenomenon in terms of salience, contingency, and redundancy, and explain how adult acquirers show effects of learned attention and blocking which further limit learning. We outline educational interventions targeted upon these phenomena. We conclude with further readings which widen the coverage of usage-based L2A.

2. The targets of language learning: Constructions

Learning a language involves the learning of constructions. These are the form-function mappings that are conventionalized as ways to express meanings in a speech community. Constructions range from morphemes – the smallest pairing of form and meaning in language – to words, phrases, and syntactic frames (Goldberg, 2006; Trousdale & Hoffmann, 2013). That is, simple morphemes such as *–aholic* (meaning 'being addicted to something') are constructions in the same way as simple words like *nut* (meaning 'a fruit consisting of a hard or tough shell around an edible kernel'), idioms like *It is driving me nuts* (meaning 'It is greatly frustrating me') , and abstract syntactic frames like Subject-Verb-Object-Object (meaning that something is being transferred, as realized in sentences as diverse as *Max gave the squirrel a nut*, *Nick gave Max a hug*, or *Steffi baked Max a cake*, where nuts, hugs, and cakes are being transferred, respectively). As the latter examples illustrate, not all constructions carry meaning in the traditional sense; many constructions rather serve a more functional purpose. The passive construction, for instance, serves the function of shifting the focus of attention in an utterance from the agent of the action to the patient undergoing the action (compare the passive *A cake was baked for Max* with its active counterpart *Steffi baked Max a cake*).

Consequently, constructions have to be simultaneously stored in multiple forms that differ in their level of complexity and abstraction. To give a simple example of different levels of constructional complexity, the words *nut* and the plural *-s* morpheme are simple constructions; both are stored also as constituent parts of the more complex construction *nuts* ('more than one nut'). Different levels of constructional abstraction (also referred to as schematization) are evident for example in the fully lexicalized formula *Thank you* vs. the partially schematized slot-and-frame greeting pattern [*Good* + (time of day)], which renders lexicalized phrases like *Good afternoon* and *Good evening*, and the completely schematic

[Adjective + Noun Phrase] construction, which in turn could be lexically specified as *happy camper*, *sweet tea*, or *grand finale*, to give but three examples.

Given this widely encompassing definition of constructions, the dividing line between the lexicon and the grammar, or words and rules, is blurred: rather than seeing a sentence as the product of applying a rule that strings a number of words into a particular order, a sentence is the product of combining a number of constructions – some simple, some complex, some lexically specific, some abstract – in a particular way. A sentence like *What did Max give the squirrel*, for instance, is a combination of the following constructions:

– *Max*, *squirrel*, *give*, *what*, *do* constructions
– VP, NP constructions
– Subject–Verb–Object–Object construction
– Subject–Auxiliary inversion construction

An adult speaker's knowledge of their language(s), therefore, can be equated to a huge warehouse of constructions that vary in their degree of complexity and abstraction. Constructions come with properties that define if and how they can be combined with other constructions; for the most part, these properties are semantically and/or functionally motivated such that any two constructions can only be combined if their meanings/functions are compatible, or can at least temporarily attain compatibility in the specific context or discourse situation (Goldberg, 2006). How compatible two constructions are is crucially driven by the frequency with which they are used (and therefore, heard) together: the more often they co-occur, the more entrenched that particular constructional arrangement becomes. Conversely, we can predict that learners will acquire constructions first in the contexts of the constructions that they most often occur with in the input, and then gradually expand the repertoire of combinations to less frequent combinations and even acceptable novel combinations, provided a native-like knowledge of each construction's semantic and functional properties.

3. The processes of language learning: Exemplar-based rational contingency analysis

In other words, language learning means learning the associations within and between constructions. Constructionist accounts of language acquisition involve the distributional analysis of the language stream and the parallel analysis of contingent perceptual activity, with abstract constructions being learned from the conspiracy of concrete exemplars of usage following statistical learning mechanisms, relating input and learner cognition (see Rebuschat & Williams, 2012 on statistical learning mechanisms). Psychological analyses of this learning of constructions as form-meaning pairs is informed by the literature on the associative learning of cue-outcome contingencies that hinge on both construction-related and learner-related factors. For constructions, their frequency of experience, salience of form, significance of meaning, prototypicality, redundancy vs. surprise value, and the contingency of form and function seem to matter; for learners, cognitive factors like learned attention, automaticity, transfer, overshadowing, and blocking play a crucial role (Ellis, 2008b). These various psycholinguistic factors conspire in the acquisition and use of any linguistic construction (see Ellis & Wulff, 2015a, 2015b for a detailed discussion of each factor).

Research in psycholinguistics demonstrates that generally, the more frequently a construction (or combination of constructions) is experienced, the earlier it is acquired and the more fluently it is processed (Ellis, 2002). Words such as *one* or *give* occur more frequently than *sixteen* or *syndicate* – and the learner's perceptual system gradually attunes to the probabilities of these constructions in the input.

When a learner notices a construction for the first time, this can result in a unitary representation in memory that binds all its properties (i.e., phonological make-up, spelling, etc.) together. This representation subsequently receives activation whenever the construction's properties are present in the language environment, hence it serves as a form of detector, or pattern-recognition unit. Once the detector unit's activation threshold is met, it will fire. With each firing, the resting level of activation of the detector unit increases (and correspondingly, the threshold for firing decreases) – in other words, it is readied, or primed, for re-activation. This priming effect accrues over a speaker's lifespan such that frequently occurring constructions and the properties associated with them obtain habitually high resting activation levels.

The form-function mappings between a phonological form and its interpretation are strengthened through continued use in the same way: every encounter of /wʌn/ as *one* strengthens the association between the two; every encounter of /wʌn/ signaling *won* is tallied as well; as is the association between /wʌn/ when it is the initial part of *wonderland*.

Once a first memory representation is built, the language system compares each subsequent exemplar that the learner encounters in their language environment against that representation, and gradually alters and adapts it to fit the accumulating experience of that construction, its properties, and its contexts. As encounters with exemplars of a construction manifest similar or identical properties time and again, prototypes emerge that then serve as the basis of comparison for future encounters. Prototypes are knowledge representations that bind together the most typical properties of a construction. They are mental constructs in the sense that they are abstractions that are the sum of a learner's encounters of sufficiently similar exemplars. Prototypes are the defining center pieces of categories by virtue of being maximally similar to other members of that category and maximally dissimilar to non-members of that category. For example, people are quicker to confirm that sparrows are birds than they are with other kinds of birds like geese or albatrosses. This is because sparrows are more prototypical birds: they unite the most typical features of birds in terms of size, beak shape, wing length, etc.

It is important to note that according to research in cognitive psychology, this adaptive fine-tuning of a learner's language representations is not conscious and explicit in nature, but happens unconsciously and implicitly. As far as properties of categories are concerned (whether it is a conceptual category like *bird* or a linguistic category like *noun phrase*), learners do not consciously take stock of their frequency in the cognitive/linguistic environment; instead, statistical learning happens unconsciously (Ellis, 1994; Rebuschat, 2015).

Another important tenet of usage-based theories in the context of categorization is that no principled distinction is drawn between linguistic and other cognitive categories. In the same way that speakers classify the world around them, so they classify the language that accompanies their experiences. Psycholinguistic research has demonstrated prototypicality, neighborhood, and other categorization effects in learning quasi-regular patterns of construction form. For instance, people are fastest when asked to produce regular forms (like, for example, plural *sparrow* + *s*), slower and less accurate at generating more marked forms (like *finch* + *es*), and slowest still to produce irregular forms (such as *geese*) (Chater & Manning, 2006; Seidenberg & Plaut, 2014).

4. The language system emerges from usage

Over usage experience, form-function mappings are woven into a network of construction forms and their meanings. This language system is sometimes referred to as the "constructicon". Activation spreads through this network as a function of the learned probabilities of the different form-interpretation associations that a speaker has built over his/her lifespan. The resulting mental model that learners build is, at any time in language development, a custom-tailored, adaptively fine-tuned reflection of the learner's summed language experience (Ellis, 2006a). In that sense, language learning is rational as defined in the field of rational cognition: a major impetus for human psychology is to adapt behavior best as possible to its environmental conditions (Anderson, 1989). It is also emergent in the sense that learners employ few and simple learning mechanisms, yet the knowledge networks that arise from employing these mechanisms over time are complex, dynamic, and adaptive (Ellis, 1998; Beckner et al., 2009; Ellis & Larsen–Freeman, 2009). Language is a complex-adaptive system in the sense that it involves many agents (people who communicate with each other) in many different configurations (individuals, groups, networks, and cultures); and it operates across many different levels of the system architecture (neurons, brains, and bodies; phonemes, constructions, interactions, and discourses) as well as on multiple time scales (evolution, epigenesis, ontogenesis, interactional, neuro-synchronic, and diachronic) (Ellis, Römer, & O'Donnell, 2016; MacWhinney & O'Grady, 2015).

5. Lexical and grammatical constructions in first and second language acquisition

Frequency of usage is a driving force of construction learning. However, not all constructions are equally learnable by all learners. In early stages of acquisition (and for a good number of learners, even after years of naturalistic exposure), learners tend to focus more in their language processing upon open-class words (nouns, verbs, adjectives and adverbs) than on grammatical cues. The limited language attainment of those learners who never move beyond that stage has been described as stabilizing at a "Basic Variety" of interlanguage that is less grammatically sophisticated than that of native-like L1 ability (Klein, 1992; Bardovi-Harlig, 1992). Although naturalistic L2 learners are surrounded by the available target language input, not all of it becomes intake, that subset of input that actually gets in and that the learner utilizes in some way (Corder, 1967). A classic case study illustrating the limitations of intake is that of the naturalistic language learner, Wes, who was described as being very fluent, with high levels of strategic competence, but low levels of grammatical accuracy: "using 90% correct in obligatory contexts as the criterion for acquisition, none of the grammatical morphemes counted has changed from unacquired to acquired status over a five year period" (Schmidt, 1984: 5).

Although the Basic Variety is sufficient for everyday communicative purposes, grammatical morphemes and closed-class words tend not to be put to full use (e.g., Bardovi-Harlig, 1992; Clahsen & Felser, 2006; Schmidt, 1984; Van Patten, 1996, 2006). So, for example, L2 learners initially make temporal references mostly by use of temporal adverbs, prepositional phrases, serialization, and calendric reference, with the grammatical expression of tense and aspect emerging only slowly thereafter, if at all (Bardovi-Harlig, 1992, 2000; Klein, 1998; Lee, 2002; Meisel, 1987; Noyau, Klein, & Dietrich, 1995). L2 learners have been found to prefer adverbial over inflectional cues to tense in naturalistic L2A (e.g., Bardovi-Harlig, 2000; Noyau et al., 1995), training experiments (e.g., Cintrón-Valentín & Ellis, 2015; Ellis et al., 2014), and studies of L2 language processing alike (e.g., Sagarra & Ellis, 2013; Van Patten, 2007).

A key challenge for L2A research is therefore to explain why grammatical morphemes and closed-class constructions are more difficult to learn than open-class constructions, especially in early stages of language development. Usage-based theories attribute this to three standard phenomena of the psychology of learning: The learnability of a construction is affected by (i) salience, (ii) contingency of form-function association, and (iii) learned attention.

6. Salience and learning

Learnability depends on salience: less salient cues are less readily learned than highly salient ones (Ellis, 2006c, in press; Rescorla & Wagner, 1972). Salience refers to the property of a stimulus to stand out from the rest. Salient items or features are more likely to be perceived, to be attended to, and are more likely to enter into subsequent cognitive processing and learning. Salience can be independently determined by physics and the environment, and by our knowledge of the world.

1. The physical world, our embodiment, and our sensory systems come together to cause certain sensations to be more intense (louder, brighter, heavier, etc.) than others.
2. As we experience the world, we learn from it, and our resultant knowledge values some associations higher than others. These associations can make a stimulus cue "dear". A loved one stands out from the crowd, as does a stimulus with weighty associations ($500000.0 vs. $0.000005, however similar the amount of pixels, characters, or ink in their sensation), or one which matches a motivational state (a meal when hungry but not when full). The units of perception are influenced by prior association (James, 1890: 82). Psychological salience is experience-dependent: hotdog, sushi, and 寿司 mean different things to people of different cultural and linguistic experience. This is why, contra sensation, the units of perception cannot simply be measured in physical terms. They are subjective. Hence Miller's definition of the units of short-term memory as "chunks": "We are dealing here with a process of organizing or grouping the input into familiar units or chunks, and a great deal of learning has gone into the formation of these familiar units" (Miller, 1956: 91).

Rescorla and Wagner (1972) presented a formal model of conditioning which expresses the capacity of any cue (Conditioned Stimulus, CS, for example a bell in Pavlovian conditioning) to become associated with an outcome (Unconditioned

Stimulus, US, for example food in Pavlovian conditioning) on any given experience of their pairing. This formula summarized over eighty years of research in associative learning, and it elegantly encapsulates the three factors of psychophysical salience, psychological salience, and surprisal. The role of US surprise and of CS and US salience in the process of conditioning can be summarized as follows:

$$dV = ab(L - V)$$

The associative strength of the US to the CS is referred to by the letter V and the change in this strength which occurs on each trial of conditioning is called dV. On the right hand side, a is the salience of the US, b is the salience of the CS, and L is the amount of processing given to a completely unpredicted, surprising, US. Thus both the salience of the cue (a) and the psychological importance of the outcome (b) are essential factors in any associative learning. As for ($L - V$), the more a CS is associated with a US, the less additional association the US can induce. As Beckett (1954) put it: "habit is a great deadener". Alternatively, with novel associations where V is close to zero, there is much surprisal, and consequently much learning: first impressions, first love, first time…

This is arguably the most influential formula in the history of learning theory. Physical salience, psychological salience, and surprisal interactively affect what we learn from our experiences of the world.

One factor determining the learning of construction form is psychophysical salience. In his landmark study of first language acquisition, Brown breaks down the measurement of perceptual salience, or "clarity of acoustical marking" (1973: 343), into "such variables as amount of phonetic substance, stress level, usual serial position in a sentence, and so on" (1973: 463). Prepositional phrases, temporal adverbs, and lexical linguistic cues are salient and stressed in the speech stream. Verb inflections are usually not.

Many grammatical form-function relationships in English, like grammatical particles and inflections such as the third person singular -s, are of low salience in the language stream. This is a result of the well documented effect of frequency and automatization in the evolution of language. The basic principles of automatization that apply to all kinds of motor activities and skills (like playing a sport or a musical instrument) are that through repetition, previously independent sequences of units come to be processed as a single unit or chunk (Ellis, 1996). The more frequently they use a form, the more speakers abbreviate it: this is a law-like relationship across languages. Zipf (1949) summarized this in the principle of least effort – speakers want to minimize articulatory effort, and this leads to brevity and phonological reduction. They tend to choose the most frequent words, and the more they use them, automatization of production causes their shortening. Frequently used words become shorter with use. Grammatical functors are the most frequent words of a language, thus they lose their emphasis and tend to become abbreviated and phonologically fused with surrounding material (Bybee, 2000; Jurafsky, Bell, Gregory, & Raymond, 2001; Zuraw, 2003). In a corpus study by Cutler and Carter (1987), 86% of strong syllables occurred in open class words and only 14% in closed-class words; for weak syllables, 72% occurred in closed-class words and 28% in open-class words.

Because grammatical function words and bound inflections are short and unstressed, they are difficult to perceive from the input. When grammatical function words (*by, for, no, you*, etc.) are clipped out of connected speech and presented in isolation at levels where their open-class equivalents (*buy, four, know, ewe*, etc.) are perceived 90 to 100% correctly, adult native speakers can recognize them only 40% to 50% of the time (Herron & Bates, 1997). Clitics, accent-less words or particles that depend accentually on an adjacent accented word and form a prosodic unit together with it, are the extreme examples of this: the /s/ of 'he's', /l/ of 'I'll' and /v/ of 'I've' can never be pronounced in isolation.

In sum, grammatical functors are extremely difficult to perceive from bottom-up auditory evidence alone. Fluent language processors can perceive these elements in continuous speech because their language knowledge provides top-down support. But this is exactly the knowledge that learners lack: they haven't had sufficient experience and corresponding retuning of their L1 system to come up with a sufficiently schematized knowledge system (or constructicon) that would offer the same levels of top-down support as in fluent L1 processing. Thus the low psychophysical salience of grammatical functors contributes to L2 learners' difficulty in learning them (Ellis, 2006c; Goldschneider & DeKeyser, 2001).

These effects are also compounded by redundancy. Grammatical morphemes often appear in redundant contexts where their interpretation is not essential for correct interpretation of the sentence (Schmidt, 2001; Terrell, 1991; Van Patten, 1996). Tense markers often appear in contexts where other cues have already established the temporal reference (e.g. "*yesterday* he walk*ed*"), plural markers are accompanied by quantifiers or numerals ("*10* nut*s*"), etc. Hence their neglect does not result in communicative breakdown, they carry little psychological importance of the outcome (term *b* in the Rescorla-Wagner equation), and the Basic Variety satisfices for everyday communicative purposes (Simon, 1957).

7. Contingency and learning

The degree to which animals, human and other alike, learn associations between cues and outcomes depends upon the contingency of the relationship. In classical conditioning it is the reliability of the bell as a predictor of food that determines the ease of acquisition of this association (Rescorla, 1968). In language learning it is the reliability of the form as a predictor of an interpretation that determines its acquisition and processing (Ellis, 2006b; Gries & Ellis, 2015; Gries & Stefanowitsch, 2004; MacWhinney, 1987). The last thirty years of psychological investigation into human sensitivity to the contingency between cues and outcomes (Shanks, 1995) demonstrates that when given sufficient exposure to a relationship, people's judgments match the contingency specified by ΔP (the one-way dependency statistic, Allan, 1980) which measures the directional association between a cue and an outcome, as illustrated in Table 1.

Table 1. A contingency table showing the four possible combinations of events showing the presence or absence of a target cue and an outcome

	Outcome	**No outcome**
Cue	*a*	*b*
No cue	*c*	*d*

a, b, c, d represent frequencies, so, for example, *a* is the frequency of conjunctions of the cue and the outcome, and c is the number of times the outcome occurred without the cue.

ΔP is the probability of the outcome given the cue $P(O|C)$ minus the probability of the outcome in the absence of the cue $P(O|\neg C)$, calculated using this formula:

$$\Delta P = P(O|C) - P(O|\neg C) = \frac{a}{a+b} - \frac{c}{c+d}$$

When the outcome is just as likely when the cue is present as when it is not, there is no covariation between the two events and $\Delta P = 0$. ΔP approaches 1.0 as the presence of the cue increases the likelihood of the outcome. A learnable cue is one where when the cue is there, the outcome is there, and when the cue is not there, neither is the outcome, i.e. where *a* and *d* are large and *b* and *c* are small.

There are rarely 1:1 mappings between forms and their interpretations. The less reliably a form is associated with a function or interpretation, the more difficult learning becomes (Ellis, 2006b; Shanks, 1995). Cues with multiple interpretations are ambiguous and so hard to resolve; cue-outcome associations of high contingency are reliable and readily processed. Consider how, in the learning of the category of birds, while eyes and wings are equally frequently experienced features in the exemplars, it is wings which are distinctive in differentiating birds from other animals. Wings are important features to learning the category of birds because they are reliably associated with class membership while being absent from outsiders. Raw frequency of occurrence is therefore less important than the contingency between cue and interpretation.

Cue-outcome reliability can be reduced in two directions: forms can have multiple interpretations (polysemy and homophony) and interpretations can be realized by more than once form (synonymy). The same usage-phenomenon whereby frequently used words become shorter drives grammatical functors towards homophony since different functions associated with forms that were originally distinct eventually merge into the same shortened form. An example is the -s suffix in English: in modern English, it has come to encode a plural form (*squirrels*), it indicates possession (*Max's toy*), and it marks third person singular present (*Nick sleeps*). The -s form is abundantly frequent in learners' input, but not reliably associated with any/just one of these meanings/functions (increasing *b* in Table 1). Conversely, the plural, possessive, and third person singular constructions are all realized by more than one form: they are all variably expressed by the allomorphs [*s*], [*z*], and [ɨz]. Thus if we evaluate just one of these, say [ɨz], as a cue for one particular outcome, say plurality, then it is clear that there are many instances of that outcome in the absence of the cue (*c* in Table 1). In other words, the low cue-interpretation contingency makes plurals difficult to learn.

This fact that many high frequency grammatical constructions (as well as all other kinds of constructions; see Gries, 2015) are highly ambiguous in their interpretations, poses a challenge to language learners (DeKeyser, 2005; Ellis, 2008a; Goldschneider & DeKeyser, 2001).

8. Learned attention

L2A is subject to attentional biases which result from L2 learners' history of learning – from their knowledge of a prior language. Ellis (2006a, 2006c) attributes L2 difficulties in acquiring inflectional morphology to an effect of learned attention known as "blocking" (Kamin, 1969; Kruschke, June 2006; Kruschke & Blair, 2000; Mackintosh, 1975). Blocking is an associative learning phenomenon, occurring in animals and humans alike, that shifts learners' attention to input as a result of prior experience (Rescorla & Wagner, 1972; Shanks, 1995; Wills, 2005). Knowing that a particular stimulus is associated with a particular outcome makes it harder to learn that another cue, subsequently paired with that same outcome, is also a good predictor of it. The prior association "blocks" further associations. ALL languages have lexical and phrasal means of expressing temporality. So ANYONE with knowledge of ANY first language is aware that that there are reliable and frequently used lexical cues to temporal reference (words like German *gestern*, French *hier*, Spanish *ayer*, English *yesterday*). Such are cues to look out for in an L2 because of their frequency, their reliability of interpretation, and their salience. Learned attention theory holds that, once known, such cues block the acquisition of less salient and less reliable verb tense morphology from analysis of redundant utterances such as *Yesterday I walked*.

A number of theories of L2A incorporate related notions of transfer and learned attention. The Competition Model (MacWhinney, 2001; MacWhinney & Bates, 1989) was explicitly formulated to deal with competition between multiple linguistic cues to interpretation. Input Processing (IP) theory (Van Patten, 1996) includes a *Lexical Preference Principle*: "Learners will process lexical items for meaning before grammatical forms when both encode the same semantic information" (Van Patten, 2006: 118), and a *Preference for Nonredundancy Principle*: "Learners are more likely to process nonredundant meaningful grammatical markers before they process redundant meaningful markers" (Van Patten, 2006: 119). Benati (2013) reviews a series of studies showing learners are better able to identify temporal reference when presented with temporal adverbs rather than verbal morphology.

A series of experimental investigations involving the learning of a small number of Latin expressions and their English translations have explored the basic mechanisms of learned attention in SLA. Ellis and Sagarra (2011) illustrates the core design. There were three groups: Adverb Pretraining, Verb Pretraining, and Control. In Phase 1, Adverb Pretraining participants learned two adverbs and their temporal reference – *hodie* today and *heri* yesterday; Verb Pretraining participants learned verbs (shown in either first, second, or third person) and their temporal reference – e.g., *cogito* present or *cogitavisti* past; the Control group had no such pretraining. In Phase 2, all participants were shown sentences which appropriately combined an adverb and a verb (e.g. *heri cogitavi, hodie cogitas, cras cogitabis*) and learned whether these sentences referred to the past, the present, or the future. In Phase 3, the Reception test, all combinations of adverb and verb tense marking were presented individually and participants were asked to judge whether each sentence referred to the past, present, or future. The logic of the design was that in Phase 2 every utterance contained two temporal references – an adverb and a verb inflection. If participants paid equal attention to these two cues, then in Phase 3 their judgments should be equally affected by them. If, however, they paid more attention to adverb (/verb) cues, then their judgments would be swayed towards them in Phase 3.

The results showed that the three groups reacted to the cues in very different ways – the Adverb pretraining group followed the adverb cue, the Verb pretraining group tended to follow the verb cue, and the Control group lay in between. For example, multiple regression analyses, one for each group, where the dependent variable was the group mean temporal interpretation for each of the Phase 3 strings and the independent variables were the information conveyed by the adverbial and verbal inflection cues showed in standardized ß coefficients, Adverb

Group Time = 0.99Adverb – 0.01Verb; Verb Group Time = 0.76Adverb + 0.60Verb; Control Group Time = 0.93Adverb + 0.17Verb.

This experiment demonstrated how short-term instructional manipulations could affect attention to language. Ellis and Sagarra (2010) Experiment 2 and Ellis and Sagarra (2011) Experiments 2 and 3 also illustrated long-term language transfer effects whereby the nature of learners' first language (+/− verb tense morphology) biased the acquisition of morphological vs. lexical cues to temporal reference in the same subset of Latin. First language speakers of Chinese (no tense morphology) were less able than first language speakers of Spanish or Russian (rich morphology) to acquire inflectional cues from the same language experience where adverbial and verbal cues were equally available, with learned attention to tense morphology being in standardized ß coefficients: Chinese (−0.02) < English (0.17) < Russian (0.22) < Spanish (0.41) (Ellis & Sagarra, 2011, Table 4). These findings demonstrate long-term attention to language, a processing bias affecting subsequent cue learning that comes from a lifetime of prior L1 usage.

Ellis et al. (2014) replicated Ellis & Sagarra (2010) in demonstrating short-term learned attention in the acquisition of temporal reference in L2 Latin in EFL learners, extending the investigation using eye-tracking indicators to determine the extent to which these biases are overt or covert. Eye-tracking measures showed that prior experience of particular cue dimensions affected what participants overtly focused upon during subsequent language processing, and how, in turn, this overt study resulted in covert attentional biases in comprehension and in productive knowledge. These learned attention effects have elements of both positive and negative transfer. Prior use of adverbial cues causes participants to pay more attention to adverbs – positive effects of entrenchment of the practiced cue. Additionally, increased sensitivity to adverb cues is accompanied by a reduced sensitivity to morphological cues – blocking. A meta-analysis of the combined results of Ellis and Sagarra (2010, 2011) demonstrated that the average effect size of entrenchment was large (+1.23) and that of blocking was moderate (−0.52).

While these learned attention demonstrations concern the first hour of learning Latin, Sagarra and Ellis (2013) show the results of blocking over years of learning in intermediate and advanced learners of Spanish. 120 English (poor morphology) and Romanian (rich morphology) learners of Spanish (rich morphology) and 98 English, Romanian and Spanish monolinguals read sentences in L2 Spanish (or their L1 for the monolinguals) containing adverb-verb or verb-adverb congruencies/incongruencies. Eye-tracking data revealed significant effects for sensitivity (all participants were sensitive to tense incongruencies), cue location in the sentence (participants spent more time at their preferred cue), L1 experience (morphologically rich L1 learners and monolinguals looked longer at verbs than morphologically poor L1 learners and monolinguals), and L2 experience (intermediate learners read more slowly and regressed longer than advanced learners).

Experience with the second language is shaded by attentional biases and other types of interference from the first language. Transfer phenomena pervade SLA (Flege, 2002; Jarvis & Pavlenko, 2008; Lado, 1957; MacWhinney, 1997; Odlin, 1989). As a result of this interference, second language learning is rarely entirely native-like, even if the learner is surrounded by ambient input. Since everything is filtered through the lens of the L1, not all of the relevant input is in fact taken advantage of (hence Corder's distinction between input and intake; Corder, 1967).

It is important to emphasize here that the limitations of L2 learning do not license the conclusion that L2 learning is qualitatively different from L1 learning – second language learners employ the same statistical learning mechanisms that they employed when they acquired their first language. Rather, first language learning is (nearly always) so marvelously successful that it – paradoxically perhaps – hampers second language learning. First language learners have learned to attend to their language environment in one particular way. L2 learners are tasked with reconfiguring the attentional biases of having acquired their first language (Slobin, 1996).

9. Implications for language teaching

The fact that L2 learners have to learn to adjust their attention biases shaped by their L1 has consequences for L2 instruction. Children acquire their first language primarily in an implicit manner. *Implicit learning* is the learning of complex information without selective attention to what is being learned. L2A, in contrast, is characterized in large parts by *explicit learning*. For reviews on implicit and explicit language learning see Ellis (1994); Rebuschat (2015).

Schmidt's (2001) *Noticing Hypothesis* holds that conscious attention to linguistic forms in the input is an important precondition to learning: "people learn about the things they attend to and do not learn much about the things they do not attend to" (Schmidt, 2001: 30). In order to successfully acquire specific aspects of their L2, learners must pay conscious and selective (i.e. focused) attention to the target structures. Given the bottleneck effect of input vs. intake discussed above even in dense-input, immersive environments, explicit learning and teaching gain even more relevance for the second language learner who receives only limited L2 input (as the typical foreign language learner learning their L2 through instruction does). This holds in particular for aspects of form in the L2 that are redundant and/or lack perceptual salience (like the above-mentioned examples of inflectional morphemes in English). Form-focused Instruction (FFI) attempts to encourage noticing, drawing learners' attention to linguistic forms that might otherwise be ignored (Ellis, 2012). Variants of FFI vary in the degree and manner in which they recruit learner consciousness and in the role of the learner's metalinguistic awareness of the target forms.

Norris and Ortega's (2000) meta-analysis comparing the outcomes from studies that employed differing levels of explicitness of L2 input demonstrated that FFI instruction results in substantial target-oriented L2 gains, that explicit types of instruction are more effective than implicit types, and that the effectiveness of L2 instruction is durable. More recent meta-analyses of effects of type of instruction by Spada and Tomita (2010) and Goo, Granena, Yilmaz, and Novella (2015) likewise report large advantages of explicit instruction in L2 acquisition. However, the studies gathered in these meta-analyses used a wide variety of types of instruction, learner, targeted feature, and method of assessment. Future research should control for these factors to see how robust effects of FFI really are.

Cintrón-Valentín and Ellis (2015) and Cintrón-Valentín and Ellis (2016) used eye-tracking to investigate the attentional processes whereby different types of FFI overcome learned attention and blocking in learners' online processing of L2 input. English and Chinese native speakers viewed Latin utterances combining lexical and morphological cues to temporality under control conditions (CC) and three types of explicit Focus on Form (FonF): verb grammar instruction (VG), verb salience with textual enhancement (VS), and verb pretraining (VP). All groups participated in three phases: exposure, comprehension test, and production test. VG participants viewed a short lesson on Latin tense morphology prior to exposure. VS participants saw the verb inflections highlighted in bold and red during exposure. VP participants had an additional introductory phase where they were presented with solitary verb forms and trained on their English translations. When the verb is presented on its own like this, rather than in potentially redundant combination with adverbial cues, there is less scope for blocking. CC participants were significantly more sensitive to the adverbs than verb morphology. Instructed participants showed greater sensitivity to morphological cues in comprehension and production. Eye-tracking revealed how FonF affects learners' attention during online processing and thus modulates long-term blocking of verb morphology.

Such results demonstrate how salience in physical form, learner attention, and instructional focus all variously affect the success of L2 acquisition. Form-focused instruction recruits learners' explicit, conscious processing capacities and allows them to consolidate unitized form-function bindings of novel L2 constructions (Ellis, 2005). Once a construction has been represented in this way, its use in subsequent implicit processing can update the statistical tallying of its frequency of usage and probabilities of form-function mapping.

10. Further reading

This chapter has focused upon salience, contingency, and learned-attention in usage-based explanations of L2 morphology acquisition. This is just a part of usage-based approaches to L2A. Ellis and Wulff (2015a, 2015b) and Ortega, Tyler, In Park, and Uno (2016) provide more detail of the broader approach. Ellis et al. (2016) describe a large body of complementary work showing the joint effects of type-token frequency, contingency, and prototypicality in usage-based L1 and L2 acquisition and processing of verb-argument constructions. Cadierno and Eskildsen (2015), Beckner et al. (2009), Douglas Fir Group (Atkinson (2016), and Hulstijn et al. (2014) marry the cognitive of usage-based approaches with the social, since so much of usage and attention-in-usage is socially driven. Robinson and Ellis (2008), Littlemore (2009) and Tyler (2012) give broader overviews of cognitive-linguistic research in L2 learning and teaching.

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CHAPTER 4

Formal linguistics and second language acquisition

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This paper motivates formal linguistic approaches to second language (L2) acquisition, particularly approaches grounded in generative grammar, and provides an overview of how such approaches have developed over time. The role of the mother tongue grammar and Universal Grammar (UG) in shaping the acquisition of linguistic representations is examined, starting with early debates on the effects of principles and parameters of UG in L2 (the UG access debate). This focus has been replaced with more nuanced analyses of the nature of interlanguage representations, for example, the nature of the initial state, the status of functional categories and features in L2 grammars, as well as potential problems at the linguistic interfaces. Discrepancies between underlying L2 competence and L2 performance are discussed, focusing on research that addresses the question of how representations are accessed and used in real time processing.

1. Introduction

A major tenet of the generative approach to second language acquisition (SLA) is that formal linguistic theory provides a well-developed framework to explore the linguistic competence of second language learners and speakers (henceforth L2ers). In this chapter, I will motivate the formal linguistic approach and examine the ways in which this perspective has allowed researchers to formulate and address questions relating to L2 acquisition.

There are, of course, many different aspects of second language acquisition that researchers and practitioners are interested in; the focus of research will depend on the kinds of questions that are deemed to be relevant. Those adopting a formal linguistic approach are interested in discovering the nature of the unconscious linguistic competence (or grammar) that language acquirers develop, as well as an explanation of how the grammar is acquired. Such a grammar is assumed to underlie linguistic behaviour (comprehension and production); in the case of L2ers, it is typically referred to as the interlanguage grammar (following Selinker, 1972).

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Those adopting a formal linguistic approach are generally proponents of the position that SLA is a branch of cognitive science. As Doughty and Long (2003: 869) put it, underlying the work of many L2 researchers is a "shared conception of SLA as a cognitive process involving representations and computations on those representations". This is true regardless of whether one is interested in L1 transfer, L2 development, age effects, fossilization, attrition, near-nativeness, ultimate attainment, the role of Universal Grammar (UG) or of domain general mechanisms. Crucially, it is necessary to understand the nature of linguistic representations (what is learned) in order to determine how they are learned and what factors influence learning. There are, in fact, various different formal linguistic approaches which have been adopted by L2 researchers, providing differing perspectives on the nature of interlanguage representations and their acquisition.

2. What is formal linguistics?

Although formal linguistic approaches to SLA are often identified with generative grammar, particularly the concept of Universal Grammar (UG) (see White, 1989, 2003), it is important to understand that there are other L2 frameworks that recognize that a formal linguistic analysis at the very least provides suitable linguistic descriptions to form the basis for exploring issues relating to language learning. However, there is disagreement over the precise nature of the description, and over the level of sophistication required.

Approaches differ more fundamentally over the kind of explanation that formal linguistics can provide. On the one hand, linguists working in the generative tradition seek to discover the precise nature of linguistic competence, on the assumption that our knowledge of language is determined by a 'language faculty'. In this framework, an innate and specifically linguistic basis is assumed ('special' nativism, Universal Grammar), at least for first language acquisition. In opposition to this view is the claim that, in the course of language acquisition, the grammar emerges from the input, possibly constrained by more general learning principles (emergentism).

As O'Grady et al. (2009) acknowledge, what most emergentist theories lack is a strong property theory. Following Cummins (1983), Gregg (1996) distinguishes between property theories and transition theories. A property theory, as far as linguistics is concerned, is a theory about the nature of linguistic competence. UG-based theories of L2, whether grounded in Government Binding Theory (Chomsky, 1981) or Minimalism (Chomsky, 1998) or their successors, embrace a strong property theory which provides a detailed characterization of the nature of linguistic representations, constrained by UG. A transition theory addresses the question of how linguistic competence develops over time, the learning mechanisms involved. As Gregg (2003) has pointed out, UG-based theories often lack a strong transition theory. See Carroll (2001, 2007) for one exception.[1]

Emergentists tends to be transition oriented, more interested in how language emerges than what exactly emerges. Emergentist approaches are based on the premise that learning proceeds by an analysis of the distributional characteristics of the input, with input frequency playing a crucial role. Some kind of universal basis for language acquisition is, however, often assumed by emergentists, including those working on L2, taking the form of computational principles (e.g. O'Grady, 2003, 2008), general associative learning mechanisms (e.g. Ellis & Wulff, 2015), cognitive principles (e.g. DeKeyser, 2009) or typological universals (e.g. Eckman, 2007). O'Grady is exceptional in the emergentist camp; while he does not accept UG as the basis for language acquisition (L1 or L2), he does recognize the complexity of the linguistic generalizations that learners must attain (the logical problem of language acquisition). On his account, universal computational principles are at play, which apply to sentence processing in addition to other non-linguistic domains.

For the remainder of this chapter, I will discuss only one type of formal linguistic perspective, namely generative grammar, setting the other approaches to one side. In other words, I will focus on L2 perspectives that adopt a linguistic approach grounded in Universal Grammar. In the following sections, I will trace the history of generative L2 research and how it has changed, partly in response to changes in linguistic theory. As we shall see, issues that were taken up in early research are often revisited subsequently, in the light of developments in the theory.

3. Motivation for the formal linguistic approach

The generative linguistic approach is motivated by arguments about first language acquisition, which have been extended to non-native acquisition as well (see White, 1989, 2003). Crucially, in the approach to be considered here, language acquisition is assumed to be constrained by innate and specifically linguistic knowledge, taking the form of UG.

Arguments for UG hinge on the claim that there are many abstract grammatical properties that we acquire as native speakers that could not have emerged on

1. Another possible exception is the Processability Theory of Pienemann and colleagues. This is a transition theory grounded in Lexical Functional Grammar, a linguistic theory which assumes that certain aspects of the grammar are innate. Pienemann argues for universal processing principles which apply in SLA. See Pienemann & Lenzing (2015) for a recent exposition of Processability Theory.

the basis of input alone, or on the basis of input interacting with general cognitive principles and learning mechanisms. In other words, there is a mismatch between the input and the unconscious knowledge of language that native speakers attain. Hence, it is claimed, there must be built-in knowledge determining what natural language grammars can be like and mediating the acquisition process. This knowledge is not derivable from more general cognition and must be specifically linguistic in nature.

As far as L2 acquisition is concerned, researchers who accept the generative linguistic perspective consider whether or not UG constrains the interlanguage grammars of L2ers. According to proponents of the view that UG still constrains the acquisition of non-primary languages, if interlanguage competence can be shown to go beyond the L2 input (naturalistic and instructed) and the L1 grammar can be shown not to be the (sole) source of abstract linguistic knowledge achieved by learners, then UG must be implicated. On the other hand, there are researchers who accept the generative linguistic perspective on L1 acquisition, including the role of UG, and who do not accept all aspects of this approach to L2. Some have argued that L2 acquisition is unlike L1 acquisition, in that UG (fully) constrains only L1 (e.g., Bley-Vroman, 1989; Clahsen & Muysken, 1986; Meisel, 1997). These researchers share core assumptions about the nature of native speaker competence and linguistic representations. For them, however, adult L2 competence is different in its very nature from native speaker competence and is achieved by different means.

It is important to understand that adopting a formal linguistic approach does not mean that one necessarily accepts all the tenets of a particular theory. Rather, it means that debate is couched within an agreed-upon framework. While interlanguage grammars are argued by generative second language researchers to be characterizable in terms of unconscious representations, researchers do not necessarily agree as to the precise nature or source of these representations. There has, for example, been many years of ongoing debate over the extent of L1 influence. The formal linguistic theories that underlie these approaches change and develop over time, with concomitant changes in theories of SLA, as we shall see.

4. Research under the formal approach

Phase 1: Focus on principles and parameters

Originally (1980s onwards), and in line with linguistic theory at the time, particularly Government Binding Theory, generative L2 research investigated the status of UG principles and parameters, focusing on the extent to which interlanguage grammars conform to UG principles and show evidence of parameter resetting.

This work was often formulated in terms of 'access' to UG (direct access, indirect access, no access). (See White, 1989 for overview.)

Whether trying to demonstrate that UG is available or that it is not, researchers aimed to identify situations where other sources of the relevant knowledge could be discounted. Situations were identified where it could be shown that the phenomenon in question could not be acquired on the basis of knowledge transferred from the L1, nor by observation of the L2 input, nor as an effect of input frequency, nor on the basis of instruction or analogical reasoning. If L2 learners show evidence in such cases of acquiring the relevant L2 properties, then UG is implicated, since other potential sources of knowledge have been eliminated. In line with this approach, much of the early research on UG in L2 focused on principles which happen, for independent reasons, to be inactive in the L1, or parameters where the L1 and L2 differ in their settings. In such cases, researchers are able to assess the potential role of UG independently of the possibility that apparent adherence to UG constraints is totally attributable to L1 transfer.

Probably the most studied principle in L2 research during the 80s and 90s was the Subjacency Condition, which subsumed several different Island Constraints (Ross, 1967); these constraints place restrictions on wh-movement.[2] While wh-movement occurs in languages like English, there are many other languages, such as Japanese, where wh-phrases do not move, instead remaining in situ. Compare English (1) and Japanese (2). Wh-movement can take place in simple clauses or out of more complex clauses; see (3). Again, in a wh-in-situ language, these more complex questions are asked by leaving the wh-phrase in the lower clause, as in (4).

(1) What did John buy?

(2) John-wa nani-o kaimasita-ka?
John-TOP what-ACC bought-KA
'What did John buy?'

(3) What did Mary say that John bought?

(4) Mary-wa John-ga nani-o katta-to iimasita ka?
Mary-TOP John-NOM what-ACC bought-that said-KA
'What did Mary say that John bought?'

However, wh-movement is not free; rather there are certain conditions determining when it is or is not possible to move a wh-phrase. In (5), for example, the wh-phrase has been moved out of a relative clause, which is illicit, rendering the

2. See Belikova & White (2009) for an overview of this research, couching the Subjacency Condition in light of developments in linguistic theory.

sentence ungrammatical. In (6), the Japanese equivalent is grammatical because no movement has taken place.

(5) *Who do you like the book that wrote?

(6) Anata-wa dare-ga kaita hon-ga sukidesu-ka?
you-TOP who-NOM wrote book-NOM like-KA
'You like the book that who wrote?'

The Subjacency Condition was formulated as a UG constraint on wh-movement, the argument being that, given the many legitimate types of wh-movement exemplified in the input, it would be impossible to work out the restrictions without built-in knowledge. In wh-in-situ languages, such as Japanese, Chinese or Korean, there is no wh-movement to restrict (at least at surface) and so the constraint is vacuous. This situation, then, provides a test case: if interlanguage grammars are constrained by UG, learners of English should observe the relevant restrictions on wh-movement, even if they are non-operative in the L1.

An early study looking at whether L2ers whose mother tongues lack wh-movement would 'know' the restrictions on English wh-movement was by Schachter (1990). She showed that Korean and Chinese-speaking learners of English were significantly less accurate than native speakers in rejecting ungrammatical sentences which violate Subjacency, such as (5). In contrast, L2ers whose L1 was a wh-movement language (in this case, Dutch) rejected the same ungrammatical violations, suggesting that access to UG principles is mediated via the L1; if a principle is exemplified in the L1, it operates in the L2. If it is not operative in the L1, L2ers cannot access it.

The availability of Subjacency in L2 was also investigated by Johnson and Newport (1991) who looked at L2 learners of English whose L1 was Chinese. A comparison of performance of participants (adults at the time of testing) who had learned English at different ages found that only those who learned English as young children rejected Subjacency violations to the same extent as native speakers.

However, in contrast to such results, White and Juffs (1998) report that Chinese speakers who learned English as adults were not significantly different from native speakers in their rejection of Subjacency violations. More recently, Ma, Kim and Schwartz (2007) conducted a partial replication of Johnson and Newport (1991), comparing child L1, child L2 and adult L2 learners of English with adult native speakers. The L2ers were speakers of Korean, a *wh*-in-situ language. Only the adult native speakers of English were accurate in rejecting the three types of island constraint violations tested. Crucially, the learner groups, whether acquiring their L1 or an L2, showed similar patterns of acquisition regardless of age, with some of the island constraints taking effect before others. These results suggest that whatever is going on is not a question of L2 access to UG.

Investigation of UG parameters was also prevalent in the 1980s and 1990s. Parameter theory offered the means to potentially account for language transfer, on the assumption that L2ers initially adopt L1 parameter settings. Parameter theory could also account for 'successful' outcomes, if it could be shown that parameters are reset to appropriate L2 values. The position that learners initially transfer parameter settings from L1 to L2, followed by subsequent resetting to the appropriate L2 value (or to some other value made available by UG) came to be known as the Full Transfer Full Access Hypothesis (FTFA) (Schwartz & Sprouse, 1996).

The null subject (or pro-drop) parameter was one of the earliest, if not the first, to be proposed (e.g., Chomsky, 1981; Rizzi, 1982). Languages were divided into two types, [+null subject] and [–null subject], with a cluster of syntactic properties associated with each setting of the parameter. Early L2 research focused on this parameter (e.g., Liceras, 1989; White, 1985). White (1985) was one of the first to advance the possibility that L2ers would initially transfer parameter settings from the L1; she investigated whether parameters could appropriately be reset to the L2 value, in other words a precursor to FTFA. White compared Spanish and French speaking learners of English, with respect to three properties identified by Rizzi as part of the null subject parameter. As Spanish is a null subject language whereas French is not, comparing these two L1s allows one to assess the extent of initial transfer of the L1 setting. Results showed that the two groups behaved differently from each other in their assessment of the grammaticality of null subjects in L2 English, with only the Spanish speakers accepting them. White concluded that there was indeed transfer of the L1 setting; with increasing proficiency, there was also evidence for parameter resetting. However, there was little evidence that the other effects associated with the parameter worked as a cluster in the L2 grammar, somewhat problematic from the point of view of applying parameter theory to L2.

Recently, Ortifelli and Grüter (2013) have claimed that the acceptance of null subjects in such cases is not due to transfer of the [+null subject] setting. In a grammaticality judgment task based on the one used by White, null subjects were indeed accepted. However, null subjects were never produced in a production task and sentences without subjects were interpreted as imperatives (rather than indicatives with missing subjects) in a truth value judgment task. Ortifelli and Grüter argue that acceptance of null subjects in judgment tasks reflects task processing problems, rather than being an indication of the learner's underlying grammar. However, as they note, the processing account predicts that incorrect judgments should be expected regardless of whether the L1 is [+null subject] or [–null subject], contrary to the findings reported by White (1985).

In summary, early work on parameters suggested that, while there is evidence for L1 transfer followed by resetting, parametric properties do not consistently work as a cluster. Whether this relates to the original formulation of certain parameters or to the nature of L2 acquisition remains unclear.

Phase 2: Focus on representation

In the 1990s, coinciding with the change from Government Binding Theory to Minimalism (Chomsky, 1998), generative perspectives on L2 shifted from a traditional UG principles and parameters approach to a more nuanced analysis of the properties of the interlanguage grammar, beginning with an emphasis on grammatical features. In the Minimalist Program, it is assumed that the computational operations, move and merge, are universal and not subject to variation. Instead, parametric differences are couched in terms of the lexicon, specifically featural differences (different features/functional categories represented and/or differences in feature strength). UG provides an inventory of features, including morphosyntactic, semantic, and phonological features; languages differ as to which features are selected from this inventory (Chomsky, 1998; Ritter, 1993). It is important to understand, however, that some features may be realized in a language but by means of null lexical content, a point that became important in the debate over presence versus absence of features in interlanguage grammars. As far as L2 is concerned, there has been a particular interest in situations where the L1 and the L2 differ as to which features are instantiated in their grammars. Several issues have been explored in this context: categories and features in the initial state; the status of grammatical features in subsequent development and ultimate attainment; the role of features at the interfaces.

The focus on representation and the status of functional categories and features started with a consideration of the initial state in L2 acquisition. In this context, researchers addressed the question of what the early interlanguage representation looks like with respect to the presence or absence of grammatical features, as well as functional categories and their projections. At one extreme, the Minimal Trees Hypothesis of Vainikka and Young-Scholten (1996) claimed that functional categories are not represented at all in the initial state. Rather, learners start out projecting only lexical categories. In opposition, Schwartz and Sprouse (1996) argued for FTFA, with the initial state consisting of all the properties of the L1 grammar, including categories and features drawn from L1. A crucial aspect of the debate centred on what counts as evidence for presence or absence of features/categories, an issue that also colours debate about later acquisition stages. Vainikka and Young-Scholten argued that the absence of morphology (or inconsistent suppliance) in the early stages of L2 acquisition supports the absence of the categories in the grammar; Schwartz and Sprouse (1996) took the opposite view, showing that syntactic reflexes of functional categories are present even when morphology is not consistently supplied.

Other researchers considered the status of functional categories and features beyond the initial state, i.e., how they shape the interlanguage grammar over time. According to Vainikka and Young-Scholten, functional categories are gradually added during the course of development (drawn from the UG inventory rather than from L1). Schwartz and Sprouse also assume that L2 categories and features can be added after the initial state. In other words, on both views, the UG inventory of features is still accessible to non native learners; it is the starting point that is presumed to be different.

Hawkins and colleagues put forward the Representational Deficit Hypothesis. Like Schwartz and Sprouse, they assume that the L1 constitutes the initial state. Unlike Schwartz and Sprouse, they argue that L2ers are 'stuck' with L1 features, at least uninterpretable ones; later stages resemble the initial state in this regard, with learners unable to acquire abstract grammatical features which differ from those represented in the L1 grammar. On this view, the full UG feature inventory is no longer accessible, resulting in a representational deficit in interlanguage grammars whenever the L1 and L2 differ in terms of the features that are required. A variety of features have been claimed to be inaccessible in this way. For example, Hawkins and Liszka (2003) argue for the absence of a tense feature in the interlanguage grammars of Chinese-speaking learners of English. Hawkins and Chan (1997) and Hawkins and Hattori (2006) argue for the absence of a [±wh] feature in the case of Chinese- and Japanese-speaking learners of English. Franceschina (2001) argues for absence of gender features in the case of L1 English/L2 Spanish. In all these cases, the interlanguage grammar is assumed to be permanently defective because it will always lack a feature which is necessary to represent the L2 appropriately.

While it may not be the case that the interlanguage grammar lacks features when morphology is either missing or inconsistently supplied, it certainly is the case that L2ers often demonstrate poor performance as far as overt inflectional morphology is concerned. Different inflections (tense, agreement, number, case, gender, etc.) and function words (determiners, auxiliaries, complementizers), are produced variably, in circumstances where they would be obligatory for native speakers. Morphology is often omitted or certain forms are over-used in place of others.

To account for such discrepancies, the Missing Surface Inflection Hypothesis was proposed, according to which morphosyntactic features can be represented in a grammar despite lack of corresponding overt morphology, the implication being that when inflection is missing in L2 production, it is not in fact missing from the underlying grammar (e.g., Haznedar & Schwartz, 1997; Lardiere, 1998, 2000; Prévost & White, 2000). According to Lardiere, the behaviour reflects difficulties in mapping between the underlying morphosyntactic structure and the associated language specific morphological forms. In the case of agreement, for example, the learner/speaker of L2 English fails to consistently link the agreement feature to the form /*-s*/ in English, resulting in variable suppliance of the morphology.

To summarize so far, the investigation of grammatical features has resulted in transfer being conceived of in terms of L1 features rather than L1 parameter settings, with the parameter resetting debate centering on whether new features are or are not acquirable; claims for representational deficits involve the idea that certain features are never represented in the interlanguage grammars of speakers from particular L1s. The positions that researchers have adopted often centre on differing conceptions of the relationship between underlying forms and their surface manifestations.

However, Lardiere (2009) has argued that this approach to parameters is also misconceived. According to her Feature Reassembly Hypothesis, it is not enough to think of L2 acquisition as a case of parameter resetting couched in terms of losing old features (L1) and acquiring new ones (L2). Rather, the task of the L2 learner is to reassemble or map features into new formal configurations and this is just as likely to affect learners whose L1 and L2 share the same features but differ in how they are realized structurally and lexically.

In the past decade or so, following developments in linguistic theory (see, for example, papers in Ramchand & Reiss, 2007), L2 researchers have turned their attention to linguistic interfaces, investigating how different components of the interlanguage grammar relate to each other, and to other domains. For example, in work on the syntax/discourse interface, Sorace and colleagues proposed that failure to use the L2 grammar in a fully native-like way can be attributed to problems integrating material at the syntax/discourse interface and that a discourse feature is implicated (see Sorace & Filiaci, 2006).

Sorace and colleagues have undertaken extensive research on how the topic of discourse affects pronoun choice in null subject languages like Italian. Null subjects are strongly preferred when there is no change in topic, whereas overt subjects imply a change of topic. This has been expressed in terms of a feature, [±topic shift], null pronouns being [−topic shift] and overt pronouns [+topic shift]. Typically, subjects are topics, so when a pronoun refers to the subject of another clause, a null pronoun is appropriate. When a pronoun refers to someone who is not the previously mentioned subject, an overt pronoun is appropriate. In (7), if the subject of the adverbial clause refers to the old lady, a null pronoun is the normal choice (*pro*), whereas if it refers to the girl, an overt pronoun is preferable (*lei*).

(7) L'anziana signora saluta la ragazza, quando lei/*pro* attraversa
The.old lady greets the girl when she/*pro* crosses
la strada
the road
'The old lady greets the girl when she crosses the road.'

Sorace and colleagues have shown that advanced and near native L2ers of Italian (L1 English) overgeneralize the use of overt pronouns, accepting them in [−topic shift] contexts to a greater extent than native speakers.[3] On this account, the [±topic shift] feature is un(der)-specified in L2 because it is has not been selected in the L1. As a result, the overt pronoun is not interpreted as necessarily involving a shifted topic.

Features are not, of course, the only aspect of the interlanguage grammar that have been investigated from a formal linguistic perspective. Researchers have addressed the nature of interlanguage representations from the perspective of syntax and semantics as well. In several studies, this research has investigated properties relating to word order, often with a focus on effects of word order differences on semantic interpretation.

Dekydtspotter and colleagues were probably the first to examine the syntax/semantics interface in L2, in many cases looking at the acquisition of French by English speakers. They investigated situations where French shows word order alternations which do not occur in English and which yield subtle interpretive differences. Dekydtspotter and Hathorn (2005) provide one example of this line of research. They investigate a phrase (meaning 'something remarkable') which occurs in continuous (8a) and discontinuous (8b) versions in French.

(8) a. Quelque chose de remarquable a été observé par
Something of remarkable has been observed by
chacun des chercheurs
each of.the researchers

b. Quelque chose a été observé de remarquable par chacun
Something has been observed of remarkable by each
des chercheurs
of.the researchers
'Something remarkable was observed by each of the researchers.'

The continuous version is ambiguous, meaning either that all the researchers saw the same remarkable thing or that each of them saw a different remarkable thing.

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3. In a sense, this can be seen as a reassembly problem, in Lardiere's sense. In languages without null pronouns, like English, this feature is either not expressed at all, or only on overt pronouns, for both the + or – values. A learner has to work out that this feature is distributed across two different types of pronoun in the L2.

The discontinuous version, in contrast, only has the meaning that each researcher observed a different thing. The change in word order (syntax) results in the loss of an interpretation (semantics). English only has a continuous version of this construction and the sentence is ambiguous, like the continuous version in French.

Results from a truth value judgment task show that high intermediate French L2ers accept answers involving the researchers seeing the same object significantly less in the discontinuous version of the sentence than the continuous version, just like native speakers, suggesting that they have acquired the subtle interpretive contrast associated with the word order alternation. In general, Dekydtspotter and colleagues have shown that, once L2ers acquire L2 word order alternations not found in the L1, they also acquire the relevant interpretive distinctions that hold only for the L2, suggesting that in this domain at least the syntax/semantics interface is not generally problematic.[4]

Other research has looked at word order alternations and issues of potential ambiguity to address questions about the initial state. Grüter (2005/2006) makes use of an ambiguity that arises in German with certain respect to wh-questions in order to determine which initial state theory, Minimal Trees or FTFA, is supported in beginner L2 German. The verb second property of German allows any constituent to appear immediately in front of the verb. In consequence, questions like (9a) and (9b) are ambiguous, depending on whether *was* ('what') is the subject or the object.

(9) a. Was beisst die Katze?
What bite-3SG the cat
'What is biting the cat?' (subject) or 'What is the cat biting?' (object)
b. Was hat die Katze gebissen?
What has the cat bitten?
'What has bitten the cat?' (subject) or 'What has the cat bitten? (object)

The structure necessary to represent these German sentences involves an IP and a CP layer, in order to accommodate verb raising to I and C and fronting of either the subject or object to Spec CP. In the case of L1 English, because English is not verb final (unlike German) and does not have V2, sentences like (9a) will be unambiguous with only a subject interpretation of *was* ('what'); sentences like (9b) will also be unambiguous but with an object interpretation. FTFA, then, predicts that English speaking learners of German in the initial state will fail to recognize the ambiguity and will choose a subject interpretation for (9a) and an object interpretation for (9b), transferring the corresponding functional structure from English. Under the

4. See Slabakova (2008) for cases where difficulties occur at the syntax/semantics interface, attributable to problems with morphology.

Minimal Trees Hypothesis, on the other hand, the initial state consists only of lexical categories. While the subject interpretation is derivable via a VP structure, the object interpretation is not; consequently, learners would be expected to guess. In a picture interpretation task with pictures consistent with either interpretation, results showed that the native speakers of German gave similar responses to both tenses, choosing either the object interpretation or both interpretations (i.e., ambiguity recognized).[5] The L2ers speakers did not recognize the ambiguity; they picked predominantly subject only responses in the present tense and object only in the perfect tense, with no evidence of guessing, suggesting that there are effects of L1 syntax on semantic interpretation in the initial state, as predicted by FTFA.

Many other syntactic and semantic properties of L2 grammars have been investigated over the years. See Slabakova (2016) for an overview. Another area which has been receiving increasing attention in this framework is the nature of interlanguage phonological representations. Some of the same issues have been investigated from a phonological perspective, including the issue of parameter resetting, the effects of the L1, the role of features, and phonology at the interfaces. For example, Archibald (1992) and Pater (1997) looked at differences between the L1 and L2 in terms of the metrical parameters proposed by Dresher and Kaye (1990), which determine how word stress is assigned. Archibald looks at Polish speaking learners of English and reports that the failure to reset one of the parameters (quantity sensitivity) results in numerous errors of stress assignment. Pater, looking at French-speaking learners of English, reports that some of the metrical parameters are successfully reset to the L2 value while others are not; for some of the parameters, the interlanguage setting was different from both the L1 and the L2 (as reported also by Finer and Broselow (1986) for syntactic parameters in L2). On related lines, Özçelik (2016) has investigated word level stress in L2 Turkish (L1s English and French), proposing that the Foot itself is parameterized (not included amongst the metrical parameters in previous accounts); certain languages (e.g., Turkish, French) are footless, whereas others project a Foot (e.g., English). English speaking L2ers must lose the Foot, something which is impossible, according to Özçelik. In support of this claim, he shows that French speakers and English speakers differ in their success in acquisition of Turkish word stress. The French speakers but not the English speakers were able to produce footless structures with target-like prominence on the final syllable. The English, on the other hand, placed stress incorrectly in their pronunciation of Turkish words.

As far as features are concerned, Brown (1998) proposed that, in the acquisition of L2 phonemes, it is their featural content which is crucial. If the L1 and L2 share

5. The native speakers did not behave fully as expected, since the ambiguity was only recognized about half of the time.

a feature (even if it is not realized on the same phonemes), then an L2 contrast depending on this feature will be acquirable. But if the L1 lacks the relevant feature, then the L2 contrast will not be acquirable. Brown shows that Japanese and Chinese speaking learners of English behave differently with respect to the English l/r contrast. Neither Chinese nor Japanese has an l/r contrast at the phonemic level. However, Chinese, but not Japanese, includes [coronal] as a contrastive feature in its feature inventory, and this is the feature which distinguishes [l] from [r] in English. Brown shows that Chinese speakers are significantly more successful than Japanese speakers at detecting the English l/r contrast. Brown's theory as to the role of L1 features can be seen as a phonological version of the Representational Deficit Hypothesis of Hawkins and colleagues. That is, L1 features are initially adopted and maintained; new L2 features are not acquirable.

As far as interfaces are concerned, Goad and White (e.g., 2004) examine phonological effects on other components of the interlanguage grammar. These researchers advance the Prosodic Transfer Hypothesis, arguing that L1 prosodic structures can account for many of the morphological errors shown by L2 learners (as discussed above). According to this hypothesis, there is transfer at the prosodic level such that learners have difficulty in constructing prosodic representations required for the L2 but disallowed in the L1: their L1 prosodic structure determines what they can and cannot produce. As a result, inflections and function words may be omitted altogether, or produced variably, or subject to certain substitutions, making it appear that the learners have problems with morphology (or features on some accounts, see above) when in fact these problems are attributable to difficulty in acquiring the L2 prosodic representation due to L1 influence.

To summarize, so far we have seen that researchers working in the generative L2 tradition have investigated the acquisition of interlanguage representations, the early focus being on the role of UG and the extent of the involvement of principles and parameters. Subsequently, more detailed aspects of morphological, syntactic, semantic and phonological representations have been addressed, still on the assumptions that these representations are UG-constrained, and with particular attention paid to the effects of L1 representations on the interlanguage grammar.

5. Beyond representation: Accessing and using the interlanguage representation

As much of the research discussed above has demonstrated, interlanguage representations are in conformity with natural language grammars (i.e., fall within the range of linguistic systems permitted by UG). At the same time, L2 performance often falls short of being native-like. Differences between L2ers and native speakers are not necessarily amenable to an explanation in terms of representation (for example, effects of the L1). Rather, grammatical knowledge on the part of L2ers appears to be under-reflected in performance In consequence, other factors have been invoked to explain why L2ers are not always able to access their underlying representations, or are unable to access them efficiently. Non-target-like behaviour indicates problems in accessing appropriate linguistic representations due to multiple demands that arise in communicative contexts.

Along these lines, we have already seen that L2ers sometimes have difficulties mapping between lexicon and morphosyntax, resulting in morphological errors at the same time as syntactic successes (e.g., Lardiere, 1998; Prévost & White, 2000). This kind of explanation assumes that there are problems relating one grammar subsystem to another. We have also seen that some researchers have explored the relationship between the grammar and external domains, such as discourse, proposing that residual problems may arise at this interface. While Sorace and colleagues originally attributed such problems to a representational issue involving the feature [±topic shift], as discussed above, more recently, Sorace (2011) has suggested that processing problems are implicated, in that bilinguals are less efficient at integrating information from multiple domains, in this case syntax and discourse. She offers several possibilities including less automaticity in use of processing resources on the part of bilinguals as compared to monolinguals. Other possibilities are that working memory may be more stretched in the L2 context (e.g., Juffs, 2004; Hopp, 2014) or that lexical processing, including word frequency, impacts L2 syntactic processing to a greater extent than native speaker processing (Hopp, 2016).

A number of researchers have explored in some detail what the relationship between representation and processing might be by considering how L2ers parse the input. They have examined whether there are differences between L2ers' underlying representations (as revealed, for example, in offline tasks) and their parsing abilities, such that non-native performance can be attributed to processing problems rather than representational deficits (problems of use rather than problems of knowledge). Parsing is the assigning of a structural representation to an incoming string in real time; in this context, several studies have considered how L2ers process filler-gap dependencies in cases involving wh-movement. When processing wh-questions like those in (1) and (3) above, as soon as the parser encounters a wh-phrase (the filler), it looks for the gap that that phrase originally filled, creating a filler gap dependency.

Along these lines, Clahsen and Felser (2006) claim that L2ers differ from child and adult native speakers in how they parse the input. They propose the *Shallow Structure Hypothesis*, whereby L2ers rely on lexical and semantic cues, such as the thematic structure of verbs together with pragmatic information, rather than syntax to parse L2 sentences. In the case of filler gap dependencies, L2ers are purported to be unable to compute intermediate gaps. In a sentence like (3), repeated here as (10), the wh-phrase passes through a position at the edge of the lower CP on its way to the front of the sentence. Clahsen and Felser suggest that native speakers activate the filler gap dependency at the intermediate gap site as well as the original gap site and that L2ers are unable to do so.

(10) What$_i$ did Mary say [e_i [that John bought e_i]]?

In the case of ungrammatical sentences violating Subjacency like (5), repeated here as (11), there is no possible gap position at the edge of the complex NP containing the relative clause. Consequently, the wh-phrase cannot 'escape' out of the complex NP, which forms an island, in accordance with the Subjacency Condition.

(11) *Who$_i$ do you like [the book[e_i [that e_i wrote]]]?

On the Shallow Structure Hypothesis, structural differences between grammatical and ungrammatical *wh*-movement should disappear, since there would be no intermediate gap in either case, so violations of Subjacency should be treated no differently from grammatical wh-movement. The studies that Clahsen and Felser (2006) report on do not include ungrammatical sentences. Omaki and Schultz (2011) show that L2ers, like native speakers, are in fact sensitive to the effects of islandhood in online tasks, as do results from Kim et al. (2016), suggesting that UG-constraints are operational both offline and online and that processing cannot be as shallow as Clahsen and Felser propose. In other words, sentences violating Subjacency are represented differently from grammatical sentences (or are not representable at all) and this information is accessed off line and online.

While many researchers have reported problems attributable to processing in online tasks, Hopp (2009) makes the point that sometimes offline tasks can induce greater processing complexity than online. He investigates scrambling in the L2 German of English, Russian and Dutch speakers. Here I will only report on the results from the English speakers. In German, scrambling of embedded objects over subjects is possible provided that the scrambled NP denotes given information, as shown in (12), in response to a question like *Who beat the father* ?

(12)	Ich	glaube	dass	den	Vater	der	Onkel	geschlagen	hat
	I	think	that	the-ACC	father	the-NOM	uncle	hit	has
	'I think that the uncle hit the father'								

English, on the other hand, does not allow scrambling. Hopp uses offline measures (acceptability judgments) and online (reading time) to assess whether advanced and near native L2ers observe the information structure requirements (givenness) on scrambling. In the acceptability judgment task, the near native English group but not the advanced group showed knowledge of the appropriate morphosyntax for scrambling (word order and case marking), together with the relevant discourse constraint. In the online reading task, on the other hand, both English groups took longer to read sentences where the scrambled word order was in conflict with the information structure. In other words, the English near native group were sensitive to information structure effects on word order in both tasks, while the English advanced group performed better on the online task than the offline one. Hopp suggests that this is because the offline task is actually more demanding: learners must assess word order, case, and information structure. In the reading task, the well-formedness of the sentences is not in question. As a result, the computational burden is greater in the offline task and this is reflected in the L2ers' performance. (Recall, also, that Ortifelli and Grüter argue that offline grammaticality judgment tasks may reflect processing problems rather than underlying linguistic representations.)

To summarize, whether difficulty in accessing the interlanguage grammar shows up as effects on online processing or in offline tasks, the important issue is that this line of research takes seriously the issue of how representation interfaces with processing. Things that may cause occasional problems for native speakers appear to cause greater problems for L2ers. These problems turn out not to be attributable to representations as such.

6. Conclusion

To conclude, it is the domain of linguistic theory to determine the nature of the formal linguistic system that represents the competence of native speakers, as well as L2ers under the perspective advanced here. Linguistic theory is not static; proposals have developed over time. Research that has adopted a formal linguistic perspective on L2 acquisition has similarly advanced and developed over the past 30 years. As Schwartz and Sprouse (2000) have pointed out, despite changes in our understanding of the nature of UG, poverty-of-the-stimulus arguments remain crucial in motivating a role for UG in language acquisition. The formal account may have changed but not the basic observation of the need for such an account.

As we have seen, the preoccupation with UG principles and parameters in L2 acquisition (the UG access debate) has lessened somewhat over the years and has been replaced with a detailed focus on interlanguage representations (morphological, syntactic, semantic and phonological) and the role of the L1 grammar and UG in shaping the acquisition of these representations. There has been increasing interest in how representations are accessed and used, for example, in real time processing.

Currently, there are suggestions that the formal linguistic approach (particularly, the generative linguistic approach that assumes UG) has little to offer applied linguists and practitioners (de Bot 2015: Chapter 6). This dismissal of formal linguistics is based on a misconception as to what generative L2 research is about. As we have seen, this research focuses on the nature of interlanguage competence, factors underlying the acquisition of that competence, as well as factors that lead to less than perfect performance. In other words, the formal linguistic perspective contributes to our understanding of the basic science of language in particular and cognitive science more generally; it does not aim to provide applications for the classroom, nor should it be expected to do so. Of course, sometimes there are applications (see, for example, papers in Whong, Gil & Marsden, 2013) and, as we advance our understanding of how languages are learned, further applications may emerge. But applications are a bonus rather than a necessity. The crucial question is whether formal linguistic approaches have helped us to understand the nature of L2 competence and how that competence is acquired. And surely the answer is that they have done so and will continue to do so.

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PART II

Child bilingualism

CHAPTER 5

Simultaneous child bilingualism

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Simultaneous bilingual children are exposed to two languages from an early age. They show a remarkable ability to differentiate their two languages from early in development. They nonetheless show some small signs of cross-linguistic influence, or processing their two languages in ways that show influence from the other language. Bilingual children's language development can lag behind that of monolingual children's, at least when including only the results of one of their languages. Some (but not all) studies have shown bilingual advantages in some aspects of cognitive development. It is not yet clear why there are differing results across studies.

1. Introduction

Simultaneous bilingual children are children who are exposed to two languages from early in development. The reason to distinguish between simultaneous bilinguals and sequential bilinguals (see previous chapter, this volume) is that by adulthood, there are often differences in language use or knowledge of a language depending on the age of acquisition of that language. Adults who started learning a second language later in life often speak that language with an accent (Hopp & Schmid, 2013; Munro & Mann, 2005; cf. Kupisch, Barton, Hailer, Lein, Stangen, & von de Weijer, 2014, for a study on accentedness in adults who learned both languages simultaneously), although there can be exceptions to that general rule (see White & Genesee, 1996). Bilingual adults often score lower on vocabulary tests than monolinguals in at least one of their languages (Bialystok & Luk, 2012). However, in situations that foster proficiency in both languages, adults who speak two languages can attain the same levels of vocabulary and syntax in both of their languages as monolinguals (Smithson & Nicoladis, 2013; White & Genesee, 1996). Taken together, these observations suggest that, by the time a person has attained adulthood, the age of acquisition of a language can show some effects on language knowledge.

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Researchers have reached no consensus as to the specific age or even the age range at which age of acquisition starts to make a difference. Part of the challenge of identifying a specific age (or age range) is that the age of acquisition may affect different aspects of language differently (see discussion in Long, 1990; Singleton, 2001). Nevertheless, researchers have sometimes used adolescence as a rule of thumb to identify late learners from early learners (Nicoladis, Pika, Yin, & Marentette, 2007), sometimes middle childhood (Long, 1990; Perani et al., 1998), sometimes the preschool years (Meisel, 2004), sometimes even infancy (De Houwer, 1990). In this chapter, we are concerned with the language acquisition and development of simultaneous bilingual children in approximately the first five years of life. There is little research addressing whether the age of acquisition makes a difference among children within this age range (although see Ågren, Granfeldt, & Thomas, 2014, and cited references for some exceptions; see also, Unsworth, 2008, 2016, for work with older children). For that reason, I will include research on children who became bilingual within the first two to four years of life, although in doing so, there may be some overlaps with the findings regarding sequential bilingual children (see previous chapter, this volume).

The overview of this chapter is as follows. To begin this chapter, I will first discuss reasons why simultaneous bilingual children might be exposed to two languages. Understanding the patterns of exposure to each language will be important to understanding children's dominance and proficiency in their two languages. I next show that while it has been assumed that bilingual children must be confused by their bilingualism, they are actually able to differentiate their languages early in development. Nonetheless, bilingual children's language processing and acquisition do show some differences from monolingual children. Finally, I discuss the evidence for and against the argument that early bilingualism can lead to cognitive advantages over monolinguals.

2. Language exposure

Simultaneous bilingual children are, by definition, children who are exposed to two languages from an early age (De Houwer, 1990; Meisel, 2004). Some simultaneous bilingual children grow up in bilingual communities, in which adults speak both languages (Tabouret-Keller, 1962). Even in bilingual communities, adults often speak primarily a particular language with children (Genesee, Nicoladis, & Paradis, 1995). For that reason, many bilingual children grow up hearing their two languages in different contexts, where a context could correspond to a particular person or a location (e.g., home vs. preschool, the neighbourhood, etc.).

There has been a fair bit of research on families in which one parent speaks primarily one language with the child and the other parent speaks the other, usually with each parent speaking his or her mother tongue (e.g., Bain & Yu, 1980; De Houwer, 1990; Genesee et al., 1995). The idea of a one person-one language principle originates from advice given by a colleague of Ronjat (1913) on how to raise his son so that he would speak both languages well. Ronjat (1913) reported that his son developed both French and German at a high degree of proficiency, suggesting that the one person-one language approach might be an approach that could foster healthy bilingual development. Several studies have shown that in families practicing a one parent-one language approach do result in children who speak both languages (Bain & Yu, 1980; Genesee et al., 1995; Paradis & Nicoladis, 2007). There is, however, little research comparing bilingual children growing up in one person-one language homes with bilingual children growing up in other bilingual circumstances (cf. Rodina & Westergaard, 2015). One study on Spanish-speaking children in the United States showed that children's expressive vocabulary was higher when both parents consistently spoke Spanish rather than when one or more parents spoke English (Hoff, Rumiche, Burridge, Ribot, & Welsh, 2014). The results of this study should not necessarily be interpreted as indicating that a one parent-one language approach is to be discouraged, since the mother tongue of most of the parents in that study was Spanish. Recall that parents usually speak their own mother tongue in one parent-one language families.

In sum, simultaneous bilingual children may often grow up in circumstances in which they hear languages in different physical locations, such as home vs. school. Many of the subsequent studies have focused on one parent-one language families so it is not clear if the results will generalize to other bilingual situations.

3. Proficiency and language dominance

Bilingual children almost always speak one language better than the other, or are dominant in one language. This simple principle follows logically from the patterns of exposure discussed in the previous section. That is, bilingual children generally do not spend equal amounts of time in both of their languages. Even if they did, the time in the two languages is often spent discussing different concepts, resulting in at least slightly different knowledge in the two languages over the course of development (De Houwer, 1990).

As a general rule, children's exposure time to a language is highly related to how proficient they are in that language during childhood: the more they hear a language, the better their knowledge of that language (Dixon, 2011; Hurtado, Grueter, Marchman & Fernald, 2014; Pearson, Fernández, Lewedag & Oller, 1997; Place &

Hoff, 2011). The relationship between amount of exposure and proficiency can start as early as toddlerhood (Pearson et al., 1997) and lasts throughout childhood. Within childhood, the amount of exposure may be a more important predictor of language knowledge than the age of acquisition (Bedore, Pena, Summers, Boerger, Resendiz, Greene, Bohman, & Gillam, 2012).

While the amount of exposure to a particular language is a strong predictor of how proficient bilingual children will be in that language, there are other variables that play a role. By the time children are four years of age, they can become sensitive to the majority language of the community (Paradis & Nicoladis, 2007). It is possible that the mechanism for children's identification of the majority languages is through the number of different speakers of a particular language. Preschool children tend to be more proficient in a language if there is a larger number of speakers of that language in their community (Hurtado et al., 2014), an effect that can persist into adulthood (Gollan, Starr, & Ferreira, 2015). So, bilingual children may adjust their own language choices depending on the number of speakers of a particular language in their community.

There are probably many other factors affecting proficiency, including the quality of the input (see review in Unsworth, 2016), language of media (Dixon, 2011), and parents' attitudes (Cha & Goldenberg, 2015). Curiously, there is some evidence that proficiency in one language can be positively related to proficiency in another language (Cha & Goldenberg, 2015; Dixon, 2011). In other words, the better a child speaks one language, the better he/she speaks the other.

In sum, there are a number of variables related to how proficient bilingual children will be in each of their languages. The amount of time that bilingual children are exposed to a particular language is a strong predictor, but not the only predictor, of their proficiency. It is important to recognize that bilingual children can show a great deal of variability in their proficiency of their two languages. As will be seen in the next section, language dominance can mask some important developmental changes in language choice.

4. Fusion vs. differentiation

Following an intensive diary study of his English-German bilingual daughter, Leopold (1949) concluded that she had passed through an initial stage of confusing or fusing the two languages. Other researchers reached similar conclusions on the basis of observations of a few children (Volterra & Taeschner, 1978). Their evidence for claiming fusion was that the children under study sometimes produced code-mixed utterances, that is, utterances that included words from both of their languages. For example, a French-English bilingual child might say "doggie dodo", with the word “doggie” from English and “dodo” from French (a child-directed word meaning ‘sleep’ or ‘sleeping’). Since these children were growing up in one parent-one language families, the researchers concluded that the children’s code-mixing could not have come from the parents and must reflect something about the children’s own representation of the two languages as a single system.

Genesee (1989) pointed out that researchers could not conclude on the basis of code-mixing alone that bilingual children are fused. Even bilingual adults code-mix (see review in MacSwan, 2016). Even the parents in one parent-one language families who think they do not code-mix do, in fact, code-mix when observed in naturalistic interactions with their parents (Goodz, 1989). Genesee (1989) argued that to conclude that bilingual children had confused their two languages they would also have to use their languages indiscriminately with different participants.

In order to test this interpretation, it is important to control for children’s language dominance. Bilingual children tend to code-mix more when speaking their non-dominant or weaker language (Deuchar & Quay, 2000; Genesee et al., 1995; Lanvers, 2001; Nicoladis & Secco, 2000). Part of the reason that language dominance affects code-mixing is that the dominant language often corresponds to the language in which children have a greater range of vocabulary. So, when trying to speak their non-dominant language, bilingual children may encounter situations in which they know how to express a concept in their dominant language but simply do not have the words for it in their non-dominant language. Indeed, one study that systematically tested whether a young bilingual child’s code-mixing could be explained by gaps in his vocabulary showed that 90% of his code-mixing could be accounted for by gap-filling (Nicoladis & Secco, 2000).

Thus, in order to identify if children are fusing their two languages early in development, it is important to take into account their dominant language. Genesee et al. (1995) showed that French-English bilingual two-year olds could choose the correct language for their interlocutor, particularly once their dominant language was taken into account. Other studies have since shown that other bilingual children also show this sensitivity, usually around two years of age (see review in Quay & Montarnari, 2016).

Since showing that bilingual children are capable of choosing the appropriate language from their interlocutor at quite a young age, researchers have become interested in the developmental course of language differentiation. Researchers are showing that bilingual children’s ability to differentiate their two languages emerges at different ages depending on at least two important factors: (1) the aspect of language under study (e.g., phonology, syntax, etc.) and (2) how the languages are presented to children.

Let us first consider the aspect of language under study. Bilingual children cannot show systematic distinction between their two languages until systematic behavior can be observed in children generally (Vihman, 2002). For example, Walley (1993) argued that monolingual children only start to use phonology systematically once they know a critical mass of words over which they can generalize phonological patterns. So, it would be no surprise if bilingual children did not show systematic usage of phonology before that age. Indeed, Nicoladis and Genesee (1996) showed that bilingual children generally do not use the appropriate language for their interlocutor at 18 months of age, but did closer to two years. They argued that the children's vocabulary was so limited at the earlier age that the children could not show differentiation.

Keeping in mind that language differentiation in bilinguals can only be observed when language acquisition reaches a particular critical phase of systematicity, it is perhaps no surprise to observe that language differentiation seems to emerge with different aspects of language at different ages. Language differentiation among simultaneous bilingual children can begin in infancy. Infants who hear two languages show sensitivity to differences in the prosodic patterns of the two languages (see review in Fennell, Tsui, & Hudon, 2016). Several studies have shown that bilingual infants show small but statistically significant differences in how they babble when they are in the two different language contexts (Andruski, Casielles, & Nathan, 2014; Maneva & Genesee, 2002). It is important to note that not all studies have shown phonological differences in the babbling of bilingual infants (e.g., Poulin-Dubois & Goodz, 2001). So, it is unclear whether all bilinguals will show these differences. Johnstone (2004) reported on a bilingual child who babbled more Spanish-like in Spanish contexts, more English-like in English contexts and showed a mixture of both with his grandmother who code-mixed a lot.

Other aspects of language development may not show signs of differentiation until children are at least two years of age and have developed their language abilities well enough and systematically enough to be able to demonstrate their ability to differentiate. For example, the ability to differentiate the phonologies of words of each of the languages may not emerge until around the age of two years of age (e.g., Paradis, 2001; see review in Quay & Montarnari, 2016), even though phonological differences in babbling can be observed much earlier.

Nicoladis (1998) proposed a developmental sequence for the emergence of language differentiation in bilingual children. She argued that bilingual infants can associate languages and contexts (see also Kandhadai et al., 2014), allowing some signs of language differentiation in infancy. As bilingual children start to learn words, they need to learn enough words in each language to be able to use their languages appropriately with interlocutors (this ability is sometimes referred to as pragmatic differentiation), consistent with observations of French-English bilingual children (Nicoladis & Genesee, 1996). Only after children start using their languages in particular contexts do they learn that words in their two languages can refer to the same referent (i.e., learn translation equivalents like "cat" in English and "gato" in Spanish). Several studies have shown that this is an ability that can be observed in bilingual children around the age of two years (Holowka, Brosseau-Lapré, & Petitto, 2002; Quay & Deuchar, 2000; Nicoladis, 1998; cf. Umbel, Pearson, Fernández, & Oller, 1992). Soon after this age, bilingual children can start to show systematic syntactic and phonological differentiation with language use (see review in Quay & Montarnari, 2016).

Most of the research on language differentiation in bilingual children has focused only on a single aspect of language, so it is not clear if the developmental sequence proposed in Nicoladis (1998) is correct. Nicoladis (1998) did show earlier pragmatic differentiation than translation equivalent use in a Portuguese-English bilingual child. Future research will test whether that developmental sequence generalizes to other children.

Another variable that might affect bilingual children's language differentiation is their patterns of exposure. Kandhadai, Danielson, and Werker (2014) argued that infants associate faces (e.g., their mothers' faces) and contexts (e.g., the room in which conversations are taking place, other people who are present and so on) in order to learn appropriate behavior for their community. Bilingual children can therefore associate faces and languages, resulting in differentiation of languages. Most evidence looking at the developmental course of differentiation comes from bilinguals growing up in situations in which there are clear language and context associations possible, such as one parent-one language families (see review in Quay & Montarnari, 2016). It is, as of yet, unclear whether these results will generalize to bilingual children who hear many individuals speaking multiple languages (although see Rebelos, 2013, for some preliminary evidence that this is the case). If the reasoning of Kandhadai et al. (2014) is correct, then the results below should generalize to children growing up in these situations. They reason that people are in different contexts when they speak different languages. For example, the mother of a bilingual child might speak Hindi at home with her mother (the child's grandmother) and English with her friend the neighbor. Kandhadai et al. (2014) argue that infants should be able to track those language-context associations so that they should be able to differentiate the two languages.

In sum, while some researchers claimed that bilingual children went through an initial stage of fusion, subsequent research has shown that this is not the case, once children's dominant language is controlled for. In fact, bilingual children start to show signs of differentiating their languages from infancy. Language differentiation becomes more systematic and evident in multiple aspects of language as children get older and develop their linguistic sophistication.

5. Cross-linguistic influence

While bilingual children can differentiate their two languages from early in development, differentiation does not mean that they always use both of their languages exactly like monolinguals of each language would. Indeed, researchers have noted that bilingual children show signs of influence of one language on the other, or cross-linguistic influence, when processing both of their languages. For example, a Spanish-English bilingual child might use a possessive construction in English like "the paw of the cat" more frequently than an English monolingual, influenced by the similar construction in Spanish (e.g., "la pata del gato" or literally "the paw of the cat"). Note in this example, all the words are in English but the construction might be influenced by Spanish. Furthermore, this particular construction is not incorrect in English, it is simply less preferred than "the cat's paw".

Cross-linguistic influence has been observed in bilingual children's phonology, lexicons, morphology, syntax, and fixed expressions (see review in Nicoladis, 2016). While the example given above resulted in a grammatical construction, cross-linguistic influence can sometimes result in ungrammatical constructions in the target language. For example, Nicoladis (2012) showed that French-English bilingual children sometimes reversed the order of the words in French possessive constructions. In French, to create a grammatical possessive construction, the possessed thing precedes the possessor (e.g., "la patte du chat" 'the paw of the cat'). Yet, French-English bilingual preschoolers sometimes used the English order of possessor then possessed when speaking French. It is not yet clear whether cross-linguistic influence is more likely to result in grammatical constructions than ungrammatical ones (see discussion in Yip & Matthews, 2007).

Researchers have generally agreed that cross-linguistic influence is not a sign of language confusion (Nicoladis, 2006; Serratrice, 2013; Yip & Matthews, 2007). Part of the reason for this is that, as a general rule, cross-linguistic influence does not appear in the majority of instances of language processing of children (Nicoladis, 2006; 2012; Nicoladis & Gavrila, 2015; Serratrice, 2013). In other words, bilingual children most often process their languages in target-like ways for the language in question and only occasionally show signs of cross-linguistic influence.

Nicoladis (2006; 2012) has proposed that cross-linguistic influence might appear as a result of on-line language processing. When processing a language, all speakers and listeners occasionally make slips of the tongue or slips of the ear (see MacNeilage, 1983). Nicoladis (2006; 2012) has argued that cross-linguistic influence is a kind of processing error that appears because bilinguals' two languages are always a little activated (see Grosjean, 2001) and therefore compete for realization.

Paradis and Genesee (1996) pointed out that cross-linguistic influence could lead to three possible effects in acquisition: delay, acceleration, and transfer. Indeed, there is evidence for all three of these effects. When the structures of a bilingual's two languages are similar in both languages, acceleration of acquisition can be observed (Bosch & Ramon-Casas, 2014; Kupisch, 2007; Lleó, Kuchenbrandt, Kehoe & Trujillo, 2003; Nicoladis, 2003). Other studies have showed some possible delays in bilingual children's morphosyntactic acquisition relative to same-aged monolingual children (Nicoladis, Palmer, & Marentette, 2007). Still other studies have simply shown differences in bilingual and monolingual children's language use (Müller & Hulk, 2001; Nicoladis, 2012; Yip & Matthews, 2007).

In sum, while bilingual children can clearly differentiate their two languages early in development, they do occasionally show signs of influence from one language on the other. Cross-linguistic influence may often result from language competition during on-line processing; in other words, may simply be slips of the tongue or the ear. Nevertheless, cross-linguistic may also affect the rate of acquisition, either accelerating or delaying, depending on how similar the two languages are.

6. Language development of bilingual children

As noted in the last section, when the structure of a bilingual's two languages is dissimilar, acquisition can be delayed. There are, however, other reasons to predict that bilingual children's language acquisition might be delayed relative to monolingual children. Much of language, like vocabulary and morphology, is learned through frequency of exposure and practice (Tomasello, 2009). As discussed earlier in this chapter, bilingual children's language use is divided across their two languages. As a result, on average, bilingual children would use each of their languages less often than monolingual children of that language. It is no surprise, then, that bilingual children show some delays in some aspects of language acquisition relative to monolingual children (see review in Akhtar & Menjivar, 2012). In other words, bilingual children can perform worse than same-aged monolinguals on measures of language acquisition in at least one of their languages. For example, preschool bilingual children often score lower than monolingual children on vocabulary tests within a language (Allman, 2005; Ben-Zeev, 1977; Bialystok, Craik, & Luk, 2007; Bialystok & Luk, 2012; Bialystok, Luk, Peets, & Yang, 2010; Carlson & Meltzoff, 2008; Doyle, Champagne, & Segalowitz, 1978; Engel de Abreu, 2011; Junker & Stockman, 2002; Mancilla-Martinez & Vagh, 2013; Morales, Calvo, & Bialystok, 2013; Nicoladis, 2003; Oller, 2005; Oller, Pearson & Cobo-Lewis, 2007; Pearson, Fernández, & Oller, 1993; Uchikoshi, 2006; see reviews in Akhtar & Menjivar, 2012, and in Bialystok, 2009). Bilingual children also show delays relative to monolinguals in acquiring other aspects of language that require frequent exposure and practice, such as past tense morphology (e.g., Nicoladis, Palmer, & Marentette, 2007) and gender morphology (Thomas & Gathercole, 2007).

Pearson et al. (1993) pointed out that vocabulary tests within a single language do not count the totality of bilingual children's vocabulary, since they exclude vocabulary items from the other language. They proposed counting bilingual children's total conceptual vocabulary, or the total number of concepts for which children knew a word in either language. They showed that Spanish-English bilingual children's total conceptual vocabulary size was equivalent to that of monolinguals' vocabulary size. These results suggest that bilingual children's vocabulary is simply shared across their two languages. These results were replicated in another Spanish-English bilingual sample including slightly older children (Core, Hoff, Rumiche, & Señor, 2013). Another study showed that low-income Spanish-English bilinguals scored lower than monolinguals, even when counting the total conceptual vocabulary (Mancilla-Martinez & Vagh, 2013). However, the authors noted that the difference from monolinguals was much smaller when the total conceptual vocabulary was counted rather than the vocabulary from a single language.

A few studies among French-English bilingual children growing up in Canada have shown that some of the bilinguals at some ages can attain vocabulary sizes equivalent to monolinguals in both of their languages. Thordardottir (2011) showed that children with relatively balanced proficiency in both of their languages in Montreal attained vocabulary sizes equivalent to those of monolinguals in both of their languages. Similar results have been reported for French-English bilinguals in middle childhood, around 8 to 10 years of age (Smithson, Paradis, & Nicoladis, 2014) and into adulthood (Smithson & Nicoladis, 2013). As these results have been reported among French-English bilinguals in Canada, and not necessarily all such bilinguals in Canada (Nicoladis, 2003; Thordardottir, 2011), they may reflect something about the bilingual situation in Canada. Further evidence for this interpretation comes from studies showing that adults in Canada speaking other language pairs do not necessarily attain monolingual norms (Bialystok et al., 2010). There is a lot of social and political support of French-English bilingualism in Canada and the social-political context can make a difference in bilinguals' language outcomes (see Montarnari & Nicoladis, 2016). For these reasons, these results may indicate simply that it is possible for bilingual children to attain the same degree of proficiency as monolinguals in both of their languages, but only in situations in which there is extensive support for the children's learning of both languages.

Another important factor to keep in mind when interpreting the results of bilingual delays in language relative to monolinguals is that most of the research thus far has focused on performance on standardized vocabulary tests. One study looked at bilingual children's word choice in a language task a bit closer to everyday language use: storytelling (Barbosa, Nicoladis, & Keith, in press). This study found that bilinguals were, indeed, less likely to produce target words for key elements in the story than same-aged monolinguals. However, the bilinguals nonetheless spoke about the key elements in the story, using words that would likely be adequate to convey the point (e.g., "cat" instead of "panther" or "ocean" instead of "river"). These results suggest that while bilingual children may not necessarily know a particular vocabulary item (explaining why they perform lower on vocabulary tests), but can use language creatively and adequately to make points clear in everyday contexts.

In sum, bilingual children show some delays in language development relative to monolinguals in domains that require frequent exposure and/or practice. There is some preliminary evidence suggesting that these delays may not necessarily cause difficulties in day-to-day communication, in which some flexibility in word choice is acceptable.

7. Cognitive development of bilingual children

Part of the reason that bilingual children may be able to overcome language delays in day-to-day communication is that they may show advantages on some cognitive abilities relative to monolinguals (see reviews in Akhtar & Menjivar, 2012, and in Barac, Bialystok, Castro, & Sanchez, 2014). The rationale behind the argument that bilinguals might show cognitive advantages over monolinguals comes from the usage of their two languages. Bilinguals often grow up in situations in which they have to choose the appropriate language for a particular context (see Quay & Montarnari, 2016). With repeated practice at choosing the appropriate language, bilingual children can learn to think of words independent from their referents to a degree that monolingual children do not experience (Ben Zeev, 1977). As a result, bilingual children might become more flexible in their thinking than same-aged monolinguals. For example, Adi-Japha, Berberich-Artzi, and Libnawi (2010) showed that preschool bilingual children were more creative in drawing non-existent things than same-aged monolinguals. This creativity was manifest in bilinguals' greater tendency to combine novel elements (e.g., a giraffe with a flower) relative to monolinguals.

Another potential sign of creativity among bilinguals is their greater willingness to agree that words can have more than one meaning relative to monolinguals (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Byers-Heinlein & Werker, 2013; Davidson, Jergovic, Inami, & Theodos, 1997). Bilingual children generalize this flexibility to novel words. Marinova-Todd (2012) showed that French-English bilingual children were more willing than English monolingual children to guess what novel words might mean. These results are compatible with those reported earlier in this chapter, showing that bilingual children express target concepts in a story in perfectly adequate ways, even if not necessarily the same ways that monolinguals do (Barbosa et al., in press).

Another possible cognitive advantage attributed to early bilingualism is in terms of theory of mind. Theory of mind refers to an understanding that other people have feelings, thoughts, and beliefs (Bartsch & Wellman, 1995), an understanding that develops considerably over the preschool years. By consistently choosing that language that is required of children's interlocutors (Comeau, Genesee, & Lapaquette, 2003), bilinguals might come to understand that others have thoughts and beliefs earlier in development than monolingual children do. Some researchers have reported results consistent with this claim of earlier development (Bialystok & Senman, 2004; Goetz, 2003) while others have not (e.g., Jean-Louis, 1999). It is not yet clear why different studies report different results. One possibility is that bilinguals would have to have consistent experience choosing the appropriate language for a context and the studies of children's theory of mind have not yet systematically measured the degree of children's experience in choosing languages for contexts.

This variable could be one possible explanation for the differing results across studies with regard to executive functioning. Executive functioning refers to a collection of cognitive abilities related to selecting and controlling one's behavior (Bialystok, 2011). Since bilingual children have extensive experience attending to cues allowing them to choose the appropriate language for the context (Kandhadai et al., 2014), they might develop better executive functioning ability than same-aged monolinguals (Bialystok, 2001, 2011). Indeed, some studies have shown that bilingual children outperform monolingual children on executive function tasks, both related to language (e.g., grammaticality judgment tasks) and non-linguistic tasks (e.g., sorting cards according to changing rules; Bialystok, 2011, 2001; Bialystok et al., 2010; Bialystok & Martin, 2004; Cromdal, 1999; Morales et al., 2013; Tare & Gelman, 2010). Other studies, sometimes using the exact same tasks, have shown no differences between monolinguals and bilinguals on executive function tasks (Duñabeitia et al., 2014; Gathercole, Thomas, Kennedy, Prys, Young, Vinas Guasch, Roberts, Hughes, & Jones, 2014; Hutchison, 2010; Morton & Harper, 2007). In some of these studies, the researchers have ruled out proficiency or dominance as an explanation for why they did not find a bilingual advantage (Gathercole et al., 2014; Hutchison, 2010). Here again, it is not clear why some studies show bilingual advantages and others do not. As noted above, bilinguals' experience in choosing the appropriate language for the context could be important in predicting the directionality of results. Morton and Harper (2007) also pointed out that not all studies have controlled for the participants' socio-economic status, a variable that is known to be important in the development of executive functioning. In their study, in which they controlled for socio-economic status, they showed no differences between bilinguals and monolinguals. Future studies will also take into account bilinguals' age of acquisition of their two languages and their daily usage.

In sum, bilingual children have shown some cognitive advantages over same aged monolinguals in terms of flexibility of word meaning, theory of mind, and executive functioning. Other studies on theory of mind and executive functioning have shown no differences between bilinguals and monolinguals. To date, it is not clear why there are variable results across studies. Researchers are currently exploring the myriad of different experiences individual bilinguals undergo, in order to understand which of these might make a difference in when bilingual advantages are seen.

8. Summary and conclusion

In this chapter, we have seen that simultaneous bilingual children are often exposed to each of their languages in different contexts. Since the amount of time spent in each language is rarely equal, bilingual children often show greater proficiency in one language than the other (or language dominance). In some early studies, language dominance masked children's ability to differentiate their two languages, leading researchers to think that bilingual children initially fuse their two languages. However, studies controlling for children's language dominance have shown that bilingual children can differentiate their two languages from early in development. The ability to differentiate the two languages does not mean that bilinguals speak their two languages like monolinguals would. In fact, bilingual children often show signs of cross-linguistic influence, or processing their two languages in ways that show influence from the other language. They may therefore occasionally produce or understand language a little differently than monolingual children.

Bilinguals' language and cognitive development may differ from monolinguals' in other ways as well. Bilingual children's language development can lag behind that of monolingual children's, at least when including only the results of one of their languages. It is possible that these lags will not be evident in day-to-day communication, however, since some research shows that bilinguals can adequately convey concepts when communicating even when they do not choose the same target word as monolinguals. As for cognitive development, some studies have shown bilingual advantages when bilinguals are compared to same-aged monolinguals (although others have shown no differences). It is not yet clear why there are differing results across studies. Researchers are actively seeking how individual differences in bilinguals' experiences might make a difference in their cognitive development.

Much of the research cited above has focused on bilinguals growing up in situations in which languages are clearly separated by context (e.g., school vs. home, one parent-one language families). Further research needs to be done on bilinguals growing up in bilingual communities, to see if the results generalize to other bilingual populations. Another point to keep in mind is that, with a growing number of exceptions (e.g., Bosch & Ramon-Casas, 2014; Meisel, 1989; Müller & Hulk, 2001), in much of the research on bilingual children to date, English is one of the languages. As English can be associated with status in many of the places in which bilingual children are growing up (e.g., Paradis & Nicoladis, 2007), studies including language pairs that do not include English will be important in determining the generalizability of the present results.

This chapter focused on language and cognitive development of simultaneous bilingual children during the first five or so years of life. Research shows that developmental trajectories past this age vary enormously between individuals (see discussion in Genesee, 2016). Some bilingual children can be virtually monolingual as adults while others retain a high degree of proficiency in their two languages (Gollan et al., 2015; Kupisch et al., 2014; Smithson & Nicoladis, 2013). There are a myriad of variables related to the adult proficiency of simultaneous bilinguals (see Chondrogianni & Marinis [2011] for a more thorough discussion of some of those variables), including the language of schooling (Bridges & Hoff, 2014; Jia, Chen, Kim, Chan, & Jeung, 2014) and the language of media and extracurricular activities (Nagpal & Nicoladis, 2010).

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CHAPTER 6

Child L2 acquisition

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Successive childhood bilingualism or child second language (L2) acquisition is the acquisition of an L2 during childhood after some properties of the first language (L1) are already in place. The study of child L2 development can inform us about the *mechanisms* and *processes* involved in second language learning and highlight the ways in which these mechanisms are similar or different from those reported for L1 children and L2 adults. Therefore, it is important to investigate how child L2 development compares with child L1 development and adult L2 acquisition, what the role of the L1 in the acquisition process is, whether and when age of L2 exposure effects are observed in the acquisition of an L2 during childhood, and how input quality and quantity can shape the child L2 acquisition process.

1. Introduction

As the number of bilingual speakers around the world increases, so does the number of bilingual children whose exposure and acquisition of the two languages occurs sequentially during childhood (Grosjean, 2010). Successive or sequential childhood bilingualism or child second language acquisition (L2A) refers the acquisition of an L2 during childhood after exposure to the first language (L1) has begun and after certain L1 properties are in place. A child L2 learner has been generally defined as a non-native learner whose exposure to the L2 occurs around the ages of three or four years and before the age of seven years (Meisel, 2008; Schwartz, 2004; Unsworth, 2005). The lower cut-off point is motivated by crosslinguistic evidence demonstrating that by the child's fourth birthday most properties of the L1, e.g. word order, nominal and verbal inflection, are already in place. The upper cut-off point is couched within the long-standing literature on critical or sensitive periods in L2A that postulates a decline in neuroplasticity and the language learning mechanism of L2 learners as a function of the age of L2 exposure or onset (AoO) (Abrahamsson & Hyltenstam, 2009; Meisel, 2013). This cut-off point has been proposed to take effect as early as the age of seven years (Abrahamsson & Hyltenstam,

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2009; Schwartz, 2004), although this may vary depending on the language domain being acquired (Muñoz & Singleton, 2010).

Historically, the study of child L2A enjoyed a surge in interest in the 70s, when it was perceived as the missing link between child L1A and adult L2A. Child L2A could shed light into the debate on whether or not there is a universal developmental path shared by all learner groups over and above L1 transfer (Dulay & Burt, 1974), at a time when L1 transfer was considered the most important variable guiding adult L2A within the then dominant Contrastive Analysis framework (Lado, 1957). Despite its historical importance, most research during that period was primarily descriptive and based on longitudinal case studies that did not always allow for theoretical and empirical generalisations to be made (Lakshmanan, 2009). From the mid 90s and afterwards, child L2A research has received renewed attention with the last decade enjoying a surge of experimental studies in this field (Blom & Paradis, 2016; Haznedar & Gavruseva, 2008; Unsworth, 2005). This renewed interest in child L2A from the late 90s was primarily motivated by theoretical questions within the generative account of language acquisition (Chomsky & Lasnik, 1993), which assumes an innate capacity of language learning guided by a set of principles and parameters (White, 2003). The child L2-adult L2 comparison in this framework could shed light into the longstanding question in the L2A literature regarding whether or not adult L2 learners have access to the same learning mechanism as child learners. Assuming that child L2 learners have access to the same mechanism guiding L1 acquisition, a similar developmental path between L2 children and L2 adults could provide the missing link between adult L2 and child L1 acquisition (Schwartz, 1992).

The study of child L2A is theoretically informative in other ways. Examining how L2 children acquire their language in comparison to their L1 counterparts offers a testing ground for theories of L1 acquisition that either postulate the presence of an innate developmental path which is subject to maturation (Wexler, 1998), or argue for more general frequency and input effects guiding the acquisition process (Bybee, 2009). If maturation is at play in L1 acquisition, one would expect L2 children who are exposed to the L2 after the end of the maturational period to exhibit a distinct developmental path compared to their L1 peers. Evidence for this has been provided in what has been coined as the 'precocious acquisition of BE' by L2 children (Ionin & Wexler, 2002; Paradis & Blom, 2015). Auxiliaries are exceptionally problematic for English-speaking L1 children, and have been argued to be subject to maturational effects (Wexler, 1998). The lack of these effects in L2 children due to their later age of L2 exposure, provides support for maturational accounts of L1 development. Similarly, if following usage-based accounts of acquisition, frequency of a form in the input influences development, one would expect the same factors to affect child L2A, with input quality and quantity being equal (Blom & Paradis, 2014; Bybee, 2009).

The growing interest in child L2A is also motivated from the practical need to understand the environmental and individual factors that influence L2 development during childhood in their own right. To that effect, a growing body of recent literature is devoted to how child-internal factors such as the age of L2 exposure or onset (AoO) and the child's general cognitive abilities, as well as child-external factors, such as input quantity and quality, length of exposure (LoE), educational setting and socioeconomic status (SES), among other things, influence the acquisition process in childhood (Chondrogianni & Marinis, 2011; Paradis, 2011; Paradis & Jia, 2017). Understanding the interrelations of these factors and how they affect language outcomes has important implications for educational and clinical provisions. The latter is of great importance given the similarities that have been observed between L2 children and L1 children with language impairment at the levels of vocabulary and morphosyntax (Paradis, 2010)

The present chapter will follow this comparative line of research by reviewing primarily state-of-the-art experimental studies that compare different groups of L2 learners with a focus on L2 children. The paper is organised as follows. Section 2 addresses the recent debate regarding age effects during childhood bilingualism. We then examine the different language domains, namely phonology, lexicon, and morphosyntax, separately, before we conclude with the various child-internal and child-external factors that have been shown to influence development in L2 children.

2. Age of L2 onset effects during childhood

To treat sequential childhood bilingualism in its own right, it is important to understand the variables that give L2 children their special characteristics and qualify them as a different population from both (2)L1 children and L2 adults (Meisel, 2016). The first variable to be considered in this context is that of age of L2 onset (AoO). In recent years, the main question has been whether or not AoO effects and hence, sensitive periods can be identified even earlier in child L2A. To that effect, L2 children, whose L2 exposure is between the ages of one to three years, what is coined as *early* sequential bilingual acquisition (eL2A) have been compared to both (2)L1 children and to L2 children with a later age of L2 onset (Meisel, 2008; Meisel, 2016; Unsworth, 2013). In a study by Meisel (2016) on the acquisition of French gender by German-speaking L1 children acquiring French in an immersion setting, the L2 children in the sample with an age of L2 onset at around 3;6 years and later behaved more similarly to adult L2 learners, whereas the L2 children exposed to the

L2 before that age had an acquisition profile similar to that of French L1 children. Interestingly, the L2 children exhibited not only quantitative differences in terms of proportions of errors and accuracy, but more importantly, *qualitative* differences in terms of error types. The L2 children who behaved more similarly to the L2 adults produced gender errors that did not follow the phonological properties of French nouns, e.g. **la éléphant* 'the elephant', an error pattern found in French L1 acquisition of gender, whereas the L2 children with the earlier AoO exhibited this L1-like profile. According to Meisel (2016) these results indicate that AoO effects come into force even before the L2 child's fourth birthday for certain morphosyntactic phenomena, and that L2 children with an AoO after 3;6 years may be behaving more like L2 adults by relying more on inductive learning and general learning mechanisms. This is in contrast to the results reported by Unsworth and colleagues (Unsworth et al., 2014) in their study on Dutch neuter gender. The authors found that, when consistency of gender assignment and agreement is considered, apparent AoO differences between the (e)L2 children and the (2)L1 children disappeared. All groups of children in their study consistently marked gender on the adjective and the determiner irrespective of whether or not it was the target gender, and target-like gender marking was a function of length of exposure rather than of AoO (Unsworth et al., 2014).

A further factor that is critical for whether or not AoO effects will emerge in childhood bilingualism relates to when a particular structure is acquired by L1 children. According to Tsimpli (2014), AoO differences between L2 children and (2)L1 children are expected to emerge for those phenomena that are early-acquired by L1 children, as properties related to these phenomena are set early. Conversely, late-acquired phenomena in L1A will be subject to length of L2 exposure effects rather than to AoO effects. This account would explain the AoO effects reported for gender in French, which is an early-acquired property (Meisel, 2016) as opposed to gender in Dutch (Unsworth, 2014), a late-acquired property. These predictions were also borne out in a study by Roesch and Chondrogianni (2016) on the comprehension of German wh-questions in French-German (2)L1 and eL2 children. The eL2 children in the study behaved similarly to their (2)L1 counterparts on the conditions that targeted early-acquired properties of German, such as case-marking; the groups differed and LoE effects were reported for late-acquired structures such as ambiguous *wh*-questions.

A later age of L2 onset during childhood has additional developmental implications. L2 children with a later AoO come to the acquisition task cognitively more mature than their 2L1 or eL2 counterparts who have an earlier AoO. This cognitive maturity may give rise to a cognitive advantage in L2 children in relation to their peers with an earlier AoO, especially for language domains with a closer link to cognition. This has been illustrated in studies on L2 vocabulary development, where

L2 children with a later age of L2 onset have been shown to reach age-appropriate monolingual norms faster than their 2L1 peers or than L2 children exposed to the L2 at a younger age (Blom & Bosma, 2016; Golberg, Paradis, & Crago, 2008). This is because, older L2 children's primary task is to learn new labels for existing concepts already established in their L1. Conceptual transfer from the L1 to the L2 is expected to facilitate such learning. Similarly, in the domain of syntax, (Rothman et al., 2016) reported that L2 children with an AoO of six-to-seven years outperformed their L2 child counterparts with an earlier AoO (4–5 years) on the acquisition of English passives, which is a late-acquired structure. This was because the processing resources of the older L2 children were much more robust than those of the younger children and that allowed them to acquire L2 passives faster than their younger counterparts.

Most research on AoO effects has been devoted to L2 child-L2 adult comparisons in the domains of phonology (Baker & Trofimovich, 2005; Abrahamsson & Hyltenstam, 2009) and morphosyntax (see Unsworth, 2005 for a review). The area where perhaps the clearest differences between L2 children and L2 adults have been observed is that of the acquisition of L2 phonology (Abrahamsson & Hyltenstam, 2009). Retrospective L2 studies have shown that L2 learners who were exposed to the L2 before the age of seven years and are tested on production tasks during adulthood are perceived by native speakers as being more native-like than L2 learners with a later AoO (Baker & Trofimovich, 2005; Baker, Trofimovich, Flege, Mack & Halter, 2008; Tsukada et al., 2004). Given that phonological representations develop slowly through childhood into adolescence, the younger the age of L2 exposure and the longer the L2 exposure,[1] the more accurate the perception and production of the L2 phonological properties is going to be because interference from L1 representations is going to be less strong (Flege, 1995). Reduced interference also leads the faster acquisition of L2 phonological properties (Flege & MacKay, 2004).

Acquisition asymmetries between L2 children and adults have also been observed for syntax and morphology. In the study by Unsworth (2005) on the acquisition of scrambling in Dutch by English-speaking child and adult L2 learners, both groups exhibited transfer of the L1 English word order at initial stages of acquisition producing NegVO sentences instead of the target ONegV structures. Conversely, in a study by (Blom, Polisenska, & Weerman, 2008) on the acquisition of Dutch gender, L2 children had similar accuracy and error patterns to the L1 children and differed from their adult L2 counterparts in terms of accuracy and error types. These differences between L2 children and adults in the domain of syntax but not of morphology gave rise to Schwartz's Domain-by-Age Model (DAM)

1. As one reviewer rightly points out, in these studies AoO and LoE are confound, hence it is hard to disentangle the relative contribution of each factor.

(Schwartz, 2004). This model is couched upon a generative framework of language that assumes a dissociation between morphology and syntax (Halle & Marantz, 1993), namely syntax may develop independently of morphology (Schwartz, 2004). However, the predictions of this account have been challenged in studies that have shown that L2 children may behave differently from L1 children in the domain of morphology, as in the study on French gender by Meisel (Meisel, 2016), or that L2 adults may behave differently from L2 children in the domain of syntax, as demonstrated by (Blom, 2008), in the acquisition of the V2 properties in Dutch. Despite the contradicting results, behavioral and neuroscientific studies have shown that language domains are differentially sensitive to the timing of second-language exposure and that other factors such as language experience and use may play a more defining role in the L2 individual's ability to reach native-like levels of competence (Muñoz & Singleton, 2010; Weber-Fox & Neville, 2001). We return to these issues later in the chapter.

3. Child L2 development across language domains

3.1 Phonological development in L2 children

Research on successive bilingual phonological development has focused on primarily two issues: (i) whether the path and rate of acquisition of child L2 phonological development resembles that of L1 phonological development, and (ii) the role of crosslinguistic transfer, that is transfer from the L1 to the L2 or vice versa. There are two major caveats in this line of work. Firstly, much research has predominantly focused on Spanish-English bilingual children in the US (see Hambly, Wren, Mcleod, & Roulstone, 2013 for an overview of these studies), with studies with children from other L1 backgrounds residing in countries other than the US being few but on the rise (McCarthy, Evans, & Mahon, 2013; McCarthy, Mahon, Rosen, & Evans, 2014; Morrow, Goldstein, Gilhool, & Paradis, 2014). Secondly, studies tend to collapse 2L1 and L2 children in their sample under a single group of 'bilingual' children, rendering the comparison between L2 and L1 children less transparent (Bunta, Fabiano-Smith, Goldstein, & Ingram, 2009; Fabiano-Smith & Goldstein, 2010).

Crosslinguistic transfer, path and rate of acquisition are interrelated. Transfer from the L1 to the L2 can lead to facilitation when the phonemes between the two languages are shared, and hence, to an accelerated acquisition rate (Anderson, 2004; Goldstein & Washington, 2001); it can also lead to a decelerated acquisition rate, when the L2 has a more complex phonological system that requires reorganization of the existing simpler L1 system, as in the vowel production study by Gildersleeve-Neumann, Pena, Davis, and Kester (2009) with Spanish-speaking children acquiring L2 English. Crosslinguistic transfer in child L2A may also surface as influence from the L2 to the L1, as various studies on Voice-Onset-Time (VOT) from L2 Dutch to L1 English (2010) or from L2 English to L1 Spanish (Yavas, 2002) have shown.

Acquisition paths and rates may develop differentially for vowels and consonants. In the study by Morrow, Goldstein, Gilhool, and Paradis (2014) examining English-speaking children in Canada from a variety of L1 backgrounds over a period of three years, L2 children's overall consonant and vowel accuracy increased over time, whereas the occurrence of phonological patterns, that is of systematic phonological errors, such as cluster reduction, voicing errors, consonant deletion or vowel errors, decreased over time. In the case of vowels, L2 children produced similar error rates to those reported for L1 children in the literature. Consonants exhibited a more protracted developmental pattern in the L2 children compared to the L1 children, with L2 children producing phonological errors related to cluster reduction and stopping at an increased rate compared to their monolingual peers of similar age.

It seems, however, that L1 transfer at the phonological level may be short-lived and that L2 children are able to catch-up to their monolingual peers after relatively brief systematic L2 exposure. In a longitudinal study with Sylheti-English L2 children living in the UK, McCarthy et al. (2014) examined L2 children's perception and production of English plosives at two time points: in the nursery and a year later. Results showed that in terms of perception, L2 children failed to categorize the English voiced plosives (/b/, /d/, /g/) in a similar way to their monolingual counterparts in Time 1. However, the two groups did not differ in Time 2 and for both groups, there was improvement in perceptual acuity. In terms of production, at Time 1, the bilingual children used significantly shorter VOT values for voiced plosives /b/ and /g/ that were closer to those of their L1, Sylheti (/p/, /k/). This finding was interpreted as evidence for the influence of the home environment on English sound perception and production, as the children up until nursery entry had been exposed predominantly to Sylheti as well as Sylheti-accented variants of English. By Time 2, there was no significant difference between the groups, which suggests that L1 transfer was short-lived.

3.2 Lexical development and vocabulary acquisition

Given the strong link between literacy and vocabulary development in both monolingual (Verhoeven & Perfetti, 2011) and bilingual (Hammer et al., 2014) children, it is not surprising that lexical development in L2 children has been of central importance for researchers and educators. Vocabulary knowledge is often measured using criterion-referenced expressive and receptive single word vocabulary assessments (see for example Golberg et al., 2008) standardized usually with monolingual children (Paradis, 2010; Pearson, Fernandez, & Oller, 1993). Although L2 children come to the task of L2 vocabulary learning cognitively more mature compared to their monolingual peers (Golberg et al., 2008), and this cognitive maturity may result in older L2 children accumulating vocabulary faster than their younger bilingual peers (Blom & Bosma, 2016; Golberg et al., 2008; Hammer, Lawrence & Miccio, 2008), L2 children have been consistently found to underperform on vocabulary assessments compared with their monolingual peers (Chondrogianni & Marinis, 2011; Golberg et al., 2008; Kohnert & Kan, 2005). Under conditions of limited L2 exposure, they may even perform within the range of monolingual language impaired children (Paradis, 2010). Vocabulary acquisition has been described as a "moving target" in that while L2 children are trying to catch up in vocabulary size, monolingual children are increasing their vocabulary as well (Paradis & Jia, 2017). However, with sufficient L2 exposure and as a shift in dominance from the L1 to the L2 takes place, L2 children are able to catch up to their monolingual peers, even at a faster rate than their 2L1 peers (Hammer et al., 2008).

To explain the bilingual children's underperformance on monolingual standardized tasks and to better address the fact that bilingual children's vocabulary abilities are distributed across the two languages, studies have used conceptual scoring as a method to obtain a more complete picture of a bilingual child's lexical knowledge. Conceptual scoring refers to the total number of concepts for which a child has a word in at least one language (Gross, Buac, & Kaushanskaya, 2015; Kohnert & Kan, 2005; Umbel, Pearson, Fernandez, & Oller, 1992). In a comprehensive study, Gross et al. (2015) examined the effect of modality (production vs. comprehension) on conceptual scoring in a group of five-to-seven-year-old Spanish-English L2 children after controlling for SES. Gross et al. (2015) reported that even when conceptual scoring is implemented to account for distributed vocabulary knowledge and differences in SES are statistically controlled, L2 children still performed significantly worse than their monolingual English-speaking peers on both receptive and expressive vocabulary. Although L2 children continued to differ from their monolingual peers, conceptual scoring resulted in a significant improvement in vocabulary scores for the L2 children in both modalities. As L2 children grew older, they received higher scores in English than in Spanish, especially in the case of expressive vocabulary. This finding has been reported in other studies with different language combinations, and has been interpreted as evidence for a shift towards the majority language (Gathercole & Thomas, 2009; Kohnert & Kan, 2005; Sheng, Lu & Kan, 2011).

Another dimension of vocabulary development is vocabulary growth, that is the increased representation of word meanings and their corresponding word forms

(Verhoeven & Perfetti, 2011). Vocabulary growth may take the form of vocabulary breadth (form-meaning connections) and depth of lexical knowledge (the extent of semantic representations) (Karlsen et al., 2017). In a large-scale longitudinal study with Urdu/Punjabi L1-Norwegian L2 children tested in kindergarten (mean age: 5;3 years) and in the first year of primary school (mean age: 6;5 years), Karlsen et al. (2017) reported that the L2 children displayed similar growth rates as their monolingual peers in Norwegian, even though they had overall weaker L2 vocabulary skills. Interestingly, the authors reported that L1 vocabulary breadth and depth predicted L2 vocabulary growth, suggesting that a common underline proficiency or cognitive skills related to conceptual transfer may facilitate vocabulary learning in L2 children (Cummins, 1991; Paradis, 2011; Pham, 2016; but see Cobo-Lewis, Pearson, Eilers, & Umbel, 2002 for opposite results).

More robust lexical representations and networks can also lead to processing lexical information more efficiently (Fernald, Perfors, & Marchman, 2006; Kohnert & Bates, 2002). Processing efficiency is operationalized as the time (in milliseconds) it takes to access and retrieve lexical information in real-time. In a series of studies, Kohnert and colleagues examined processing efficiency using timed picture naming (Jia, Kohnert, Collado, & Aquino-Garcia, 2006) and picture verification tasks (Kohnert & Bates, 2002; Pham & Kohnert, 2014) in American English L2 children. L2 children exhibited an asynchronous development of vocabulary production measured through naming, versus vocabulary comprehension measured through picture verification tasks, with the latter showing steeper developmental trends and greater gains across the two languages compared to the former. The same studies reported that dual-language programmes where children's L1 is fostered, positively impacted on L1 outcomes (Jia et al., 2006; Pham & Kohnert, 2014). Importantly, although a positive growth was observed in both languages, the gains were more prominent in the dominant L2, which suggests that bilingual educational programmes with L1 and L2 instruction positively impacted L1 outcomes and had no effect on L2 outcomes.

3.3 Morphosyntactic development in L2 children

As stated in the *Introduction*, much research on the morphosyntactic abilities of L2 children from the late 90s and afterwards was influenced by the generative framework of language acquisition (Chomsky & Lasnik, 1993). In this framework, the investigation of child L2 acquisition serves multiple purposes, with studies focusing both on child L1-child L2 as well as child L2-adult L2 comparisons using primarily naturalistic, at times longitudinal, or elicited production data from a small group of participants. Apart from testing the validity of L1A theories, the child L1-child L2 comparison can reveal whether or not L2 children's initial stages of acquisition consist of the same functional categories, such as Tense, Agreement or Complementizer, found in L1 children's grammar, how these categories develop in the child L2 grammar over time, and what the role of the L1 is (Haznedar & Gavruseva, 2013; Lakshmanan, 2009). Another prominent question has been whether errors at the morphological level observed in L2 children indicated absence or underspecification of underlying syntactic categories (Haznedar, 2001; Haznedar & Schwartz, 1997). This question is again motivated by the dissociation between syntax and morphology argued by a generative view of language, where morphology could develop independently from syntax (Halle & Marantz, 1993).

The review of these studies and their findings is beyond the scope of the present review, as two recent detailed chapters on these issues are available (Haznedar & Gavruseva, 2013; Lakshmanan, 2009). For the purposes of this chapter, it is important to point out that studies during that era tried to answer the question regarding the dissociation between syntax and morphology by examining the morphosyntactic contingencies related to these categories. For example, Haznedar (2001) reported that the Turkish L1- English L2 child was able to produce nominative subjects, which are associated with the presence of a Tense category, despite the absence of overt tense morphology on verbs. However, in the last fifteen years, research on L2 children has adopted more sophisticated and subtle experimental paradigms that used to be confined to the child and adult L1 acquisition and processing literature. These include offline comprehension paradigms, such as sentence picture matching tasks, picture selection tasks or truth value judgment tasks and online processing techniques. This methodological development has had two major contributions: it has allowed us to (i) address longstanding questions, e.g. the relationship between morphology and syntax in L2 children, using novel experimental techniques, and (ii) investigate the psycholinguistic processes and constraints that guide child L2 development (Roesch & Chondrogianni, 2016; Rothman et al., 2016; Unsworth, 2005). Furthermore, crosslinguistic studies where different L1-L2 combinations are explored, have allowed us to answer the issue of transfer more effectively. In the following section, we review studies on child L2 morphosyntax more closely.

3.3.1 *Crosslinguistic influence in child L2A and the role of the L2 system*

Naturalistic and experimental studies have shown that crosslinguistic influence in the form of L1 transfer effects can be observed at initial stages of child L2A in the domain of syntax (Chondrogianni, 2008a,b; Unsworth, 2005; Whong-Barr & Schwartz, 2002) and morphology. Early-acquired syntactic properties, such as word order, and the relative placement of arguments or modifiers in relation to the verb, the noun or the preposition are the best candidates for transfer (Haznedar, 2001; Kwon & Han, 2008). Haznedar (2001) reported that an L1 Turkish child L2 English learner produced English sentences that carried a Turkish verb final word order in the form of *"I apples not like"* at initial stages of L2 acquisition showing transfer effects at the level of word order from L1 Turkish. In the domain of morphology, L2 children from isolating L1s have been shown to take longer to acquire L2 inflectional properties (Paradis, Tulpar, & Arppe, 2016; Zdorenko & Paradis, 2008) and make more omission errors than L2 children from non-isolating/inflecting L1s suggesting L1 transfer effects at the level of morphosyntax (Blom & Paradis, 2013a; Blom & Paradis, 2014; Chondrogianni, 2008a,b; Jia & Fuse, 2007).

Crucially, transfer effects can be modulated by the nature of the L2 morphophonological paradigm. L2 children acquiring morphological paradigms where zero forms are not the default, as in the case of Greek or Spanish, tend to make more commission or substitution errors rather than omission errors when not producing the target forms (Blom et al., 2015 on Greek vs. Dutch; Herschensohn et al., 2005 on Spanish). Additionally, language-specific factors such as the transparency or opacity of the morpho-phonological paradigm, as well as the frequency and the morpho-phonological make-up of a particular form can modulate the course and rate of acquisition. In a study by Unsworth et al. (2014) comparing the production of gender in L2 children learning an opaque morpho-phonological system such as Dutch and in a transparent system with transparent gender cues such as Greek, L2 Greek children reached higher accuracy than their Dutch age-matched counterparts. Similar, although less pronounced between Dutch and Greek, were observed in a study by Blom et al. (2015) on the production of verbal agreement in L1 Turkish-L2 Dutch and L1 Turkish-L2 Greek children of similar primary school age.

The acquisition of morphology by L2 children has been recently dominated by a usage-based approach to acquisition (Bybee, 2010). According to this account, low-level, surface morphophonological properties of items, type/token frequency, and vocabulary size are set to influence L2 morphological development in the same way that they do for L1 development (Plunkett & Marchman, 1996). In a series of studies on past tense and third person inflection, Paradis, Blom and colleagues have shown that L2 children displayed higher omission rates in contexts where regular past tense verbs ended in an alveolar /t/ or /d/ than in another consonant or vowel (Blom & Paradis, 2013b; Blom & Paradis, 2014). Similarly, allomorphic variants of low token frequency, such as the syllabic ending /iz/ for third person -s elicited lower production rates than consonant clusters in /s/ or /z/ (Blom, Paradis, & Duncan, 2012; Paradis, Schneider, & Duncan, 2013) (see also Rispens & de Bree, 2015) for similar findings on Dutch tense morphology).

Finally, transfer from the L1 to the L2 has also been documented in the area of semantics, and more specifically in the acquisition of definite and indefinite articles. Languages such as English or Hebrew use definite and indefinite articles to encode semantic notions such as definiteness and specificity (Ionin, Zubizarreta, &

Philippov, 2009). L2 children whose L1 does not use overt markers for encoding this distinction may fluctuate in their article use, producing definite articles in contexts where indefinite articles are required (Ionin et al., 2009; Schwartz & Rovner, 2015; Zdorenko & Paradis, 2008, 2012). However, L2 children have been reported to fluctuate considerably less than their adult counterparts (Chondrogianni & Marinis, 2016) or L2 children with a later AoO (Schwartz & Rovner, 2015), suggesting that this area of semantics may be subject to AoO effects.

3.3.2 *Comprehension and processing of morphosyntax in L2 children*

In recent years, studies with L2 children have started to investigate the comprehension and processing of morphosyntactic information in real time to better understand the underlying processes that lead to certain outputs or performance patterns. This shift has been facilitated by the adoption of more sophisticated methods, such offline and online comprehension and processing tools (see Unsworth & Blom, 2010 for an overview). The implementation of these tools has also allowed researchers to address long-standing questions in the L2A research in a novel way. As stated above, one of these questions, especially within the generative paradigm, has been about the relationship between production and comprehension of morpho-phonological forms and the status of the syntactic categories associated with these forms (Haznedar & Gavruseva, 2013). Early studies examining the relationship between morphology and syntax in L2 children focused on the presence of morpho-syntactic contingencies in the context of missing or erroneous inflection. Current studies have revisited this relationship using offline (Herschensohn, Stevenson, & Waltmunson, 2005) and more subtle online processing methods (Chondrogianni & Marinis, 2012; Chondrogianni & Marinis, 2016; Chondrogianni, Marinis, Edwards, & Blom, 2014). These studies focus on whether L2 children who variably produce verbal and/or nominal morphology are able to detect morphosyntactic violations in the context of verbal and nominal agreement, exhibiting thus sensitivity to such violations. The converging finding is that L2 children can detect these grammatical violations offline or in real time despite their lower proficiency or length of exposure to the L2 compared to their L1 peers. This finding supports a dissociation between morphology and syntax in the bilingual grammar (Haznedar & Schwartz, 1997).

The use of more sophisticated methodologies has also allowed researchers to investigate how L2 children comprehend and/or process sentences offline and in real time, and whether they adhere to the same processing constraints similarly to those reported for their L1 peers (Choi & Trueswell, 2010; Omaki, Davidson White, Goro, Lidz, & Phillips, 2014). Current studies on the comprehension and processing abilities of L2 children have focused on whether or not their processing patterns differ from those of their monolingual peers when comprehending complex sentences such as passives (Marinis & Saddy, 2013), and how factors, such as AoO, LoE or L2 proficiency, may be affecting L2 children's comprehension of the L2 grammar (Roesch & Chondrogianni, 2016; Unsworth, 2013). These studies seem to converge on the finding that with sufficient exposure and increasing proficiency, L2 children are able to make use of morphosyntactic information similarly to their L1 peers.

4. Individual differences and child L2 development across domains

Differences in the acquisition of a second language during childhood may be induced not only by the age of L2 onset and the presence of a fully or partially fledged L1 at the time of L2 exposure, what are coined as child-internal factors, but also by child-external factors namely, input quality and quantity, educational provision and length of L2 exposure (LoE) among other things. These factors lead to further variation in the context of sequential bilingual language acquisition apart from the variation inherent to learning two languages instead of one. L2 children are more likely to be exposed to non-native speaker input (Fernald, 2006), their exposure to the L2 may be confined to distinct educational or social contexts in relation to their L1 exposure (Paradis, 2011), rendering, thus, their L2 exposure much more limited than it is necessary for them to develop full L2 mastery in a timeline comparable to that of L1 children. Recent literature has focused on how child-internal and child-external factors interact and influence the outcome of the acquisition process, especially the relationship between AoO and LoE. In a study by (Blom & Bosma, 2016) on Frisian-Dutch L2 children, children with a later AoO had steeper acquisition slopes compared with children with earlier AoO in the domain of vocabulary; in contrast, no AoO facilitation was observed in the acquisition of inflectional morphology, which improved as a function of LoE. Most studies have examined the impact of external factors on vocabulary development (Cobo-Lewis et al., 2002; Paradis, 2011), with an emerging number of studies focusing on how morpho-syntactic areas may be influenced as well (Blom & Baayen, 2012; Blom et al., 2012; Chondrogianni & Marinis, 2011).

4.1 Child-external factors and differential effects on language domains: Input quantity and quality

Input quantity has been operationalized in two ways: (i) as the absolute amount of L2 exposure, that is the frequency with which a particular construction or expression occurs in naturalistic speech, and (ii) as the relative amount of exposure, which results from a calculation of the child's daily amount of exposure to the two languages on the basis of parental or teacher questionnaires either concurrently or over time, what has been coined as cumulative exposure (Unsworth, 2012). A number of studies have shown that input defined as the relative amount of L2 exposure positively predicts higher L2 abilities, certainly for vocabulary (Bohman, Bedore, Peña, Mendez-Perez, & Gillam, 2010; Paradis, 2011), but also for various morphosyntactic structures such as inflectional morphology (Blom et al., 2012; Unsworth et al., 2014) and complex structures (Chondrogianni & Marinis, 2011; Roesch & Chondrogianni, 2016).[2] However, absolute amounts of exposure may interact with structural complexity, in that more complex structures may require longer time to be acquired regardless of absolute frequency (Thomas, Williams, Jones, Davies, & Binks, 2013).

L2 children may not only be receiving less input in their L2, but the quality of input may differ from that of monolingual children, both in their majority L2 and in their minority L1. Input quality as a proxy of input richness, namely exposure to different sources, such TV, radio, books and friends/siblings (Jia & Fuse, 2007), literacy-related activities (Scheele, Leseman, & Mayo, 2009), as well as the number of native versus non-native speakers that the child is exposed to (Fernald, 2006), coupled with the level of parental SES, has been shown to influence L2 children's development. In the studies by Chondrogianni and Marinis (2011) and Paradis (2011), low parental SES and the limited literacy activities in both the L1 and the L2 predicted children's inability to reach age-appropriate norms for grammar and vocabulary. Additionally, children's L2 abilities were better predicted by the use of English in the home than exposure to parental non-native input in the home, especially when parental fluency in the L2 was low (Bohman et al., 2010; Hammer et al., 2014).

The latter finding suggests that non-native L2 input may be qualitatively different from native input in a way that influences not only overall language abilities but also the formation of specific morphosyntactic L2 structures. In the study with L1 Turkish-L2 Dutch children in the Netherlands, Cornips and Hulk (2006) found that L2 children exhibited a protracted acquisition pattern of the Dutch gender opting for the 'default' common gender in Dutch. The authors argued that the L2 children's performance was because they are exposed to non-native variety of Dutch gender, which is qualitatively different from the target L1 Dutch gender system. This exposure pattern may, among other things, explain why Dutch gender is acquired late in Dutch L2 children (Orgassa & Weerman, 2008).

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2. These studies differ in how detailed the calculation of relative exposure is, e.g. whether the questionnaire collects information about daily exposure or a rougher estimation of L1 and L2 exposure.

Differences in input quantity and quality have been shown to affect not only L2 development but the development of the minority L1 as well. When L2 children are tested in their L1 heritage language, that is their minority language in which they usually receive less input (Rothman, 2009), they perform more poorly compared to monolingual speakers growing up in the country of origin where the L1 is the majority language (Montrul, 2008, 2015). Reduced input seems to affect their rate of acquisition and their ability to reach monolingual levels, in some cases above and beyond AoO effects (Flores, Santos, Jesus, & Marques, 2016). Input in heritage communities has also been argued to be qualitatively different from the native input. Heritage children may be receiving input by other potentially attrited or heritage speakers and this, in turn, may affect the nature of the heritage language (Rothman, 2007).

4.2 Development across domains over time

When do L2 children catch up to their monolingual peers, and is this 'catch-up' modulated by the language domain to be acquired? Existing studies seem to suggest that children with fewer than three years of exposure perform within norms for monolingual children with language impairment (Paradis, 2010) and that between four-to-six years are necessary for L2 children to perform within age-appropriate monolingual norms (Paradis & Jia, 2017). In a longitudinal study with L1 Chinese-L2 English children with a mean AoO to English of four years, Paradis and Jia (2017) tested how these L2 children perform on a range of lexical and morphosyntactic assessments when their L2 exposure was between four-to-six years. Results showed an asynchronous development of the different domains, also known as 'profile effects' (Chondrogianni & Marinis, 2011). Two-thirds of the children reached monolingual norms on receptive vocabulary and sentence repetition after five years of exposure, and it took six years of exposure for children to reach similar results for expressive vocabulary. These results are in stark contrast with the same children's performance on tense morphology in English, who even after of six years of exposure only 60% of them reached age-appropriate norms (Paradis et al., 2016), suggesting that English tense morphology may be particularly problematic for this group of L2 children. In the study by Farnia and Geva (2011) with bilingual children from diverse L1 backgrounds in Canada, growth gaps between the monolingual and the bilingual children persisted from grades one to six, even though the gap was associated with the domain of lexical knowledge that the items tapped into as well as with the difference in task demands (Bialystok, Luk, Peets, & Yang, 2009). This protracted acquisition pattern reported for vocabulary and grammar is in contrast with the speedy convergence to the L2 target reported for phonology by McCarthy et al. (2013, 2014), suggesting that the various domains develop differentially over time.

5. Conclusions and future directions

This chapter set out to achieve two main goals: (i) review studies on child L2 development of phonology, vocabulary, and morphosyntax carried out within the last fifteen years with the view to establish similarities and differences between L2 children and their (2)L1 and adult L2 counterparts, and (ii) report and evaluate the factors that affect child L2 development. The investigation of the current literature revealed that the increasing use of experimental assessments across different learner populations, as well as the use of multiple measures within the same groups of child L2 learners, can help us better understand how the different areas develop within the bilingual individual and how these areas can be affected by child-internal and child-external factors over time. Current evidence suggests that the effect of these factors is differential and that it depends on the domain to be acquired. This summary of the current literature also revealed that modality of the assessment (production vs. comprehension), the way performance is calculated (e.g. conceptual vs. lexical scoring of vocabulary) as well as the sensitivity of the experimental method can influence the outcome. At the same time, there is a growing need towards using more experimental, sensitive methods of child L2 development in the form of on-line behavioral or neuroscientific techniques. These methods at the moment seem to be focusing primarily on child L1-child L2 comparison, whereas studies of this nature comparing L2 adults to L2 children are, to our knowledge, nonexistent. However, studies comparing all three populations will help us better address long-standing questions in the (child) L2 literature such as the relationship between production and comprehension. At the same time, they will help unravel the *processes* that guide or subserve child L2 development, and how these processes are affected by AoO, LoE, L2 proficiency or other cognitive factors.

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CHAPTER 7

The role of language input environments for language outcomes and language acquisition in young bilingual children

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This chapter outlines a holistic framework for approaching the study of language input to children under age 6 acquiring oral languages in bilingual settings. After a brief historical overview, the input factors discussed include relative timing of input in two languages, cumulative, absolute and relative frequency of overall language input, input frequency of linguistic categories, language models, the people speaking to children and language choice patterns, communicative settings and media use, and interactional style. The chapter addresses methodological issues and gives an indication of the extent to which particular aspects of the input have been investigated. It ends with a selective evaluation of links between input and bilingual language outcomes and early bilingual acquisition.

1. Introduction: A brief history and setting the scene

More than a century ago, Ronjat (1913) published his colleague Grammont's recommendation about the optimal language input setting for supporting early bilingualism: everybody should stick to a single language in speaking to young children. Because some people would use a different language from others, the child would on the whole then have separate input in two languages. Ronjat implemented this 'one person, one language' (1P/1L) language choice recommendation for people speaking to his son.

As recently uncovered by Grosjean (2015), there is no trace of any empirical evidence from Grammont to support his recommendation. Nevertheless, since Ronjat, the 1P/1L recommendation has been considered an ideal that parents wishing to raise bilingual children should strive for. It is only recently that it has been put to the empirical test (see below). Given this early emphasis on parental language choice patterns in speech to children, it is fitting that the first empirical studies to examine language input to young bilingual children had the same focus. In an

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interview study Arnberg (1979) attempted to draw links between parental language choice patterns, on the one hand, and children's performance on an English word recognition test and an unpublished Swedish translation, on the other (there is no information on children's ages, but some comments in the study suggest that at least some of the children were of pre-school age). My interactional study based on longitudinal observational data involving approximately three-year-old bilingual Kate and adults engaging with her showed that when interlocutors switched to using a language they did not normally speak to her, Kate also switched (De Houwer, 1983). Furthermore, Kate spoke more English to Dutch interlocutors than Dutch to an English interlocutor, perhaps because she was sensitive to their different language abilities. Döpke (1986) studied parents' discourse behavior in interaction with their German-English bilingual children and proposed that child centered interaction styles could be key in supporting minority language development. In her study of a two-year-old bilingual in interaction with her parents, Lanza (1988) showed how repair sequences in bilingual families can be seen as negotiations about what language a child is expected to use. Goodz (1989) uncovered that parents who claimed to use the 1P/1L "rule" did not actually apply it all the time. De Houwer (1990: 71–74) gave detailed information about the number of hours per day/week that Kate heard each language, the language choices of the people in her social network, her media use, trips she had taken, and the kind of language models she heard, thus implying these factors could be relevant to bilingual acquisition.

Fitting for this volume's anniversary issue, it was 25 years ago that Döpke (1992) published her monograph on bilingual parental interaction strategies as the third volume of the SiBil series. In the same year, Lanza published her influential article on parents' interactional strategies, which was further elaborated on in her monograph from 1997. That year also saw the publication of two articles on different aspects of language input to bilingual children and their possible role for bilingual language development: one on the relative frequency with which children hear each of their languages, proposing that young bilingual toddlers know more words in the language they hear most often (Pearson et al., 1997), and another on the absolute frequencies of past verb forms in each language, proposing that Kate's differential use in each language could be partially traced back to input frequency patterns of verb forms as used by her adult interlocutors (De Houwer, 1997).

The two decades since 1997 have seen a steady increase in research attention to the role of language input for early bilingual development, as evidenced, for instance, in Grüter and Paradis' (2014) edited volume. The journal *Bilingualism: Language and Cognition* invited an article on input and bilingual development (Carroll, 2017), followed by several peer commentaries. As these showed, there are many different and often contrastive perspectives on the relations between input ("exposure", in Carroll's terms) and bilingual acquisition. Some of the divergent discourses (e.g., compare Carroll, 2017; and Paradis, 2017) seem to stem from the fact that the term "acquisition" is taken by some to refer *only* to individual processes of acquiring language over time, whereas others see it as something much broader. That is, many studies do not focus on explaining individual patterns of changes in language use over time, but aim to discover which specific aspects of language ("language outcomes") can generally be expected to be used appropriately (in production) or known (in comprehension) at a particular developmental stage or age. Typically, language outcomes such as the ability to use the English third person present tense -*s* marker (e.g., Blom & Paradis, 2015) are measured using standardized instruments that are administered to a group of children. In studies of language outcomes, the focus is on how children compare to others in their performance on a specific measure, rather than on the process of individual development.

I cannot do justice to the many studies relevant to investigating input and bilingual language acquisition and outcomes (a useful bibliography can be found as supplemental material to Paradis, 2017). My main aim instead is to outline a framework for approaching the study of language input to young children in bilingual settings (similar to the one in De Houwer, 2009: 96–146). I give some attention to research methods and an indication of the extent to which particular aspects of the input have been investigated. I then briefly explore how children could actually be utilizing the language input they hear. This leads to a selective evaluation of links between input and bilingual language outcomes and early bilingual acquisition, both of which I subsume under the term "bilingual development".

I limit my discussion to input in two spoken languages, although much will be relevant for trilingual and quadrilingual settings and bimodal bilingualism. I focus on typically developing children under age 6 who have not yet received any formal literacy instruction (Unsworth, 2016, reviews work that includes primary school aged children). I do not consider studies of young children who are getting targeted input in a foreign language that is not normally spoken in local public life. References to "input" refer to input in bilingual settings, unless stated otherwise.

2. The many facets of language input to young children growing up in bilingual settings

Language input to children is the totality of language they hear. This simple definition masks the fact that there are many different aspects to language input, especially in a bilingual setting. It is impossible to be complete but the range of factors presented below is quite wide (see also Gathercole, 2014). The factors I discuss are "proximal", viz., they bear a direct relation to the actual speech children are hearing at one time or over time, although some are more directly related than others. Examples of proximal factors are the kinds of questions children are asked (Palacios et al., 2015), the extent to which children are read to in a particular language (Kibler et al., 2016), and how parents react when children address them in a language parents do not speak to them (Juan-Garau & Pérez-Vidal, 2001). Proximal factors are embedded in language-learning environments shaped by more "distal" psychosocial and cultural factors such as maternal language ideologies (Nakamura, 2016), parental beliefs and attitudes (De Houwer, 1999, 2009), children's living conditions and social class differences (Weisleder & Fernald, 2014), and the social status of languages (Pearson, 2007).

2.1 Relative timing of input in two languages

The most basic distinction between different kinds of input to potentially bilingual children refers to the *relative timing of the start of input* in two languages. In a Bilingual First Language Acquisition (BFLA; Meisel, 1989) input setting, babies start hearing two languages A and Alpha from the moment people start to verbally interact with them. This occurs soon after birth (babies may even be in a BFLA setting prior to birth, see Byers-Heinlein, Burns, & Werker, 2010).

The second setting in which children may become bilingual is the Early Second Language Acquisition (ESLA; De Houwer, 1990) input setting. Here babies start first being addressed in only a single language (L1). Only after some time do they start to be addressed in a second language (L2) in addition to the L1. This usually happens through out of home care or preschool, so in an institutional setting (young internationally adopted children will tend to hear their L2 in their new home, and will normally no longer hear their L1; Genesee & Delcenserie, 2016). Children may meet up with their L2 in out of home care already at the age of 3 months, but there is wide variability amongst countries in the extent to which families enrol children in care programs, in the ages at which children are enrolled, and in the amount of time spent in care (Adamson, 2008).

It is not just the *relative timing of the start of input* in two languages that distinguishes BFLA and ESLA. Other aspects of input will also differ quite a bit depending on whether children grow up in a BFLA or ESLA setting. In BFLA children grow up in a bilingual family, with potentially many other family members as well as family friends speaking either of two languages, or both. In ESLA children grow up in a monolingual family, where the chance of family members and friends speaking more than a single language is far lower than in BFLA.

The question is to what extent the differences between BFLA and ESLA input settings are reflected in differences between BFLA and ESLA children's language development. Rather than comment on this question in the section on links between input and bilingual development, I discuss it here.

Already in the first year of life there are a number of differences between BFLA and monolingual children in how they perceive phonetic and phonological aspects of their input languages (Serratrice, to appear). By extension, this is a difference between BFLA and ESLA children as well, given that the latter start off as monolinguals. We do not know how the early language learning trajectories of ESLA children with input in the L2 starting at very early ages (say, 3 months) evolve, though. Such children may well exhibit patterns that are more like those of BFLA than monolingual children.

As reviewed in De Houwer (2009, 2017b), BFLA children learn to understand two languages simultaneously. This is not generally the case for ESLA children: many learn to understand their L1 first. As implied by studies of monolingual children, ESLA children starting to hear an L2 as early as at the age of 6 months will have already formed phonological categories in their L1, and will be on the brink of the first understanding of words and phrases in the L1, thus patterning differently from BFLA children. BFLA children will often start to speak in each of two languages at around the same age. For ESLA children under age 6 the gap between when they first started to speak their L1 and their L2 may be as long as 4 years (or more).

For each of their languages separately, BFLA toddlers understand and produce similar or higher numbers of words as same aged monolinguals (De Houwer, 2010). In contrast, ESLA preschoolers understand far fewer words in their L2 (English) than monolingual English-speaking peers do (Bialystok et al., 2010). In the first 6 years of life, the morphosyntactic structure of BFLA children's sentences does not show any systematic influence from one language on the other (De Houwer, 2009). In contrast, young ESLA children often exhibit morphosyntactic influence from their L1 on their L2 (e.g., Blom & Paradis, 2015; Li Wei, 2011; Schwartz & Rovner, 2015; see also De Houwer, 2017b).

If BFLA preschoolers know one language better than the other one, the better language is usually the one used at daycare or preschool (De Houwer, 2009). ESLA children start off knowing the home language better. A stark contrast between ESLA and BFLA children is that 97% of the former but only 70% of the latter actually speak two languages (finding based on re-analysis of data in Table 7 of De Houwer, 2007; note, however, that the data here are not limited to preschoolers but refer to children between 1 and 20, with most of them between the ages of 6 and 9).

The facts of bilingual development showing basic early differences between BFLA and ESLA children's language learning trajectories, then, warrant close attention to documenting their language learning environments from when they were born. Many input studies, however, ignore the important distinction between BFLA and ESLA (Carroll, 2017).

Children's language learning histories can only be assessed through caregiver report. Large scale surveys suggest that in both western Europe and the U.S. BFLA is three times more common than ESLA (De Houwer, 2007; Winsler et al., 2014).

2.2 Cumulative and absolute frequency of language input

The distinction between BFLA and ESLA is directly related to the duration of the frequency of input that children *globally* receive in each language, which leads to a cumulative frequency. In BFLA, this duration and thus cumulative input frequency is in principle the same for both languages, given that children will have received input in each language for the same number of years; in ESLA, cumulative input in each language is by definition different, because L1 input started earlier than input in L2, and thus the input in L1 over time will have been of longer duration than the input in L2.

Both within BFLA and ESLA breaks in the input in a particular language are common (e.g., the only person offering Danish input to a BFLA child growing up with Danish and German goes on a long trip; ESLA children who hear only Turkish at home but visit a Dutch preschool go on vacation to Turkey). Indeed, a bilingual input setting is highly variable. Input in a language can be quite limited in terms of overall frequency of use, or even temporarily stopped altogether, with then changes back to an opposite pattern. Marchman et al. (2016) emphasize how this variability makes it hard to correctly evaluate a bilingual input environment. There can be no assumption, then, of more or less equal levels of overall input in both languages throughout a child's early language learning years.

Building on this insight, Unsworth (2013) developed the measure of cumulative length of exposure, based on a retrospective parental assessment of who children spent time with and what language(s) these people addressed children in. This information is translated into a single absolute measure aiming to "compact" the real number of life years that children heard a particular language as part of their total bilingual input into the virtual number of life years that children presumably heard just that language, regardless of their age.[1] A major methodological hurdle here relates to validity. It is questionable that parents can accurately reconstruct their children's lives three, four or even more years prior to being asked and can know for certain which language(s) people spoke to their children in their absence.

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1. The aim behind this is to create a better basis for comparing bilinguals to monolinguals. Thus, a 6-year old BFLA child with, say, 3 years of "virtual" input to a language would then be compared to a 3-year old monolingual. There are many issues here, not in the least the fact that a "real" 6-year-old has different levels of cognitive maturity than a 3-year-old (Long & Rothman, 2014).

Whatever the measurement method, the duration of bilingual children's cumulative input frequency in a particular language largely depends on the continuity of particular language choice patterns by people talking to them. If parents change from speaking language A to speaking language Alpha to children, this has a direct effect on the cumulative input frequency for both languages. In a study of 31 French- or Dutch-speaking mothers in bilingual families, De Houwer and Bornstein (2016) found hardly any variations in maternal language choice patterns over a two-and-a-half-year period. Thus, most children had continuing input in whatever language mothers addressed them in. However, parents may shift to speaking a different language to children from the one they started out using with them (Nakamura, 2016). Often this shift happens when children start attending (pre-)school (De Houwer, 2017c; Hoff et al., 2014; Silvén et al., 2014). Cumulative input frequency is a measure of *absolute input frequency*, that is, a count of the number of years, months, weeks, or even hours that children heard particular languages, linguistic categories, pragmatic functions, lexical items, or any other linguistic element.

Many studies give an indication of how many years or months a child has heard two languages. This may be too rough an index: Hart and Risley (1995) and Weisleder and Fernald (2013) found vast differences between homes in how many words children heard per hour (for English and Spanish respectively). The cumulative effect of differences in monolingual parental speaking rates over the years can be such that one child hears 10 million words over three years, whereas another child might hear 30 million (Hart & Risley, 1995: 131–132).

Few studies investigate the actual amount of speech heard by children in bilingual settings. De Houwer (2014) recorded mothers in French-Dutch bilingual families in Dutch dyadic interaction with their 13-month old firstborn infant and again 7 months later, and analyzed several measures of frequency in maternal speech. Using the LENA™ system, Marchman et al. (2016) tallied the number of Spanish and English words that different people addressed to three-year-old bilinguals. Both studies found large variability in speaking rates, thus confirming monolingual findings.

The bilingual mothers' speaking rates in De Houwer (2014) did not differ from those of demographically matched Dutch-speaking mothers in monolingual families recorded in similar circumstances. The results from Marchman et al. (2016), who show the number of Spanish words per hour anyone addressed to bilingual preschoolers as ranging between 127 and 947, are quite comparable to those from Weisleder and Fernald (2013), who find a range of 67 to 1,200 Spanish words per hour for a demographically similar monolingual Spanish-speaking sample addressing toddlers. Thus, for at least one of a bilingual child's input languages there need not be any difference with the absolute amount of input that monolingual children receive.

Not only is there variability amongst bilingual parents' speaking rates in a particular language at any one time, there is also variability over time within one individual parent's speaking rate (Song et al., 2012). This variability relates to children's ages: Mothers in bilingual families tend to speak more to toddlers than to infants (De Houwer, 2014; cf. also my re-analysis of data in van de Weijer (2000) in De Houwer, 2009: 121–122). In spite of this variability over time, maternal speaking rates in dyadic interaction with bilingual children are stable, that is, mothers who speak less than others at time 1 speak equally less than others at time 2 (De Houwer, 2014).

After their children are 30 months of age, monolingual parents' speaking rates when addressing children decrease (Wells, 1986). This doesn't necessarily mean that children hear less talk: other kinds of interlocutors such as peers and teachers start to play a larger role, and children also increasingly have more media exposure (De Houwer, 2000). We need data on bilingual parents to investigate their speaking rates as children grow older.

Speaking rates are not the only factor determining absolute input frequency. A second aspect concerns the total amount of time that children could in principle be hearing language. The latter in turn depends on their sleep patterns and the amount of time they spend alone without language input through media, both of which can be quite variable. De Houwer and Bornstein (2003) developed the Language Input Diary (LID) to measure how much time children spent with different people and what language(s) these people spoke during which activities (audiovisual media exposure could also be recorded). Place and Hoff (2011, 2016) used an English translation of the LID that I provided, and translated that into Spanish so it could be used with Spanish-English bilingual families. Parents filled out the diary once a week for 7 weeks. In the Dutch-French bilingual study for which the LID was originally designed, caregivers ideally filled it out once a week for 15 months (De Houwer, 2011). The diary is filled out in real time per block of 30 minutes so the information asked is still fresh in memory. It can yield a wealth of information but does not by itself provide information on how much language children hear. However, information gained through the LID, combined with observation-based data on the speaking rates of people who frequently interact with children, can furnish a comprehensive picture of global absolute input frequency.

In addition to differing in how much they speak per time unit, and how much in each language, parents also differ in the absolute number of mixed utterances they use in addressing children (mixed utterances combine morphemes from two languages). Observational group studies show some parents using only an occasional one (De Houwer & Bornstein, 2016) or quite many (Tare & Gelman, 2011); these large differences are confirmed in studies where parents self-reported on their use of mixed utterances (Byers-Heinlein, 2013; Place & Hoff, 2016).

2.3 The claim of "reduced input" for bilingual children

There exists a widespread notion that young bilinguals receive less or even only half the input in each of their languages compared to monolinguals. To my knowledge, Hyams (1991: 77) was the first to claim that the input to bilingual children represents only 50% in each language of the input that monolingual children receive. This statement appeared in a response to Klein (1991) who emphasized the importance of the absolute frequency of input for child language acquisition. According to Hyams, Klein's argument that quantity of input is an important factor in language acquisition was wrong, because, she wrote, bilingual and monolingual children follow the same general course of language development in spite of the former having only half the input that the latter receive.

Hyams' (1991) idea that for one language bilingual children get half the input of monolingual children continued to be used as support for nativist theories of language acquisition: "bilingual children (who presumably hear only half as much of each language they are learning as do monolingual children, unless they sleep less) acquire both languages in about the same time that it takes the monolingual child to learn one language. That is, bilinguals speak at the level appropriate to their age, not the level appropriate to their exposure time. Such findings argue that maturational level, not extent of opportunities for practice, is the chief limiting factor in language growth" (Gleitman & Newport, 1995: 11). Similarly, Sorace (2005) stated that bilingual children receive half the input in each of their languages that monolinguals receive, and suggested that this "quantitatively reduced input" (p. 74) may have important consequences for the efficiency of language processing. Ameel, Storms and Malt (2007: 1679) also assumed that "compared to monolinguals, bilinguals get only half the input in each language", and they set up several psycholinguistic adult processing studies on the basis of this assumption.

Paradis, Tremblay, and Crago (2008) write: "Bilingual children receive less input in each of their two languages than monolingual age-mates" (p. 378). This less extreme view often functions as a general axiomatic background assumption in studies of bilingual and heritage language acquisition (see, e.g., Byers-Heinlein & Fennell, 2014; Montrul, 2012; Pirvulescu, Pérez-Leroux, & Roberge, 2012; Scheele et al., 2010). Ironically, in these studies Hyams' claim of "reduced input" for bilinguals as a basis for refuting the importance of input frequency in language acquisition has been turned on its head: The notion of bilinguals' purported "reduced input", a measure of input frequency, now functions as an *a priori* explanation for a range of phenomena-in-acquisition.

In 1996, Paradis and Genesee cautiously wrote that "bilingual children […] probably receive less input than monolinguals in each language" (p. 20). We need to go back to that caution. If scholars want to make the claim of bilingual children generally receiving less input in each of their languages than monolinguals, they should first empirically examine it on its validity. One reason that most researchers have not bothered to actually study the absolute amount of input to bilinguals may be a belief in the notion of "reduced input".

So far, as reviewed above, De Houwer's (2014) is the only study that has empirically compared the actual amount of input to bilingual versus monolingual children; it used the same design for both groups but focused on only one of bilingual children's languages. No group differences emerged. In addition, some individual bilingual children received *more* Dutch maternal input than some individual monolingual children. My comparison of the bilingual results in Marchman et al. (2016) and the monolingual results in Weisleder and Fernald (2013) confirms these findings for Spanish. This shows that the claim of "reduced input" for bilingual children does not apply to all of them. It is premature to characterize all bilingual subjects in studies as having "reduced input" without actually checking on their input.

One may say, very well, "reduced input" in a particular language does not necessarily apply to all bilingual children, but it applies to the population of bilinguals *on average*. The rationale here is: (1) on average, the population of monolingual children receives X amount of input in a single language; (2) the population of bilingual children receives input in two languages, *ergo* (3) the average X amount of the monolinguals must be divided amongst the two languages – it may not mean X/2 for each language, but it will be less for each. This argument appears logical, but relies on an assumption that can be challenged. The assumption underlying (1) is that it is valid to rely on an average number of words heard by the population of monolingual children. As Hart and Risley (1995) showed, there are huge differences amongst English-learning children in how many words they hear. We also know there are large differences amongst cultures and languages in the amount of talk to young children (e.g., Hoff & Tian, 2005). This wide variation makes any notion of average or mean (which is normally seen as a central value that other values closely evolve around, in Gaussian distributions) statistically meaningless. It is highly improbable that there is any central tendency, given the huge range of variation in the language experiences of monolingual children worldwide.

For anyone interested in understanding the extent to which input frequency influences language acquisition (whether in bilinguals or monolinguals), it is precisely the range of children's actual experiences that is of interest, not an inherently vacuous population mean (cf. also De Houwer, 2009: 119–121).

We will never be able to empirically establish the validity of the overall "reduced input" claim for the population of bilingual children compared to monolinguals.

There remains only the possibility of constructing sample means for monolingual groups that are then compared to demographically similar sample means for bilingual groups, as done in De Houwer (2014).

More fundamentally, though, the notion of "reduced input" for the population of bilinguals is based on a comparison with monolinguals. This implies that monolinguals are held up as a standard. The negative connotation of the term "reduced" further implies a deficit stance, where bilinguals as a group are assumed to be in a position inferior to that of monolinguals, without any empirical evidence. This is unfortunate, and scholars should be careful not to make the claim of "reduced input" in any venues or publications that may be accessible to educators and parents dealing with bilingual children. This would not be of benefit to them.

2.4 Relative input frequency

Absolute input frequencies measured for each language yield the derived measure of *relative input frequency* (often erroneously referred to as "amount" of input). This is, in principle, based on a comparison of absolute input frequencies across languages or categories or tokens. For instance, children who hear their L1 8 hours and their L2 6 hours every day have more input in L1, with a proportion of 0.57 to 0.43, where 1.00 equals 14 hours.

Usually, however, no absolute input frequency measures for global language use are collected. Instead, parents are asked to estimate the proportion of time that their children hear either of their languages, or receive more detailed questions about children's care arrangements and about who speaks what language(s) to them. Researchers then compute proportions of use of each language (typically expressed as percentages of an unknown total). In their calculation of the proportions of input in each language to toddlers, Cattani et al. (2014) introduce a correction based on parental estimates of the amounts of time children spend in various communicative settings. They weight the hours spent with fathers less than the hours spent with mothers, based on the assumption that paternal speaking rates to children are lower (cf. Pierce et al., 2015).

The only study so far to empirically compare quasi contemporaneous observed absolute and reported relative input frequencies in speech addressed to the same group of young bilinguals found that both measures identified the same language as being used most often and found a very moderate correlation between measures, although for several families there were large discrepancies (Marchman et al., 2016). Importantly, though, reported relative input frequencies masked considerable variability between children's actual language experience. For instance, a child who reportedly heard Spanish 80% of the time was hearing only 200 Spanish words per hour, whereas another child who reportedly heard Spanish only around half the time was hearing nearly three times as many words per hour (Marchman et al., 2016: Figure 1a).

Relative input frequency proportions usually do not take into account mixed utterances, or times that children hear both languages in the same context (but see Place & Hoff, 2016). This may ignore a substantial amount of variability between families and an important part of language input (Carroll, 2017). Furthermore, usually, possible changes over time in proportions of language input are not mentioned (but see Hurtado et al., 2014, who could find no such changes from child age 30 to 36 months).

2.5 Input frequency of linguistic categories

Although studies make claims about input frequency differences for a particular linguistic category in dual language input (e.g., Paradis et al., 2011), surprisingly few provide empirical data on actual speech addressed to children. Category type and token frequencies of specific linguistic categories need to be based on the actual language models that children hear. At the very least, there needs to be detailed information about the oral varieties children are hearing. It makes a difference whether children are growing up with a language variety that is strongly influenced by the other language they are hearing. For instance, if children hear both Hindi and English in India, it would be wrong to assume they are hearing the kind of standard English globally taught in classrooms. English in India is a variety with its own particular features that has been influenced by Hindi (Mishra & Mishra, 2016). Especially in a bilingual setting, it is important to take this into account. All too often forms that bilingual children use are seen as the result of cross-linguistic transfer whereas in reality they are likely modelled after the varieties children hear (De Houwer, 2009; Paradis & Navarro, 2003).

2.6 Language models

Children can learn from all the language models they regularly hear. For scholars studying bilingual children's acquisition it is thus of prime importance to know what these models are (De Houwer, 2009).

Many parents in bilingual families (and, indeed, in monolingual families!) speak a language to their children that they did not learn as an L1 (they may in addition speak their L1 to children). Often, parents in bilingual families who speak a language as their L2 show some influences from their L1 in their speech, or make errors in their L2 (Yamamoto, 2005). Parents who use an L2 with their children may also have a limited L2 lexical repertoire.

More and more, input studies are asking parents to rate their proficiency in one or both of the languages their children are hearing (Hammer et al., 2012; Paradis & Kirova, 2014). Studies by Hoff and colleagues (e.g., Place & Hoff, 2016) assess parental "native speaker" status (unfortunately without further explanation).

What matters in language input, of course, is what is actually said to children and how it is said (cf. also Place & Hoff, 2016). In a rare study looking at the actual speech patterns of parents in bilingual families, Bosch and Ramon-Casas (2011) found variability, inconsistencies and some errors in bilingual mothers' vowel productions. In order to explain elements of children's own productions, we need to know about such facts.

2.7 The people speaking to children and language choice patterns

It might matter what person speaks what language to children, and it might matter whether a particular language is shared by important people in bilingual children's lives (see also the section on "Diversity and uniformity in language presentation", De Houwer, 2009: 111). Parental input patterns have been linked to children's language use, as have the language choices made by older siblings (see below).

Contrary to what is sometimes assumed, language choice patterns do not directly reveal anything about amount of input. Rodina and Westergaard (2017) interpret the fact that children heard Russian from both parents (RR) rather than from just mothers (with fathers speaking Norwegian, NR) as constituting a difference in amount of input. This needs to be empirically validated. For instance, fathers in RR families might work hours that do not coincide with children's waking hours, while mothers might speak more Russian to children in RR than in NR families (in fact, half the mothers in NR families addressed children in both Russian and Norwegian). Furthermore, the fact that both parents in a family share the same (minority) language while other parent pairs do not correlates with many other potentially important input aspects rather than just absolute input frequency (De Houwer, 2007). For instance, discourse patterns may be very different, with NR families switching between languages and translating to and fro; also the fact that Norwegian fathers knew no Russian but Russian mothers used Norwegian at home with fathers likely created a bilingual setting in which it became optional for children to actually speak much Russian, and it was perhaps their lesser practice with Russian that helps explain why NR children performed worse on a Russian gender task than RR children (Rodina & Westergaard, 2017). It is also likely that RR families had more Russian speaking friends and interacted more strongly with family in Russia. This would not only have an effect on absolute input frequency but also, possibly, on attitudinal language alignment and children's opportunities to hear more varied speech models.

2.8 Communicative settings and media use

Another aspect pertaining to language input concerns the communicative settings in which children hear language. Typically, one thinks of input as consisting of dyadic face-to-face interaction, with participants sharing the same space. However, face-to-face interaction can also consist of multi-party interaction (Place & Hoff, 2011, report a daily average of 3.27 hours that bilingual two-years-olds interact with both parents, with or without others); in addition, there can be telephone or real time video-contact.

In addition to face-to-face interaction, children may overhear language not addressed to them (possible in multi-party interaction, or when mother is talking on the telephone, for instance). We know very little about bilingual children's exposure to overheard speech and how it may affect their language development (but see De Houwer, 2009: 101–103). Overheard speech is particularly relevant to some trilingual settings where children are addressed in each of two languages, but where parents address each other in a third (Chevalier, 2015; Nakamura, 2016).

Another input setting where children are not expected to talk occurs when they watch television or puppet theater shows and the like, or when they are listening to audio material. These aspects are taken into account more and more in questionnaires scholars use to assess children's language environments (e.g., Paradis & Kirova, 2014). Place and Hoff (2011) report that bilingual two-year-olds experienced media exposure for an average of nearly an hour a day. Bellay (2016) richly documents four bilingual siblings' experiences with different kinds of media (including print media and narrations).

2.9 Interactional style

There are many aspects of how people interact with young children that go well beyond the sheer amount of talk they address to them. In conversing with children, adults will, for instance, use pragmatic functions such as directives, they will have specific ways in which they respond to children's questions, or they may use child directed speech (CDS), a specific register for speech to children characterized by, amongst others, specific pitch patterns, a lot of repetition, and some very specific vocabulary items. All these aspects fall under *interactional style*. So far, few studies have studied these aspects in speech to bilingual children. A notable exception is the study by Palacios et al. (2015), who found large variability amongst mothers in the number and kinds of questions they asked their English-Spanish bilingual 4-year-olds.

There are specific bilingual aspects of conversational behavior that may be fundamental to bilingual children actually speaking two languages rather than just one (De Houwer, 2011, 2017c). Lanza (1992, 1997) proposed a continuum of parental discourse strategies ranging from monolingual strategies, that is, those that encourage children to use just a single language (e.g., asking children to repeat something they said in "the language mommy speaks") to bilingual strategies, which allow children to use either of two languages, or even a language the parent is not speaking to them (e.g., continuing with a conversation in language A, without asking children to repeat what they just said in language Alpha). Studies documenting such conversational strategies include Kasuya (1998) and Tare and Gelman's (2011) unique group study.

3. Language intake

Children are not parrots: they do not "automatically" imitate and mirror whatever (bits of) spoken utterances they hear. Rather, they are maturing individuals who, in an intensely personal experience, must process and select aspects of their language input. This is their language *intake* (Wijnen, 2000; De Houwer, 2017a). Language intake dynamically drives children's developing language skills.

In selecting "data" from their input children process physical and distributional characteristics of speech they hear. What they (can) process depends on, amongst others, their processing "proclivities" (Newman et al., 2016), the linguistic knowledge and skill they already have (Wijnen, 2000), a cognitive preparedness to process certain aspects of the input (Gathercole & Hoff, 2007), and their general level of maturity and the opportunities they have had to practice their language skills (De Houwer, 2017a; Hurtado et al., 2014; Long & Rothman, 2014). Conversely, language input may steer child-internal factors (e.g., Weisleder & Fernald, 2013, found that richer language experiences strengthened children's language processing efficiency).

Regardless of how many languages they hear, children's intake of language input depends on a multitude of child-internal factors. Immediate relations between input and children's language proficiencies and use, then, are not to be expected. Nevertheless, many aspects of bilingual children's language use are associated with input related factors. These are briefly outlined below.

4. Links between input and bilingual children's language development

As already discussed above, bilingual children under age 6 develop language quite differently depending on the *relative timing of the start of input* in two languages. It really matters in the first 6 years of life whether children grew up in a BFLA or ESLA setting. We do not know whether this continues to be the case as children move on to the primary school years. The *duration* of the input in the L2 has been shown to affect ESLA children's L2 language outcomes: ESLA children who had longer exposure to their L2 English were better at using English tense inflection than others with less long exposure (Blom & Paradis, 2015). The norms for the assessment of ESLA preschoolers' morphosyntactic outcomes in German as an L2 take into account children's length of contact with the L2 (Schulz & Tracy, 2011).

Frequent evidence from case studies (De Houwer, 2009: 127–132) shows that children's language production in each of their languages can fluctuate quite dramatically in response to *changes in language input*. For instance, bilingual children may become much more talkative and fluent in one of their languages soon after arriving in a new country where everyone speaks just one of children's languages (Garlin, 2008; Silva-Corvalán, 2014), or after starting day care. Conversely, decreases in opportunities to speak a language may lead to rapid decline in children's ability in that language. Slavkov (2015) carefully documented such changes in a Bulgarian-English toddler growing up in Canada. Before she left on a trip to Bulgaria where she was no longer hearing any English, the child hardly spoke any Bulgarian, but spoke English very well. It took just 5 days for her to start speaking a lot more in Bulgarian and to jump from a mean length of utterance of 1.25 in Bulgarian to 3.07, whilst at the same time she soon started to use less and less English (with her father, who she had previously mostly addressed in fluent English); in addition, her English mean length of utterance went down from 4.76 to 2.95 in just 5 days. As Slavkov (2015) notes, whether these large and fast changes were due to an increase in absolute input frequency, an increase in motivation on the child's part to speak Bulgarian, the increase in the number of people speaking Bulgarian (before the trip, the child only heard her father speak Bulgarian), or the increase in communicative contexts in which Bulgarian was heard – that is impossible to say. Most likely the combination of all those factors played a role.

Because of the paucity of studies measuring *absolute input frequency* we know hardly anything about its possible effect on bilingual development. Two studies that have considered language outcomes in relation to input frequency suggest that there is indeed a role for absolute frequency. In comparisons for each language, Marchman et al. (2016) found that the number of words spoken to BFLA children related to their on line efficiency in word comprehension as well as to their test scores on language proficiency measures. The absolute frequency of English input by teachers predicted ESLA children's growth in receptive vocabulary over the first year of preschool (Bowers & Vasilyeva, 2011).

Several studies have shown correlations between reported current *relative input frequency* for each language and young bilingual children's language outcomes (most of the studies look at BFLA children). Correlations have been found for a wide range of outcomes, e.g., the extent to which children reportedly switch to language A when addressed in language Alpha (Ribot & Hoff, 2014), phonological memory skill (Parra et al., 2011), growth in receptive vocabulary (Scheele et al., 2010), language processing efficiency (Hurtado et al., 2014), and reported production vocabulary size (Hoff et al., 2012). Marchman et al. (2016) found marginal effects of reported relative input frequency but absolute measures far better predicted children's language outcomes in each language than relative measures did.

As reviewed in De Houwer (2009), the combined evidence from case studies focusing on acquisition is that children who do much better in one language than in the other often hear that language relatively more often and in more circumstances than the other one.

The few existing *linguistic category frequency* studies rely on transcript-based counts of type and/or token frequencies of morphosyntactic categories in the input. Whenever case studies of BFLA children have attempted to do so, they have found correlations between adult category frequencies and child category use (De Houwer, 1997; Paradis & Navarro, 2003; Rieckborn, 2006; Silva-Corvalán & Montanari, 2008), thus lending some evidence for De Houwer's (1990) suggestion that in order for BFLA children to be able to develop two separate morphosyntactic systems, they must pay close attention to the input. Such close attention is already evident in 7-month-old BFLA children (Gervain & Werker, 2013).

Hoff and colleagues' research program (e.g., Place & Hoff, 2016) has so far provided the most convincing evidence that (BFLA) children's *language models* relate to their language outcomes. Children who heard English from "native speakers" had better English skills than children who heard English from highly proficient "non-native speakers". Just what it is in the input that differs between these two types of input providers remains to be examined. A case study suggests that a mother who spoke Spanish as an L2 to her child and produced a lot more overt subjects than Spanish-as-L1 speakers influenced her Spanish-English child's frequent use of overt subjects in Spanish (Paradis & Navarro, 2003).

The next point concerns *the people speaking to children* and *language choice patterns* in relation to language outcomes. Yamamoto (2001) and De Houwer (2007) found that 17 to 27%, respectively, of children who heard two languages through the 1P/1L rule as practiced by parents in the home did not in fact speak two languages. Children in bilingual homes were far more likely to speak two languages if both parents spoke a minority language at home and one parent in addition spoke the majority language (De Houwer, 2007). Thus, the 1P/1L rule is neither a sufficient nor a necessary language choice pattern to support children's use of two languages. The gender of the parent providing input in each language does not bear any relation to whether children speak two languages (De Houwer, 2007). Bridges and Hoff (2014) found that having older siblings who spoke English to toddlers in Spanish-English bilingual homes increased toddlers' English vocabulary; those without a school-aged older sibling were more advanced in Spanish. In a sample of Spanish-English bilingual families with a lower SES than those studied by Bridges and Hoff (2014), Kibler, Palacios and Simpson Baird (2014) showed similarly strong sibling influence: The more older siblings they had, the less likely it was that children between 2 and 4 would address their mothers and other children in just Spanish. Hammer et al. (2012) examined a number of environmental factors, including proximal input factors, to help explain bilingual 4-year-olds' performance on a receptive vocabulary test and on a story recall task. They identified different relations between factors and language outcomes depending on the language and depending on the specific language outcome. Over and above environmental factors, however, it was children's own language choice patterns with key communicative partners that could explain their receptive vocabulary in each language. Place and Hoff's (2016) study suggests that children's language skills are affected by the number of people that speak a particular language to children.

There has been little systematic attention to the role of *communicative settings and media use* in children's bilingual development. In an experimental study, Genesee et al. (2006) showed how very young bilingual children adjusted their language choice to that of unfamiliar interlocutors. Tare and Gelman (2011) examined whether the presence of a monolingual bystander while mothers interacted with their bilingual children would affect children's language choice (it didn't). Dixon (2011) found that Singaporean bilingual preschoolers who watched TV mainly in English rather than also in Chinese, Tamil or Malay had higher English receptive vocabulary scores and that the effect of watching TV in English was greater than that of having a nanny address children in English.

Kibler et al. (2016) show how older siblings interacted with their bilingual preschool-aged siblings in ways that supported preschoolers' language development. This study of *interactional style* in bilingual settings complements studies of parental discourse strategies that socialize children into using just a single language or allowing two. Juan-Garau and Pérez-Vidal (2001) document how a child who was speaking only Catalan in spite of having Catalan and English input from birth changed to also speaking English after his father adjusted his discourse strategies and introduced a supposedly monolingual English-speaking puppet to coax the child into speaking English. In a group study of maternal book reading with young bilingual children, Tare and Gelman (2011) found a direct relation between maternal explicit prompts to translate a particular word and children's furnishing of a translation equivalent. Thus, maternal interaction strategies directly supported vocabulary learning.

In the first exploration of its kind, Byers-Heinlein (2013) found that higher parental reported language mixing rates predicted smaller English comprehension vocabularies in 18-month old children who heard English and one of a wide range of other languages (but see Place & Hoff, 2016). Byers-Heinlein (2013) speculates that one underlying reason could be that processing mixed utterances is a more challenging task for infants, rendering it more difficult for them to identify and thus learn words.

Over and above relations between language input and child language outcomes, particular input aspects may also affect children's metalinguistic knowledge: Tare and Gelman (2011: 775) suggested that parents' frequent furnishing of translation equivalents may contribute to children not regarding an object's name as inextricably tied to the object itself. Oades-Sese and Li (2011) established that high quality child-caregiver relationships positively affect preschool-age bilingual children's language proficiency in both languages.

5. Conclusion

The identification here of possible aspects of bilingual children's language input is far from complete and leaves out a lot of detail. What is very clear is that language input to bilingual children is variable and dynamic. It is, so to speak, a moving target. This makes it extra difficult to accurately describe bilingual children's language input over time. It is even more difficult, then, to try and find links with yet another moving target, children's developing bilingual proficiencies. However it is measured, though, the combined evidence shows that amount of input to bilingual children matters.

Whether it is best to mainly rely on a secondary measure of amount of input, viz., relative amount of input based on parental report, is an open question. Goodz (1989) already noted a discrepancy between parental reported language choice in speaking to their children and parents' observed input (see also De Houwer & Bornstein, 2016; Marchman et al., 2016). Using reported "running" data such as those from the LID may be a better option than relying on after-the-fact questionnaires or interviews (Place & Hoff, 2016).

Ideal would be to have in depth and longitudinal measures of absolute input frequency available. Measuring actual input patterns that reflect everyday naturalistic interactions in the absence of an investigator is notoriously difficult, cumbersome, and time consuming. There is no easy solution to this problem. The LENA™

system (Marchman et al., 2016) could in principle be useful, but needs to be tested for use with languages other than English and Spanish. Regardless of the method chosen, even in the LENA™ case, any recordings-based study will have the need for labor-intensive coding and/or transcription.

Because of developing language attitudes (Carroll, 2017; Hammer et al., 2012), children may not be willing to use one of the languages they hear (De Houwer, 2017c). This may lead parents to adjust their language choice and start to use a minority language less and less frequently (ibid.). Thus, children's own language behavior can fundamentally affect the input, over and above changes in CDS as children mature linguistically.

Relations between environmental factors and early bilingual development, then, are highly complex and dynamic (see also Cha & Goldenberg, 2015). They are intricately connected with the specific sociocultural power constellations in the society children and their families live in. Universally, if BFLA preschool children speak a language better than their other one, or if they speak only a single language, it is the language used in the wider society that wins out (De Houwer, 2017c; Pearson, 2007). Even ESLA children may soon replace their L1 by the new L2 they are learning through (pre)school. A more holistic approach to input needs to take these power relations into account. It is only by examining these in combination with more proximal aspects of input and children's own developing minds that we will gain a deeper understanding of what drives bilingual development.

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CHAPTER 8

Literacy development in linguistically diverse pupils

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In this chapter the literacy skills (reading accuracy and comprehension and writing) of minority language learners is in focus. The chapter provides a selective review of some of the theoretical and empirical research which has investigated how minority language learners develop reading and writing skills in their majority language. The chapter begins with a discussion of who minority language learners are and why we should be concerned about their literacy development. A section on the development of reading ensues which presents the Simple View of Reading as a theoretical basis and identifies that minority language learners tend not to have difficulties with decoding aspects of reading, but do tend to have problems with reading comprehension skills, argued to stem from less well-developed vocabulary knowledge. Research examining the development of writing in minority language learners is discussed, again presenting a theoretical framework (Simple View of Writing) and illustrating that as with reading, minority language learners tend not to have difficulties with lower-level features of writing (such as transcription and spelling) but do have difficulties with higher-order features (such as organisation of ideas). Educational implications of this work are examined highlighting the need for theoretically motivated educational interventions across a wider range of contexts than is currently available. The effectiveness of different bilingual education programmes is briefly examined, which supports the development of the home language knowledge in minority language learners. Developing home language proficiency and literacy skills enables the opportunity for students to draw upon their L1 which in turn supports the development of their L2 literacy skills. Linguistic diversity is the global norm, and increasingly children are being educated through the medium of a majority language which is not their home language. More work across different contexts is needed in order to better understand, and support, literacy and academic achievement in linguistically diverse pupils.

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1. Introduction

This chapter focuses on the literacy development (reading accuracy, reading comprehension and writing) of children who have a home language that is different from the language of the majority of the society in which they live, often referred to as *minority language learners* in the literature (Murphy, 2014). Minority language learners constitute an interesting and important population to study for a number of reasons. First, with increasing globalisation and migration, rising numbers of children are moving to a country or setting in which the majority language is not their own. For example, the United Nations Population Fund reported that in 2015 there were 244 million people (approximately 3.3 percent of the world's population) living outside the country in which they were born (UNFPA, 2015). Furthermore, second and third generations are growing up with two cultures, and often two languages; their heritage language and the majority language. From an educational perspective, this means that increasing numbers of children will be in classrooms where the language used as the medium of instruction is not their home language. In the UK for example, approximately 20% of the primary school population have English as an Additional Language (EAL) and this figure is growing year on year (DfE, 2016). In this chapter, some of the main findings regarding how children from minority language backgrounds fare in terms of literacy development are discussed. The first section expands on who minority language learners are and what some of the educational issues and challenges are that they face. A selective review of research is then provided which identifies main themes on the development of reading, focusing on theoretical perspectives and the role of vocabulary knowledge. Less research has been carried out in terms of writing skills and development in minority language learners but a brief selective review of appropriate exemplars will be presented.[1] The chapter concludes with a discussion of crosslinguistic influence and educational implications of this work.

2. A characterisation of minority language learners

Romaine (1995) characterised 6 different contexts in which a person could become bilingual[2] and minority language learners can belong to any of these categories, highlighting the diversity of the linguistic contexts in which we find these emergent

1. Note that many of these issues are also discussed in Murphy (2017) from a mixed methods research perspective.

2. (i) one parent, one language; (ii) non-dominant home language/one language-one environment; (iii) non-dominant home language without community support; (iv) double non-dominant

bilinguals. They are children who have multiple languages available to them from very early on in their development given that they have a home language that is not the same as the majority language of the society in which they live, but either within or without the home they will have exposure to at least one other language (the majority language). This means then that they have the potential to become bilinguals – i.e., linguistically competent and proficient in more than one language. Unfortunately, it is not always the case that they actually do become bilingual (see Murphy, 2014, Chapter 3 for detailed discussion). Very young minority language learners might be dominant in their home language up until the point where they enter formal education, likely to be carried out through the medium of the majority language. At this stage, there is a strong pressure to develop high levels of fluency in the majority language for both social and educational reasons. Furthermore, the child is likely to receive formal language arts instruction in the language of school but is less likely to receive such instruction in the home language unless they attend some form of community-based school or participate in a bilingual education programme. Consequently, minority language children often shift from being dominant in their home language, to being dominant in their second (majority) language. It is also an unfortunate fact that many minority language learners fail to develop into bilingual children at all given the lack of support for bilingualism generally, and learning the home language in particular (Kondo-Brown, 2010). The focus of this chapter is on research which has examined literacy development in this population of emergent bilinguals, however, for reasons just described, it is important to recognise that they may not have yet developed into fully bilingual children and indeed may never do so. It is also equally important to understand that many of these pupils will not learn to read in their home language, and/or will not have the opportunity to acquire well-developed reading skills in their home language. Therefore, unlike the case of learning to read in a second language where the learner's knowledge of reading in their L1 is an important predictor of L2 reading success (e.g., see Koda, 2012) the minority language learner context is quite different in that the child may have minimal literacy skills in their non-majority language.

It is worth also noting that there are different types of 'minority' languages. A language can be an ethnolinguistically minority language because it is in the minority, and possibly endangered, relative to other world languages. For example, the Cornish language is a minority language in Britain, recognised by the European Charter for Regional or Minority languages (1992), and spoken by only a small number of people (precise estimates are difficult to identify but it could be as little as about 300–500). Like a number of the world's languages, it is at risk of becoming

home language without community support; (v) non-native parents and (vi) mixed languages (Romaine, 1995).

entirely lost without active support and initiatives to increase the number of people who speak it. A language can also be a minority language in one setting even if, in and of itself, it is an important world language. In the UK for example, Spanish is in the minority relative to English, so a child who speaks Spanish in the home would be considered a minority language learner despite the fact that Spanish is one of the world's most important languages and spoken by millions. De Bot and Gorter (2005) distinguish between *regional* (Cornish) and *ethnic* (Spanish in England) minority languages to clarify these differences. The research reviewed in this chapter will deal primarily with children who are ethnic minority language learners.

There are a considerable number of issues and challenges related to educational provision and practice for children who are minority language learners. These include how best to support the child's first language, and identifying how educational contexts can be a positive determinant of bilingualism, instead of what so often happens where children experience the language shift as described earlier. Other concerns relate to how to ensure that children from different minority language backgrounds are valued such that their linguistic diversity is viewed as an asset rather than a problem or educational challenge as is so often the case (Cummins, 2000; Murphy, 2014; Murphy & Evangelou, 2016). This chapter is focused on literacy skills and hence the discussion will necessarily be limited to identifying those factors for which there is tangible empirical evidence as to how they relate to and influence developing literacy (e.g., vocabulary knowledge). Furthermore, while minority language learners can be found throughout the world, and are learning many different languages, the majority of research examining literacy skills in minority language learners has been carried out where English is the majority language, hence the discussion will draw more heavily from research where children are being educated through the medium of English. Clearly, more systematic research from other socio-political and linguistic contexts is needed.

2.1 Educational outcomes in minority language learners

Research has been unequivocal in identifying that there are no cognitive or developmental reasons to question whether children can develop bilingually without cost to their academic achievement (e.g., see Murphy, 2014 for a review). Furthermore, many researchers have argued that there are various advantages to being bilingual which range from community-based, economic, and social advantages, to cognitive advantages (though note these are currently being debated in the literature; see for e.g. Bialystok, Craik, & Luk, 2012; De Bruin, Treccani, & Della Sala, 2015; Freidman, 2016; Gathercole, Thomas, Kennedy, Prys, Young, Viñas Guasch, Roberts, Hughes, & Jones, 2014; Paap & Greenberg, 2013; Rosselli, Ardila, Lalwani, & Vélez-Uribe, 2016). Despite these potential advantages, minority language learners around the world tend to under-perform academically relative to their majority language peers. The PISA studies (Programme for International Student Assessment) run by the OECD (Organisation for Economic Co-operation and Development) consistently demonstrate that children from first and second generation immigrant families underperform in both reading and math scales relative to native speaking peers, even when variability due to socioeconomic status (SES) is factored out. The PIRLS study, (Progress in International Reading Literacy Study) illustrates the same trend as PISA. The difference between ethnic minority language learners and their native-speaking peers is important because the OECD stats that "Integrating immigrant students into schools is a challenge for most countries; yet a country's success in integrating immigrants' children into society is a key indication of the efficacy of social policy in general and education policy in particular" (OECD, 2013: 71).

There are many factors which contribute to how well a child performs at school. These include socioeconomic factors (SES), parents' (and in particular mother's) level of education, number of books in the home, and so on (e.g., Sammons, Toth, Sylva, Melhuish, Siraj, & Taggart, 2015). It is beyond the scope of this chapter to be able to discuss all of these (and other relevant) variables in detail. However, one variable that is particularly relevant for minority language learners is their proficiency in the majority language.

A recent study in the UK demonstrates clearly the relationship between children's proficiency in the majority language (English in the UK) and their academic achievement. Whiteside, Gooch, and Norbury (2016) recruited 782 children with English as an Additional Language (EAL) when they began school at aged 4/5 and tested them on a range of measures, including a measure of language proficiency (the Child's Communication Checklist (CCC-2 (Bishop, 2003)), a measure of social-emotional development (Strengths and Difficulties Questionnaire (Goodman, 1997)), the assessments routinely carried out by teachers in England together with the more formal academic assessments at the end of Key Stage 2 (KS2) (i.e., end of primary school). The results of this longitudinal study indicated that children with EAL overall had lower proficiency in English relative to monolingual peers, had greater social, emotional and behavioural difficulties, and were less likely than monolingual children to achieve a good level of development as assessed by the teacher in the child's first year of school, nor were they as likely as monolingual children to perform at target-levels on the end of KS2 academic assessments. However, the regression analyses carried out by Whiteside et al. (2016) illustrated that children with EAL experience fewer social, emotional and behavioural difficulties compared to monolingual children *of similar language proficiency*. Furthermore, weaker language proficiency in English was significantly associated with lower performance on the academic tests, and importantly, EAL status was not a significant predictor. When children with EAL were matched against non-EAL pupils, EAL pupils had fewer academic and social, behavioural problems relative to the nonEAL pupils. In other words, being an EAL student was not in and of itself associated with weaker performance, but rather, lower English language performance emerged as the critical predictor variable.

These results are also consistent with previous studies showing that academic achievement in minority language learners of English is dependent on English language proficiency (Demie & Strand, 2006; Goldfeld, O'Connor, Mithen, Sayers, & Brinkman, 2014; Halle, Hair, Wandner, McNamara, & Chien, 2012; Prevoo, Malda, Mesman, & van Ijzendoorn, 2015; Strand & Demie, 2005). These findings are also consistent with the conclusions of Strand, Malmberg and Hall (2015) that EAL pupils are a highly heterogeneous group and that their proficiency in the majority language – which is associated with a range of other variables (e.g., age of arrival, whether they have a prior attainment score) – is an important predictor of children's academic attainment. It is important to remember that despite the international trends, children from minority language backgrounds are not necessarily the lowest performing group in academic achievement tests. For example, in the UK, one of the lowest performing group of children are white working class boys (Sammons, Toth & Sylva, 2015). This finding again, highlights the heterogeneity of the population, where some minority language learners might struggle and lag behind native-speaking peers, whereas others fare far better and many are at the top of academic performance scales. One of the critical features of children's proficiency in the majority language is their oral language knowledge as this underpins the development of literacy skills. It is clear that accessing the curriculum requires good literacy skills. Chall's (1983) oft-cited phrase that children need to 'read to learn' characterises this relationship between overall academic achievement and reading. Furthermore, a child with good writing skills will both enhance their reading skills and be able to demonstrate their mastery of academic content.

3. The development of reading skills in linguistically diverse pupils

Given that reading underpins the ability to access curricular content it is little surprise that researchers have long been interested in understanding and developing theoretical accounts of reading skill. Learning to read in a second language involves many different variables and is multi-componential (Geva & Wiener, 2015) and due to the inherent limitations of addressing such a vast topic in a single chapter, only a handful of the variables implicated in reading will be discussed here.

3.1 The simple view of reading

Gough and Tunmer's Simple View of Reading (SVR) (1986) focuses on two specific sets of skills that are critical in understanding how children learn to read, and has been frequently applied to the context of minority language learners. The SVR posits that comprehending texts involves the use of well-developed decoding and comprehension skills (Hoover & Tunmer, 1993). The SVR has received considerable support from research across a number of different contexts and is continuing to be discussed and developed (e.g., Hølen-Tengesdal, 2010; Silverman, Speece, Harring, & Ritchey, 2013). Studies revealing evidence consistent with the SVR include L1 English studies (Gough, Hoover, & Peterson, 1996; Hatcher & Hulme, 1999; Muter, Hulme, Snowling, & Stevenson, 2004), children with EAL[3] (Geva & Farnia 2012; Gottardo & Mueller, 2009; Mancilla-Martinez & Lesaux, 2010); children learning Chinese in China (Joshi, Tao, Aaron, & Quiroz, 2012); children learning Dutch as a second language with Turkish as a home language (Verhoeven & van Leeuwe, 2012) and children learning Hebrew as a second language (Prior, Goldina, Shany, Geva, & Katzir, 2014). These studies (and others) all consistently demonstrate that reading comprehension is underpinned by fluent and accurate single word reading and decoding performance, as well as different aspects of language comprehension. Word decoding skills include a number of other abilities such as phonological and syntactic awareness, working memory and lexical access processes (Jongejan, Verhoeven, & Siegel, 2007) and when children encounter difficulties with these processes, negative consequences on reading arise (Kame'enui & Simmons, 2001). The focus on these word reading skills has prompted some governments (such as the UK see Rose, 2006; DfE, 2012) to implement mandatory phonics instruction into the primary curriculum which seems to be a necessary, but not a sufficient, factor in developing good reading skills in schools (Duff, Mengoni, Bailey, & Snowling, 2015).

There is ample evidence that single word reading is not specifically challenging to minority language learners. Single word reading is a componential process, drawing upon automatic skills in orthographic, phonological, lexical, morphological and syntactic skills. Automatic and fluent performance in single word reading goes beyond mapping single phonemes onto graphemes and requires the reader to easily recognise and process larger orthographic units (such as -tion, -ough and the -ea- in 'bread', and 'read') which typically have irregular spellings (Lovett, De Palma, Frijters, Steinbach, Temple, Benson, & Lacerenz, 2008). Typically developing

3. Different research contexts tend to use different terms to identify minority language learners who learn English as their majority language. The US uses the term English Language Learners (ELL), the UK uses English as an Additional Language (EAL) and Canada typically uses the term ESL (English as a Second Language). The term EAL will be used throughout this chapter.

minority language learners tend not to have difficulties with single word reading accuracy. For example, a large-scale meta-analysis of research carried out in a range of countries (including The Netherlands, Canada, the UK and the USA) demonstrated comparable word reading and phonological skills between native-speaking and minority language learners (Lesaux, Geva, Koda, Siegel, & Shanahan, 2008). A two-year longitudinal study in the UK comparing children with EAL against non-EAL pupils matched on age, nonverbal IQ, and gender found no differences between the two groups of children on word reading skills (Hutchinson, Whiteley, Smith, & Connors, 2003); and similar results have been found in other, comparable studies (Burgoyne, Kelly, Whiteley, & Spooner 2009; Burgoyne, Whiteley, & Hutchinson, 2011). Age-appropriate decoding skills in minority language learners have been reported in children with Spanish as an L1 (Nakamoto, Lindsey, & Manis, 2007) and children learning Dutch (Verhoeven, 1990; 2000) and in minority language learners in Canada from both high and lower SES backgrounds (Jean & Geva, 2009; Lesaux, et al., 2008; Lesaux, Rupp, & Siegel, 2007; Lipka & Siegel, 2007). There is considerable evidence, therefore, which illustrates that children who are learning to read in their second (majority) language tend not to have difficulties with the decoding aspect of reading skill.

The other side of the SVR model is focused on language comprehension and it is here where we see that many children from minority language backgrounds have difficulties. Many studies in the L1 domain have identified the critical importance of good oral language skills to support reading comprehension (Nation, Clarke, Marshall, & Durand, 2004; Nation, Cocksey, Taylor, & Bishop, 2010; Nation & Snowling, 2004). While the majority of this research has focused on predictors of reading comprehension where English is the native language, there is a growing body of work similarly illustrating the importance of vocabulary and syntactic knowledge for reading comprehension in children learning to read in languages other than English (e.g., Babayiğit & Stainthorp, 2007; Caravolas, Lervåg et al., 2012). Less research, however, has examined the relationship between language skills, and in particular oral language, to reading comprehension in minority language learners. Those that have been carried out, however, tend to indicate, as with the L1 studies, that oral language skills are an important predictor for reading comprehension (Babayiğit, 2014, 2015; Lesaux, Crosson, Kieffer, & Pierce, 2010; Proctor, Carlo, August & Snow, 2005).

Research has shown, however, that many pupils from linguistically diverse backgrounds enter formal schooling with less developed vocabulary knowledge relative to majority language peers (e.g., Bialystok, Luk, Peets, & Yang, 2010; Cameron, 2002; Mahon & Crutchely, 2006). One would expect therefore, that those children with less well-developed vocabulary knowledge may have difficulties with reading comprehension. This is precisely what has been found in research. For example, Babayiğit (2012) compared EAL and native-speaking primary school students in England and administered a range of vocabulary, listening and reading comprehension assessments. Even after 4 years of formal schooling in England the pupils with EAL tended to underperform relative to native-speakers on measures of listening and reading comprehension and oral language (i.e., vocabulary). Additionally, vocabulary was a significant predictor of performance on reading comprehension tasks, again replicating previous studies. Other studies across a range of contexts have shown similar results where children from minority language backgrounds under-perform relative to monolingual peers on measures of reading comprehension (August & Shanahan, 2008; Burgoyne et al., 2009; Burgoyne et al., 2011; Farnia & Geva, 2013; Genesee, Lindholm-Leary, Saunders, & Christian, 2006; Hutchinson et al., 2003; Lesaux et al., 2010; Melby-Lervåg & Lervåg, 2014; Verhoeven, 1990; Verhoeven & Vermeer, 2006). Indeed, this research overall suggests that for many children from minority language backgrounds their reading comprehension skills are more like those of L1 children with comprehension difficulties (Nation, 2005; Nation & Snowling, 2004).

Bowyer-Crane, Fricke, Schaefer, Lervåg, and Hulme, (2016) compared the literacy, phonological and language skills of EAL and monolingual children in England at two time points – when the children started school and then approximately 2 years after schooling. The monolingual children were identified as having language weaknesses (as measured by the Critical Evaluation of Linguistic Fundamentals (CELF)). The EAL pupils were behind the monolingual pupils at school entry on expressive language and were still behind their monolingual peers, even after 2 years of primary school. However, the EAL pupils fared better than the monolingual pupils on measures of single word reading and spelling at both time points in their study. This finding is consistent with previous work (as described above) that EAL pupils are as good, or often better, than monolingual peers on measures of decoding. Quite surprisingly in this study, the EAL pupils were no different from their monolingual peers on measures of reading comprehension – an interesting result given the research described thus far in this chapter showing that many multilingual pupils lag behind monolingual peers on reading comprehension. The authors suggest that this outcome may be the result of the fact that the comparison was against a group of monolingual children with language weaknesses and who themselves were at the lower range on reading comprehension. They further suggest that using only one reading comprehension assessment (as was done in their study) may have had an impact on their findings since different reading comprehension measures are likely to tap into different skills. These methodological features, together with the fact that the multilingual children were at the very earliest stages of their reading development could explain why, in this study, children with EAL had similar reading comprehension scores as the monolingual peers, despite weaker oral language skills (Bowyer-Crane et al., 2016). Interestingly these results also identify how slightly different patterns of results are found across studies, which warrants further exploration as to the precise relationship between oral language and reading comprehension in pupils from multilingual backgrounds. In summary, therefore, this research underscores the importance of developing vocabulary knowledge in children with EAL and helps us understand the importance of vocabulary knowledge in developing reading comprehension skills. However, the different dimensions of vocabulary knowledge that underpin reading has not been fully explored and one aspect of vocabulary that warrants further investigation in this context this relates to multiword phrases.

There are different ways to characterise multiword phrases (MWPs), (e.g., as idioms (kick the bucket), collocations (cup of tea), phrasal verbs (see to), and the like). However, they all function as individual lexical items (Martinez & Schmitt, 2012; Wray, 2002) and while research has shown that MWPs can support other aspects of linguistic knowledge and processing (Pawley & Syder, 1983; Wray, 2002), they pose difficulties for adult English L2 learners. Adult English as a Foreign Language (EFL) students have lower scores on reading comprehension measures which contain MWPs, and importantly, they are unaware of the fact their comprehension is affected by lack of knowledge of MWPs (Martinez & Murphy, 2011). This finding has been extended to multilingual students in school where it was found that both EAL and non-EAL children had higher reading comprehension scores on texts with fewer MWPs but that EAL pupils had lower comprehension scores than non-EAL pupils on texts which contained more MWPs. Furthermore, primary school-aged (years 3–6) pupils over-estimated their comprehension on texts with higher numbers of MWPs relative to texts with fewer MWPs, suggesting that students may not even be aware of their lack of understanding of texts which contain MWPs (Kan & Murphy, in progress).

Smith and Murphy (2015) aimed to mitigate against the gap in our understanding of the role of MWPs in reading comprehension in multilingual pupils. The aim of this study was to measure MWP knowledge in multilingual and monolingual primary school children and identify whether they differ in knowledge of MWPs, and whether and to what extent knowledge of MWPs makes independent contributions to reading comprehension. EAL and non-EAL children in years 3, 4 and 5 (aged 7/8, 8/9, 9/10) were given a test where the child was required to fill in gaps of a target sentence by creating a two or three word MWP from a 2 x 3 matrix of constituent parts (see Figure 1).

The test in Smith and Murphy (2015) consisted of verb + object multiword phrases which were matched in frequency. The findings suggested that the non-EAL pupils seemed to develop their knowledge of MWPs in a more linear fashion where there were significant increases on the MWP task across year groups. There was

7. Sam talks to his friends during lessons and doesn't___________________.	
break	studies
catch	attention
pay	work

Figure 1. The multiword phrase test from Smith and Murphy (2015)

a different pattern of development for the multilingual pupils, however as there were no statistically reliable differences between years 3 and 4, but there were differences between years 5 and 4 – suggesting more of a step function of development. It is possible, (though speculative at this stage), that multilingual pupils are on a different developmental trajectory relative to their native-speaking peers on multiword phrase knowledge. Variability on the MWP task (collapsed across language groups) accounted for 25% of the variance in the reading comprehension measure (York Assessment of Reading Comprehension – see Snowling, Stothard, Clarke, Bowyer-Crane, Harrington, Truelove et al., 2009) even after controlling for the contributions of nonverbal IQ and expressive and receptive vocabulary. These findings suggest that MWP knowledge might develop differently in children with EAL and is likely to be an important contributor to reading comprehension performance. Given Smith and Murphy (2015) adhered to a cross-sectional design, further research on this issue with longitudinal designs is needed.

In summary, arguably the most widely discussed theoretical account of reading that has been applied to the minority language learner context is the Simple View of Reading (Gough & Tumner, 1986) which posits that there are two fundamental skills which underpin reading: decoding and language comprehension. Research on linguistically diverse pupils reveals that they typically do not have difficulty with the decoding aspects of reading. However, many studies have shown that they do have smaller and/or underdeveloped vocabulary knowledge in the majority language which researchers have argued in turn accounts for why many studies have shown that minority language learners often lag behind majority speaking peers on measures of reading comprehension. These weaker skills in reading comprehension are no doubt part of the explanation of weaker performance in overall academic attainment identified across international student achievement studies.

4. The development of writing skills in linguistically diverse pupils

Writing skills are fundamental in academic achievement but far less research has been focused on examining the development of writing abilities in minority language learners compared to reading. Writing is the primary means children have of demonstrating different academic knowledge (Dockrell, Connelly, Walter, & Critten, 2014). Additionally, writing has been shown to be a significant challenge for many pupils (independent of their linguistic profile) and teachers often report that finding effective ways of instructing and supporting the development of good writing skills is a complex and difficult process (Dockrell et al., 2014). It is all the more surprising therefore that comparatively less research has focused on these aspects of literacy.

As with reading, writing skill has been conceptualised within the 'Simple View of Writing' model and is considered to be multi-componential, consisting of transcription skills (e.g., handwriting and spelling), generating text, and executive functions (planning, revision and self-regulation) that support the production of text (Berninger & Amtmann, 2003; Berninger & Graham, 1998; Berninger & Winn, 2006). Within this view, working memory is a central component as it enables the coordination and integration of these three component processes in writing. Again as with reading, writing skills take time to develop, and it is constrained in the early stages by lower level transcription skills. Once these become automatized the child can develop more higher-level skills such as generating content and organising and producing this content appropriately for different texts. Reading and writing also enjoy a reciprocal relationship as shown by Graham and Herbert (2011). In their meta-analysis of the relationship between writing instruction and reading, they identified that strategies which required students to write about what they had read enhances their comprehension skills – showing that teaching and development of writing can support reading and reading comprehension. Additionally, increasing the amount that students are asked to write can also support reading skills in primary school pupils. Furthermore, recent research examining the relationship between reading and writing in minority language learners (Spanish speakers learning English as a majority language) has shown similar relationships where emergent literacy skills in the home language were related to spelling ability both within and across (i.e., in the majority) languages (Goodrich, Farrington, & Lonigan, 2016). Given these mutually supportive relationships between reading and writing it would be profitable to better understand and hopefully improve writing instruction for children from minority learner backgrounds (and indeed for all children regardless of their linguistic profile).

Research has demonstrated that minority language learners can lag behind their majority-speaking peers on aspects of writing, just as in the reading literature discussed earlier in this chapter. For example, Cameron and Besser (2004) compared EAL and non-EAL pupils' writing across two different genres (fiction and persuasive). EAL pupils were approximately 9 percentage points behind non-EAL pupils in their writing achievement on the national assessment tests that are carried out at the end of primary school in England (Key Stage 2). In analysing the written compositions of both groups further, Cameron and Besser noted that EAL pupils made more grammatical errors and were less likely to use complex syntactic structures relative to non-EAL pupils. Babayiğit (2015b) also investigated written performance of EAL pupils relative to non-EAL. In her study she recruited pupils in year 5 (who were aged 10/11) in England and gave them a standardised assessment of writing where children were required to write two paragraphs of text in response to a prompt (such as 'my favourite game is…'). She found that there were no differences between the two groups of students on lower level features of writing such as spelling, but the non-EAL pupils had higher scores on written expression tasks, measures of holistic quality, organisation, vocabulary and compositional fluency. This result mirrors the findings described earlier in this chapter concerning reading skills, where EAL pupils have little to no difficulty in lower-level aspects of the skill (decoding in reading, spelling in writing) but have difficulties in higher-level features (comprehension in reading, organisation, fluency in writing).

Murphy, Kyriacou, and Menon (2015) also examined writing skills in EAL and non-EAL pupils in England. As in Babayiğit (2015b), children in year 5 (aged 10/11) were asked to complete a narrative writing task, and were also given a range of English language assessments such as the CELF (Clinical Evaluation of Linguistic Fundamentals; Wiig, Semel & Secord, 2013)) which was used to match the two groups of children on their English language skills. Matching the pupils on this measure, however, resulted in the EAL pupils having higher scores on nonverbal IQ than the non-EAL pupils. Nonetheless, the EAL pupils had lower scores on higher-level writing processes of organisation and ideas, similar to Babayiğit's (2015b) finding. This finding is particularly revealing of the difficulties in developing writing skills in minority language learners given a sample, matched on language and with higher nonverbal IQ scores still nonetheless underperformed relative to native-speaking peers on higher-level aspects of writing.

Other research has attempted to identify what factors underpin and/or predict writing performance in minority language learners. Babayiğit (2014b) examined the written performance of 169 nine-year-old children, 72 of whom were minority language learners from diverse linguistic backgrounds living in England. Her main focus in this study was to examine the contributions of word level and verbal skills to writing. Consequently, she measured the children's vocabulary, working memory, semantic fluency, single word spelling and single word reading skills, and writing ability as measured by the WIAT-2 (Weschler Individual Achievement Test;

Wechsler, 2005). Her analyses revealed that the two groups (L1 and L2) of children were similar on the word level measures but the L1 students had higher scores on the verbal skills and writing quality. Word level and verbal skills made independent and statistically significant contributions to the writing quality in both groups, and importantly, even when the number of years in formal schooling in English and SES were factored out, the minority language learners underperformed on measures of writing quality.

Harrison, Goegan, Jalbert, McManus, Sinclar, and Spurling (2016) investigated the cognitive and linguistic components of spelling and writing skills in English as a Second language (ESL) learners and native English speakers in 112 children in third grade (approximately 8 years old) in Canada. Ninety percent of the pupils had Punjabi as their home language, with the remaining students speaking Korean, Malayalam, Urdu and Spanish, respectively. Harrison et al. measured the children's spelling, handwriting fluency, and writing (also using the WIAT-2 as in Babayiğit's, 2014b study). To examine cognitive, linguistic and word reading skills, Harrison et al measured rapid naming skills (where children had to read lower case letters as quickly and accurately as possible), verbal working memory, oral vocabulary, syntactic and phonological awareness as well as word-level reading. Their analyses revealed that the minority language learners had lower scores on vocabulary, and syntax but they performed similarly on the verbal working memory, rapid naming and phonological awareness tasks. The L1 children had higher scores on nonword reading fluency but interestingly (as it contradicts some earlier work) both groups had comparable scores on other literacy measures, including their writing performance. Slightly different components predicted writing quality for both groups (despite the similar overall quality of writing). Rapid naming and syntactic awareness were important predictors for the L2 children, whereas syntactic awareness and oral vocabulary were predictors for the L1 children. Harrison et al. conclude that there are interesting and important differences between the L2 and L1 children where the L2 children draw from grammatical knowledge in writing in English and rely more on rapid access to word-specific knowledge in writing relative to their L1 peers. The fact that their results are in some respects inconsistent with other research (i.e., Babayiğit, 2014b; Murphy et al., 2015) highlights the need to carry out far more systematic research examining the cognitive and linguistic components which underpin writing skills in minority language learners.

These studies examining the writing skills of minority language learners tends to illustrate quite similar findings as the reading research. Writing achievement across various outcome measures parallel reading achievement (Harrison et al., 2016) and models of reading and writing (Simple View of Reading and Simple View of Writing) conceive the respective processes as componential in nature where contributions from cognitive, oral language and word and text-level skills all play important roles in how children develop literacy skills. One of the more salient findings in respect of minority language learners, perhaps, is the important role that oral language (in particular vocabulary knowledge) plays in both reading and writing performance. Unfortunately, many studies uncover disadvantages for minority language learners in respect of vocabulary knowledge, but this is an area that can be enhanced through appropriate instructional support.

5. Educational implications

A number of studies across different countries have carried out educational interventions in an attempt to ameliorate the majority language and literacy skills in minority language learners. Murphy and Unthiah (2015) present a systematic review of some of the intervention studies that have focused on English as the majority language. While this review is not a representative snapshot of intervention studies around the world as it adopted a somewhat narrowly defined set of inclusion and exclusion criteria, it nonetheless highlights how focusing on key aspects within educational contexts can improve the English language and literacy outcomes of minority language pupils. One of the main findings of this review was that the majority of intervention studies around the world have been carried out in the context of the US. This is useful of course for researchers and educational practitioners in the US but is of nominal value to those working outside this context as it remains an empirical question whether the approaches adopted and identified as being effective in the context of the US enjoy the same level of success in other educational and socio-political contexts. The significant majority of interventions reviewed in Murphy and Unthiah focused on some aspect of explicit vocabulary or word-level instruction indicating that teaching vocabulary, and in particular academic vocabulary, can have a positive effect on children's reading and reading comprehension skills. Teaching word analysis strategies were also shown to be effective. For children who struggle with reading, interventions targeting word analysis, phonemic/phonological awareness were shown to be helpful whereas children who are good at reading but struggle with comprehension benefit from explicit vocabulary teaching. Other main findings from Murphy and Unthiah's (2015) review signal that there are comparatively fewer intervention studies examining the effectiveness of Continuing Professional Development (CPD) programmes which are aimed at providing practicing teachers with in-service training to support the development of their knowledge and skills. This lack of intervention studies on effective CPD programmes is a concern given the proliferation of such programmes across many contexts which are pitched as being effective (but may not have any empirical evidence to substantiate such claims). Furthermore, interventions that specifically target and aim to promote family and home engagement in supporting the language and literacy development of minority language learners are also less common in the literature. A number of studies have shown the power of the home in influencing academic outcomes (e.g., Sylva, 2014), so further research in this area for minority language learners is warranted.

Educational interventions which have specifically aimed to support the development of oral language skills in minority language pupils have been shown to be helpful. For example, in Dockrell, Stuart, and King (2010), 142 minority language learners in England aged 3–5 from inner city pre-schools across a range of different L1 backgrounds participated in an intervention called 'Talking Time' which was designed to meet the needs of preschool children who had poor language skills. Participating in the intervention had a positive effect on vocabulary, oral comprehension and sentence repetition but not on narrative skills. The authors argue that consistent evidence-based oral language interaction can have a positive impact on the development of children's oral language skills. Fricke and Millard (2016) also provided evidence that promoting oral language skills through educational intervention can be effective. In their study, 96 children with EAL from a range of different L1 backgrounds were randomly allocated to either an intervention group or a waiting control group. They were assessed on a range of speech, language and early literacy measures in English before and after participating in the 15-week intervention which aimed at improving children's vocabulary, narrative skills, active listening and confidence in independent speaking. The post-intervention assessments indicated that there were significant improvements for the intervention group on expressive naming and receptive picture selection (a measure of receptive vocabulary). Fricke and Millard conclude by arguing that setting-based randomised control trials such as theirs can be effective at promoting key features of vocabulary, an important pre-cursor to literacy development.

In summary, there is a wealth of evidence illustrating that educational interventions aimed at supporting the language and literacy development of the majority language, in minority language learners, can be effective. These interventions typically target key aspects of oral language and vocabulary skills, particularly in younger learners, as well as word analysis and academic vocabulary development (e.g., Snow, Lawrence, & White, 2009) in older students. More research is needed, however, across a broader range of educational and socio-political contexts and linguistic environments.

In addition to educational intervention, educational provision can also be a powerful tool in shaping and promoting minority language learners' linguistic and educational outcomes. Those bilingual education programmes that aim to support bilingual development, providing language arts instruction in *both* the minority and majority language can be particularly powerful here. Two-Way Immersion (TWI) programmes (also known as dual language programmes) are those that educate minority and majority language pupils in the same class, and where part of the school day is carried out in the minority language with the remaining part conducted through the medium of the majority language. Thus, two languages are used for instruction, and both groups of learners learn each other's language, sending a powerful message to minority language learners that their language is valued and worth learning. Perhaps the most widely discussed versions of these programmes are the Spanish-English TWI programmes developed originally in the US. These are additive bilingual programmes, aiming for high levels of functional oral proficiency and biliteracy in both languages, as well as grade-appropriate levels of academic achievement and where both groups of pupils (minority and majority) can be both expert and novice, depending on which language is being used (Christian, 1995; Murphy, 2014). Some regions of the US offer a K-12 TWI, but whether and to what extent TWI is consistent across all of the primary years depends on specific programmes. Note, however, that Christian (1995) emphasises that one of the characteristics of an effective TWI programme is continuation of the programme for at least 4 years. A number of large-scale evaluation studies have been carried out to examine the effectiveness of these programmes (notably in the US), and they have been largely consistent in identifying that English majority native speakers in TWI programmes perform at or above grade level in academic curricular content in their L1, achieving standardized maths and reading test scores that are comparable to or even exceeding those of peers not participating in TWI programmes. Specifically, *both* majority and minority language learners make significant progress in acquiring both languages, and have scores on oral language and literacy tests that are at or above grade when compared to peers in non-immersion programmes (August & Shanahan, 2008; Collier & Thomas, 2004; Genesee et al., 2006; Lindholm-Leary, 2001; Lindholm-Leary & Block, 2010). Importantly, parents are also generally positive about their children's learning and outcomes (Parkes & Ruth, 2011).

Of course, such TWI programmes make sense in areas where there are large concentrations of minority language learners who all speak the same L1, making the L1 (minority) and L2 (majority) type of bilingual education feasible. In many contexts, however, this is not possible, given that there is such significant linguistic diversity in the general population with respect of L1 backgrounds of the minority language pupils. Nonetheless, some have argued that there are still ways in which teachers can 'expand the pedagogical space' (Cummins, 2012, p. 1987) to include the L1 as a resource. Even in contexts where there is considerable linguistic diversity, there are many bilingual pedagogical practices that teachers can implement to both support the L1 and illustrate to minority language students that their L1 is valued (Cummins, 1996, 2009; Issa & Hatt, 2013).

One of the many advantages of supporting the minority language learners' home language is that developing proficiency in the L1 allows them to draw from their home language proficiency as a resource to support their L2 (majority) language learning. Cummins' *Common Underlying Proficiency* (CUP) framework argues that promoting proficiency of minority language learners' home language provides a solid foundation upon which development of L2 skills can proceed (e.g., Cummins, 2000). There are no costs to the development of L2 vocabulary or literacy if the L1 is developed, a finding that is supported by the success of TWI programmes identified above. Studies examining crosslinguistic influence in minority language learners also supports this notion. Hayashi and Murphy (2013) directly investigated different groups of Japanese/English learners and whether morphological knowledge in one language would predict performance on morphological processing in another. Half of the sample in this study were children born and raised in the UK with one Japanese parent and one English – in other words, EAL pupils who had Japanese as the home language. Both English and Japanese (receptive and productive) vocabulary and morphological awareness were measured, the latter through word segmentation (making → mak + ing) and word analogy tasks (anger: angry:: strength: ______). The results illustrated that Japanese word segmentation scores were positively related to English word segmentation. The ability to identify Japanese morphemes through segmentation was predictive of the ability to segment morphologically complex words in English. Furthermore, English word analogy scores predicted Japanese word analogy scores, suggesting that the ability to produce morphologically complex items was transferrable across languages. Hayashi and Murphy (2013) argue that this is evidence for bidirectional crosslinguistic influence leading to heightened morphological awareness even when the two languages are typologically distant. This finding is interesting in the context of literacy because morphological awareness is a predictor of literacy skills, even in non-alphabetic script languages (Pan, Song, Su, McBridge, Liu, Zhang, Li, & Shu, 2015).

Other research examining the nature of crosslinguistic effects in minority language learners have identified that the extent of influence from the child's home language knowledge is likely to depend on the particular feature investigated and the structural similarity between the home language and the majority language. In Pasquarella, Chen, Gottardo and Geva (2015), 51 Spanish-English and 64 Chinese-English bilingual pupils were compared on measures of phonological awareness, rapid automatized naming, word reading accuracy, word reading fluency in both their L1 (Spanish or Chinese) and their L2 (English). The children were tested in grade 1 and their word reading accuracy and fluency was tested again in grade 2. The analyses revealed that there was a predictive relationship on word reading accuracy in the Spanish-English pupils but not for the Chinese-English students, argued to stem from the structural similarity between

Spanish-English (both with alphabetic scripts) and the dissimilarity between the scripts for Chinese-English learners. There was evidence for crosslinguistic relationships however for both pupils on word reading fluency. Pasquarella et al. (2015) suggest that word reading is influenced by knowledge of different scripts but that fluency is a script-universal process.

There have been a number of studies examining the nature of crosslinguistic relationships in minority language learners across a range of settings (e.g., Luo, Chen, & Geva, 2014; Marinova-Todd, Siegel, & Mazabel, 2013; Ramirez, Chen & Pasquarella, 2013), many such studies showing ways in which knowledge in the home language can influence and support knowledge in the developing majority language. Of course, for knowledge in the home language to have a positive influence on developing knowledge in the majority (L2), the child needs to have that knowledge developed to a sufficient degree. Therefore, educational provision that promotes bilingual language development can have a particularly positive influence on developing language and literacy skills in the majority language, for minority language learners. It should be noted, however, that more work is needed in this area, and in particular across different linguistic profiles and educational contexts. Specifically, more research adopting a longitudinal design where researchers can measure the developmental trajectory of key literacy skills in the majority language, and where possible have corresponding measures of language and literacy in the home language would be ideal to be able to more specifically identify the supportive relationships between home and majority language. This type of research would lead nicely to more targeted pedagogical implications allowing practitioners to make more informed decisions about when and how to use L1 knowledge in the English classroom (where possible). Furthermore, the preponderance of research on the issue of minority language learners' language and educational achievement have examined contexts where English is the majority language. We need considerably more research examining the majority language learning of other languages and in other socio-political and educational contexts (minority language learners in China as but one example).

In summary, there are a number of educational implications from the research that has been conducted examining the language and literacy development of minority language pupils. Educational intervention studies have demonstrated that interventions aimed at key aspects of word-level and vocabulary knowledge can have positive impacts of oral language and reading skill. Furthermore, additive bilingual education, which aims to support the development of both the child's home language and the majority language have been found to be highly successful in supporting biliteracy development. Research examining crosslinguistic influence across the two languages of minority language learners (which necessitates minimum levels of proficiency in the home language) has also demonstrated interesting ways in which development in the home language can support development of key linguistic features important to literacy development in the majority language (e.g., morphological awareness).

6. Conclusions

This chapter has presented a selective review of some research which has examined the development of reading and writing skills in minority language learners. Theoretical accounts of reading have conceived the process as consisting of skills in decoding as well as language comprehension. Typically, minority language learners do not struggle with the decoding aspects of reading, but many studies have suggested that minority language learners have difficulties on reading comprehension measures. A common explanation put forward to account for these comprehension difficulties stems from a relative lack of vocabulary knowledge known to be an important in predicting reading comprehension skills. As with reading, writing skills are considered to be componential, consisting of lower- and higher-level processes. Again, minority language learners tend not to manifest specific difficulties with the lower-level processes of writing (such as transcription and spelling) but there is evidence that the higher-level aspects of writing such the overall organisation of the text, is weaker in minority language learners. More research needs to be carried out in this area as it is comparatively under-researched relative to the reading literature.

There are important educational implications which can be drawn from examining the nature of literacy development in minority language learners. From a research point of view, further work on developing effective, theoretically-motivated educational interventions, which are implemented in a broader range of socio-political and educational contexts is needed. A number of informative studies have emerged, but there are comparatively fewer intervention studies (outside the US), and examining the development other majority languages (and not just English). Literacy development can be supported in minority language learners if they have access to bilingual education, and in particular, to Two-Way Immersion (TWI) programmes where both the home language, and the majority language as used as the medium of instruction for different parts of the school day. Evaluation studies have identified that participating in such programmes yields higher language and literacy outcomes, at no cost to academic attainment, in minority language pupils. Many contexts with high degrees of linguistic diversity are likely to find implementing such programmes to be more challenging. Nonetheless, researchers have suggested that even in linguistically diverse contexts there are pedagogical approaches that can help minority language learners draw from and expand on their knowledge of the L1. Doing so has benefits not just on literacy skills in the L2 but also valorises the home language of the learner.

The development of literacy consists of a significant number of variables, many of which were not discussed here (including the home language and learning environment, socio-political and socio-cultural dimensions). In this chapter the focus was primarily on the development of linguistic knowledge, such as vocabulary and oral language skills. However, as we move forward in considering how literacy skills develop in the growing population of minority language learners, we need to factor in all the complexity that entails in order to best understand and then in turn support the developing literacy of these linguistically diverse children.

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CHAPTER 9

CHILDES for bilingualism

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The CHILDES archive has revolutionized the study of bilingual development. We review the available corpora and their properties, some methods that have been used in creating and analyzing corpus data, and the kinds of analyses that it has made possible. These points are illustrated with corpus data from Cantonese-English and other corpora documenting bilingual development.

1. Introduction

The Child Language Data Exchange System (CHILDES, pronounced as a single syllable) was established by Brian MacWhinney and Catherine Snow in 1984 to facilitate exchange of child language data (MacWhinney, 2000).[1] It has served the language acquisition research community for over three decades and will remain a powerful and unparalleled resource for many years to come. Originally documenting monolingual development, the archive was subsequently extended to include bilingual corpora. The inclusion of bilingual and trilingual developmental data in CHILDES marks a major step towards documenting the diversity of children's paths to bilingualism and beyond.

Under the dynamic leadership of its Director, Brian MacWhinney, CHILDES has achieved standardization of transcription formats, shared codes, and shared analysis programs which go way beyond the idea of a data repository. Over the last thirty years and more, it has fueled many technological advances in the theoretical and empirical study of child language across monolingual and bilingual contexts.

In this article, we review the corpora available for studying bilingual development as of 2017, the methods that have been used and some of the issues that can be addressed using the corpora, including cross-linguistic influence, language

1. Prof. Brian MacWhinney, Director of CHILDES discusses the gestation and evolution of the CHILDES archive in a 2007 interview with Virginia Yip at <https://www.youtube.com/watch?v=UZOmlxeptUQ>.

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dominance and code-mixing. These points are illustrated with cases from our work on Chinese-English bilingualism and other corpus-based studies.

2. Corpora documenting bilingual development

We first review the corpora documenting bilingual development which were available in the CHILDES archive as of 2016.

2.1 Language pairs

Let us first consider the pairs of target languages being acquired. We adopt the convention whereby the bilingual child's languages are termed language A and language α, so that neither language is assumed to take priority over the other (De Houwer, 2009). Assuming that there are around 6909 languages used around the world (Lewis, 2009), there are 23,863,686 possible language pairs that children might be acquiring. Naturally, only a tiny fraction of these combinations has been investigated so far.

As of 2016, the bilingual folder of the CHILDES database contained 32 corpora. They include longitudinal corpora and speech data collected across different contexts and elicited by different methods including the 'frog story' as in the corpus contributed by Carmen Silva-Corvalán (see Table 1). Some are tagged with part-of-speech markers for analysis, others not. In some corpora, transcripts are linked to audio and/or video files. The corpora available through CHILDES for the investigation of bilingual children's language development include a range of data sets representing different language pairs, age ranges and acquisition environments.

Table 1. Corpora for bilingual language acquisition involving Indo-European language pairs (based on MacWhinney, 2016)

Corpus	Languages	Ages	N	Comments
1. Almeida Transcripts Video	Portuguese-French	1;0–3;10	1	PHONBANK
2. Amsterdam Transcripts Audio	3 French-Dutch, one Italian-Dutch	2–5	4	unlinked for one child
3. BiSLI Transcripts	Russian-Dutch and Russian monolinguals with and without SLI	3–9	1058 transcripts	Narratives
4. DeHouwer Transcripts Audio	Dutch-English	2;7–3;4	1	case study in Netherlands, unlinked

Table 1. (*continued*)

Corpus	Languages	Ages	N	Comments
5. Deuchar Transcripts Audio	Spanish-English	1;3–3;3	1	case study in UK, unlinked
6. FerFuLice Transcripts Audio	Spanish-English	1;0–6;5	2	twins in Valladolid, unlinked
7. Genesee Transcripts	French-English	1;2–4;0	5	study of language selection in Montreal
8. Ionin Transcripts	Russian-English	2;4–12;5	22	wide age range
9. Klammler Transcripts Audio	Italian-German	1;9–2;1	1	short-term case study, unlinked
10. Koroschetz Transcripts Audio	Italian-German	2;9–2;11	1	short term case study, unlinked
11. Krupa Transcripts	Polish-English	6;2–8;0	1	longitudinal case study
12. MCF Transcripts Audio	Portuguese-Swedish-English	0;1–5;7	3	linked, with IPA
13. Perez Trancripts Audio	Spanish-English	1;3–3;3	6	short-term longitudinal, study of input, unlinked
14. ProjectS Transcripts	English-Italian-Scottish Gaelic	2;3–3;7	1	longitudinal case study
15. Serra Transcripts	Spanish-Catalan	0;10–4;4	10	five monolingual Catalan, one monolingual Spanish, four bilingual
16. Silva-Corvalán Transcripts Audio	Spanish-English	5–6	8	some audio, not all linked
17. Ticio Transcripts	Spanish-English	1;6–2;4	1	longitudinal case study
18.vanOosten Transcripts	Italian-Dutch and Dutch monolinguals	4–13	20	study of separate systems effects
19. Vila Transcripts	Spanish-Catalan	1;9–5;4	1	longitudinal case study
20. Watkins Transcripts	French-English	1;3–7;2	7	various ages
21. ZAS Transcripts Audio	Russian-German	3;11–7;0	80	story descriptions, unlinked audio only for Russian

As shown in Table 1, the Indo-European languages remain heavily over-represented: out of a total of 32 corpora, 21 involve Indo-European language pairs or triplets. Just as English and other Indo-European languages are greatly over-represented in linguistics at large, so in bilingual development an overwhelming number of studies include English as one of the target languages, while an even higher percentage involves one or more European languages. English is represented in 12 corpora, Spanish in 7 corpora, Italian in 5 corpora, Dutch, French in 4 corpora, German and Russian in 3 corpora, Catalan and Portuguese in 2 corpora, Polish, Scottish Gaelic and Swedish in 1 corpus.

Despite the disproportionate representation of Indo-European languages, the CHILDES database also includes a variety of non-Indo-European languages. Table 2 shows the 11 corpora in which a non-Indo-European language pairs with an Indo-European one (Arabic-Dutch, Chinese-English, Japanese-Danish, etc.) and two involve trilingual children acquiring Japanese, Danish and English in one case and Farsi, Hungarian and English in the other. Thus all the datasets listed still involve an Indo-European language (or two, in the trilingual cases). Among these 11 corpora, a Chinese language, either Mandarin or Cantonese is represented in 5 corpora, Japanese in 2, Dutch, Farsi, Hebrew and Hungarian in 1 corpus.

Table 2. Corpora for bilingual language acquisition involving a non-Indo-European language (based on MacWhinney, 2016)

1. CUHK Transcripts Audio/Video	Chinese-English	2–4	7	small samples recorded by Hong Kong students
2. FallsChurch Transcripts Audio	Japanese-English	1;7–2;7	1	case study in Virginia, unlinked
3. Hayashi Transcripts	Japanese-Danish-English	1;0–2;6	1	case study in Denmark
4. Guthrie Transcripts	Chinese-English	6;4–8;0	14	classroom interactions in first grade
5. Hacohen Transcripts Audio	Hebrew-English	1;9–2;4	1	case study in Israel, unlinked
6. Navracsics Transcripts	Farsi-Hungarian-English	2–5	12	longitudinal recordings
7. Seba Transcripts Audio	Arabic-English	5;3–6;2	1	story retellings at four times, linked
8. Mandarin Transcripts Audio	Mandarin-English	4;0–4;2	2	five short recordings, linked
9. Paradis Transcripts	English-Various	4–8	25	three recordings from each child
10. Singapore Transcripts Audio	English-Mandarin	4–5	55	Linked
11. YipMatthews Transcripts Audio&Video	Cantonese-English	1;3–4;6	8	large longitudinal corpus linked to audio and video

The significance of the genetic and typological distance between a pair of languages being acquired is not yet well understood, but some aspects of it can be outlined here. Most obviously, if the languages being acquired are genetically related and/

or have a history of contact, there will be lexical items deriving from a common source. If the study involves Germanic languages, there will be related words such as German *mein*, Dutch *mijn* and Swedish *min* 'my', all being related to English *mine*. Such cognate words may facilitate, hinder or otherwise affect development. To what extent will such cognate words make the acquisition of the target languages easier or more challenging is an open issue. They are assumed to be generally facilitative, although in the case of 'false friends' (i.e. cognate but different in meaning) they may be misleading: *mine*, for example, no longer functions as a determiner as the cognate Germanic words do (German *mein Mann* 'my husband'). Cognate words may also function as triggers for code-mixing (Kootstra, Van Hell, & Dijkstra, 2012).

Typological distance between a pair of languages can influence bilingual development in various ways. If the languages share certain typological features, there will be points of structural overlap between them, which may be loci of code-mixing and/or cross-linguistic influence. For example, Cantonese and English are both SVO languages, with several points of structural overlap which facilitate syntactic transfer (Yip & Matthews, 2007: 208). Structural overlap between the target languages is thought to be a condition for the occurrence of cross-linguistic influence, following Hulk and Müller (2000). For example, there is some overlap between *wh*-questions in Cantonese and English. In Cantonese, essentially all question words are 'in situ' as in (1). Similarly, in English 'echo' questions, *wh*-phrases are in situ as in (2):

(1) Keoi5 gong2 mat1je5?
3SG say what
'What did he say?'

(2) He said WHAT?

This overlap appears to be crucial in the occurrence of transfer in bilingual children, many of whom produce 'in situ' *wh*-questions as in (3):

(3) You eat what?
[sees father having breakfast] (Sophie 2;08;03)

If the languages are so different that there are no points of overlap between them, theoretically no cross-linguistic influence will occur. Typologically distant language pairs such as English and Japanese have relatively few points of overlap. This may account for the lack of cross-linguistic influence observed in studies of Japanese-English development (Mishina-Mori, 2005) and Korean-English development (Park-Johnson, 2016). In these SOV languages, the 'in situ' configuration illustrated in the Korean example does not overlap with that in English (2). This is illustrated by a Korean object question (4) given by Park-Johnson (2016: 2).

(4) sunhi-ka nuku-lul pwasse
S.-NOM who-ACC see-PAST
'Who did Sunhi see?'

Given the word order 'Sunhi who saw?' there is no basis for transferring the in-situ structure from Korean or Japanese to English.

If the languages are so similar that they overlap extensively, cross-linguistic influence is predicted to occur. Typically, it will take the form of positive transfer which will facilitate language development but will not be detectable, as it results in target-like performance. This effect is difficult to study, and therefore remains poorly understood; it may however be manifested as acceleration relative to monolingual acquisition of the same property.

2.2 Longitudinal corpora

Longitudinal corpora are compiled by regular audio and/or video recording and transcription of individual children over an extended period of time. Ideally, the transcripts are linked to the original audio and/or video files. All the transcripts in the CHILDES database use a standard format for transcription: CHAT, which stands for Codes for the Human Analysis of Transcripts, which facilitates searching and analysis using the CLAN (Computerized Language Analysis) program.

A comprehensive longitudinal picture would cover language development from birth to adolescence and adulthood. Yet it is in the nature of research projects that this ideal is almost never feasible. Instead, the lifetime of grants and research projects means that few longitudinal datasets extend beyond one to two years of development, as seen in Tables 1 and 2.

2.3 Cross-sectional corpora

Cross-sectional corpora document responses of different age or proficiency groups to the same task typically involving a larger number of participants than longitudinal corpora. An issue here is on what basis bilingual children can be put into groups. In monolingual studies, groups are assembled according to chronological age or school year. For bilingual children, additional variables such as language dominance complicate the assignment of children to groups. Many studies have an A-dominant group, an α-dominant group, and sometimes a 'balanced' group', as in Nicoladis (2006). Since dominance is a matter of degree, the cut-off between 'dominant' and 'balanced' is necessarily arbitrary (see below on measuring language dominance).

2.4 Heritage language corpora

The recent surge of interest in heritage language development has given rise to longitudinal corpora documenting heritage children's bilingualism. Heritage children are typically born and raised in as second or third generation in an immigrant family (Benmamoun et al., 2013; Mai et al., 2016; Montrul, 2015). A methodological innovation developed for studying heritage development involves data collection via video conferencing. While most of the existing bilingual corpora in CHILDES are built upon speech data of adults interacting with children in the same room, recent advances in information technology provide researchers with exciting alternatives. For example, in a child heritage Chinese corpus being constructed by Mai and Yip at the Chinese University of Hong Kong, American-born Chinese children residing in the US are regularly recorded by their parents in Chinese at home, and interact with research assistants in Chinese and English in Hong Kong via Skype video call services. With the popularization of personal computers and the internet, the equipment needed for high-quality video calls have become readily accessible to families. The combination of traditional home-recording and online video calls captures both parent-child interaction in the heritage language and adult-child interaction in the societal dominant language, in this case, English, which aligns with the one context-one language ecology of heritage bilingualism. Thanks to the relatively lower cost and greater flexibility of the Skype data collection method, it is feasible to track the language development of three Chinese heritage children across bilingual and trilingual contexts for periods longer than similar corpora in CHILDES (Mai & Yip, 2017): Arash (3;11–6;03), Luna (1;10–5;02), and Winston (1;0–3;07). With the availability of such heritage corpora, issues of incomplete acquisition under less-than-optimal acquisition conditions, language attrition and maintenance can be addressed more systematically. Web-based speech data recording crosses borders and supplements traditional home-bound recording normally conducted by home visits.

2.5 Monolingual corpora as controls

In order to explain some developmental feature in terms of bilingualism, reference needs to be made to a comparable monolingual data set serving as a control. For many languages (including Cantonese) such monolingual corpora are available through the CHILDES database. Unsworth and Blom (2010) discuss how such comparisons can be used to address theoretical and practical questions. For example, certain non-target syntactic features are observed in bilingual children's

Cantonese (Yip & Matthews, 2007). Bilingual children produce locative prepositional phrases following the verb (where Cantonese requires it to precede the verb), as in (5):

(5)	Ngo5	daa2	din6waa2	hai2	li1dou6	(Llywelyn 2;08;08)
	I	call	telephone	at	here	

‘I’m making a call here.’

In dative sentences such as (6), the indirect object *keoi5* ‘him’ is placed before the direct object *zyu1gwu1lik1* ‘chocolate’ rather than after it as in the adult counterpart:

(6)	Bei2	keoi5	zyu1gwu1lik1	laa1	(Timmy 2;07;04)
	give	him	chocolate	SFP	

‘Give him chocolate!’

In principle, these non-target features could be developmental errors general to Cantonese-speaking children, or English-influenced features specific to Cantonese-English bilinguals. In order to establish these points, comparable monolingual data are called for to serve as a baseline for comparison with bilingual data. Comparison of bilingual and monolingual corpus data shows that the non-target word order in (5) is not found in monolingual children, so that cross-linguistic influence from English is implicated here. The word order in (6), by contrast, proves to be a general developmental feature of child Cantonese across monolingual and bilingual groups (Chan, 2010). However, the non-target word order exemplified in (6) occurs more frequently in Cantonese-English bilinguals, and persists for a longer period than in monolinguals, so that cross-linguistic influence is implicated in both cases (Yip & Matthews, 2007).

An important methodological issue here is whether true monolinguals exist in the relevant populations. An extreme case is that of Singapore, where there are essentially no monolingual speakers to serve as controls (Chen, 2003). In Hong Kong, monolingual children are almost as rare. In Yip and Matthews’ (2007) study of Hong Kong bilingual children, the Hong Kong Cantonese Child Language Corpus (Lee et al., 1996) was used to generate control data. Bilingual children were found to over-generate locative Prepositional Phrases (PPs) following the verb as in (5) above. The ‘monolingual control’ children did not, with the exception of one child who consistently placed the locative PPs after the verb. The explanation was to be found in the CHILDES database manual where it is note that this particular child, LTF, spoke ‘something English-like’ with his Filipino domestic helper.

Monolingual controls can be matched by age and/or by Mean Length of Utterance (MLU). Liceras and Fernández-Fuentes (2016) compared the bilingual twins from the FerFuLice Spanish-English corpus (item 6 in Table 1) with monolingual children. The four children (English-Spanish bilingual=Simon, Leo, Spanish monolingual=María and English monolingual=Naomi) are matched by MLU as shown in Table 3. Thus the MLU range for the bilingual child Leo's English throughout the corpus (1.000–3.018) is within that of the monolingual child Naomi (1.058–3.689). The authors acknowledge that ideally the children would be matched by ages as well as MLUw, but this is rarely possible and MLU is considered a closer match.

Table 3. Data selection (Liceras & Fernández-Fuentes, 2016: 13)

Child	**Age range**	**MLUw range [Spanish]**	**MLUw range [English]**	**Corpus [CHILDES]**
Simon [EN/SP]	1;10–2;11	1.070–3.705	1.000–2.765	FerFuLice
Leo [EN/SP]	1;10–2;11	1.143–3.438	1.000–3.018	FerFuLice
María [SP]	1;07–2;06	1.481–4.647	–	López-Ornat
Naomi [EN]	1;06–2;07	–	1.058–3.689	Sachs

3. Processing of corpora

After data have been recorded, a series of steps need to be followed in order to render them usable. Transcription is usually the first step. Using CLAN software, transcription can be done by displaying the waveform of the recording. Selecting chunks of sound to transcribe is more efficient than merely listening continuously.

For a number of languages, programs are available which automatically 'tag' items on the main tier. The program uses a lexicon for the language and assigns a part of speech 'tag' to each morpheme it is able to recognize. This provides an initial morphological analysis on a tier named %mor (morphology). Figure 1 shows a sample transcript from the Tong corpus of Mandarin at age 2;5;30 (Deng & Yip, 2017). The %mor tier provides grammatical information and glosses for the morphemes transcribed: for example, *ni*3=you indicates the pronunciation of the pronoun with the third tone using the numeral 3, glossed as 'you'. Note the video window which plays the highlighted section of the recording.

@Begin

@Languages: zho

@Participants: CHI Target_Child, MOT Mother, GRA Grandmother, FAT Father

@Birth of CHI: 17-JUN-2011

@Media: audio 131215; video 131215

@Date: 15-DEC-2013

@Transcriber: Zhong Jing

@Location: Shenzhen, Guangdong Province, China

@Situation: playing with mother at home

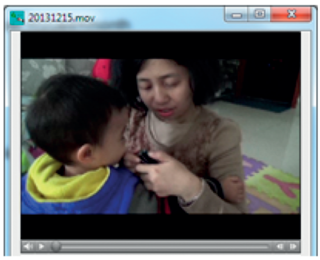
…

*MOT: 同同，你 先头 拿 那 几 个 桶子 来 跟 我 说 什么 啦 ?

%mor: n:name|tong2tong pro|ni3=you n|xian1tou2=earlier_time v|na2=hold pro|na4=that num|ji3=several class|ge4 n|tong3-NOM=pail v:dirc|lai2=come prep|gen1=with pro|wo3=I v|shuo1=say pro:wh|shen2me=what sfp|la1 ?

*CHI: <你 你> [/] <你 拿> [/] 你 拿 一 个 我 拿 一 个 .

%mor: pro|ni3=you v|na2=hold num|yi1=one class|ge4 pro|wo3=I v|na2=hold num|yi1=one class|ge4 .



*MOT: 好 啊 !

%mor: co|hao3=good sfp|a1 !

*MOT: 你 把 那 个 桶子 放 到 哪里 去 了 ?

%mor: pro|ni3=you prep|ba3=object_marker pro|na4=that class|ge4 n|tong3-NOM=pail v|fang4=put v:resc|dao4=get pro:wh|na3li3=where v:dirc|qu4=go sfp|le ?

*CHI: 放 在 你 的 电脑 后面 .

%mor: v|fang4=put prep|zai4=at pro|ni3=you poss|de n|dian4nao3=computer post|hou4mian4=behind .

…

@End

Figure 1. Sample transcript of Tong's speech data at 2;5;30

The %mor tier as generated automatically will normally contain a number of errors and inaccuracies calling for manual checking, disambiguation and correction. For example, the English *that* may be a demonstrative or a complementizer. These cases need to disambiguated either by hand or by using advances in automation. The %mor program can 'learn' by being run on manually tagged data sets. Figure 2 shows a sample English transcript from a Cantonese-English bilingual child, Darren at age 3;10;10.

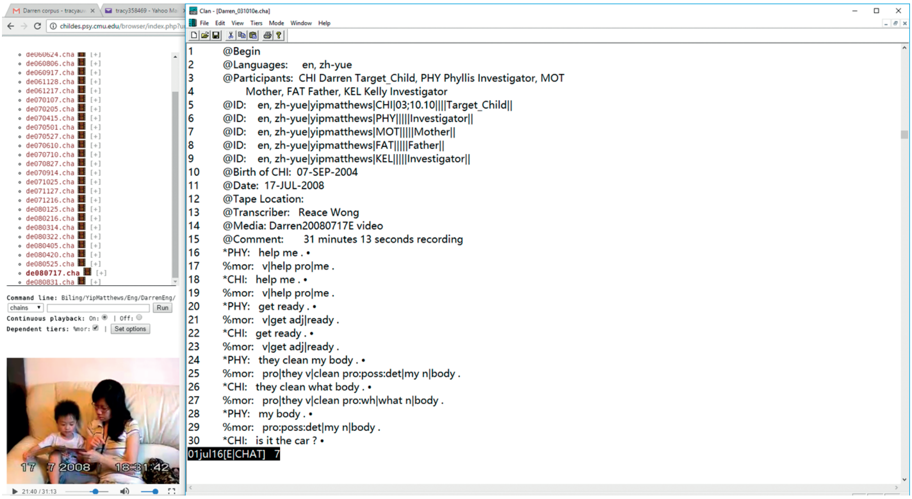


Figure 2. Sample transcript of Darren's English data at 3;10;10

3.1 Linked corpora

Tables 1 and 2 above specify which corpora are linked to audio and/or video recordings. This linkage creates multimedia corpora. While many kinds of analysis can be done with transcripts alone, the advent of linked corpora greatly enhances the potential of the data. To begin with, browsing is enriched since one can watch the action onscreen or listen to the speech while following the transcript (see Figure 1).

Multimedia corpora also allow qualitative analysis to be enriched. For example, a study may aim to focus on null subjects and objects. With the transcripts alone one can calculate the percentage of null subjects and objects, but the reader is left to guess what the child is referring to when she says, for example, 'eating'. With a video recording linked to the transcript, it may be possible to establish who is eating what. This makes it possible to test the analysis proposed in Yip and Matthews (2007: 148) according to which bilingual children use null objects in their English which are qualitatively like those in their Cantonese. This means that the missing object is present or inferable from the context, as in the diary entry (7).

(7) You get, I eat
[father takes chocolates off shelf] (Timmy 2;02;03)

In (7), the missing object of the transitive verbs *get* and *eat* is understood to refer to a box of chocolates, which would not have been known if not for the note provided to indicate the context. Video recordings linked to the transcripts make it possible to investigate this phenomenon systematically by identifying the referents of the missing objects. Zhou (2015) used video-linked transcripts to establish whether the missing object was subjected to joint attention by a child and an adult interlocutor.

Analysis using CLAN

Once transcription has been accomplished, several approaches to the analysis of transcripts may be considered.

A preliminary picture of the data contained in a corpus can be obtained by browsing through a transcript. This is particularly valuable where the audio or video files are linked to the transcripts. The browsable format allows the researcher to follow the transcript with a window showing the accompanying video or playing the linked audio file, as in Figures 1 and 2 above. This browsing method may even be necessary in order to investigate certain phenomena of interest. For example, we might wish to investigate children's use of right-dislocation as in (8) where the subject *this turtle* is 'dislocated' to the right.

(8) Have two legs, this turtle. (Timmy 2;11;12)

Because it involves no unique key words, right-dislocation cannot be searched automatically, and must be identified manually by browsing through transcripts. This 'manual' method was used to identify right-dislocation in the YipMatthews Cantonese-English corpus (Ge, Matthews, Cheung, & Yip, 2017).

However, the Computerized Language Analysis (CLAN) software allows many investigations to be carried out automatically. Constructions involving a specific grammatical morpheme can be searched using the concordance command KWAL (Key Word And Line). For example, to generate examples of the Chinese 把 BA construction from a corpus, the grammatical morpheme *ba* can be searched as a keyword. The KWAL command allows the researcher to search for all occurrences of a key word together with the line(s) of the text in which it appears. For example, to find the 把 BA construction in a Mandarin Chinese corpus, a search string kwal + s "把"–w5 + w2 + t*CHI *.cha may be used, as in a study using the multimedia Tong corpus of Mandarin (Deng and Yip, in press). In this command, + s "把" specifies the Chinese character 把, as the morpheme 把 *ba* is written, and + t*CHI specifies the child tier (+ t*MOT could be used to search for examples produced by the mother as seen in Figure 2). To provide the context for the target utterance, a command such as -w5 is added to include the 5 lines preceding the use of 把 *ba* and + w2 to include the two lines after the line containing the key word. The specification *.cha instructs the command to search all the CHAT format files in the selected directory.

The FREQ (Frequency) command computes the frequency of words used by the target child or speaker. The output of the search represents the number of times an item is used by the target speaker in the sample analyzed, together with the number of occurrences. For example, FREQ + t*CHI + s“that” ke*.cha will output the frequency of *that* in each of Kathryn’s English transcripts as shown in Figure 3.

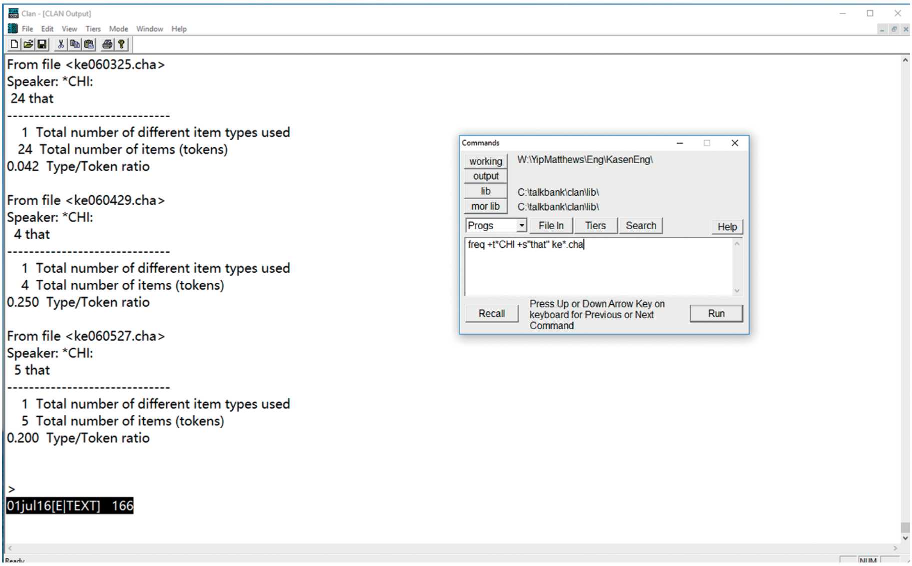


Figure 3. Sample output of FREQ command

3.2 Assessing language dominance

Language dominance is a traditional notion which remains part of many theories of bilingualism and bilingual development (Grosjean, 2008; Lanza, 2004). A controversial issue has been how to operationalize and measure the construct (De Houwer, 2009; Müller, 2003). Various approaches to this problem are discussed in Silva-Corvalán and Treffers-Daller (2015). Measures of language dominance include Mean Length of Utterance (MLU), Upper Bound and lexical diversity (VOCD) in the two languages.

A number of studies have used contrasts in Mean Length of Utterance (MLU) as an indication of language dominance (Bernardini & Schlyter, 2004; Cantone, 2007; Müller, 2003). MLU can be calculated easily using the MLU command in CLAN program. It should be noted, however that the MLU values so generated depend very much on the transcripts used: in particular, on the decisions made by researchers as to what is a word, and what constitutes an utterance.

MLU can be measured in word (MLUw) or morphemes (MLUm). A higher MLU indicates a dominant language only if the languages are comparable in overall morphological complexity. In a morphologically complex such as Hungarian, we expect high MLUm and low MLUw values. Cantonese and Thai are morphologically isolating languages with little morphological complexity, and little difference between words and morphemes, especially in child language. In response to these concerns, Yip and Matthews (2006, 2007) propose using MLU differentials (the difference between MLU values for a child's two languages) as a relative measure of the development of each language. Yip and Matthews (2006, 2007) formulated MLU differential as follows:

MLU differential: the difference between MLU values for a child's two languages at a given sampling point, or (expressed as a mean) over a period of development.

The mean MLU differential is therefore the mean MLU for language A minus the mean MLU for language α. The differential may also be expressed in proportional terms as a percentage: the MLU for language A as a percentage of the MLU for language α. For example, in the YipMatthews corpus, Sophie shows a MLU of 2.5 in Cantonese versus 1.73 in English. This gives an MLU differential of 0.85, indicating dominance of Cantonese. Charlotte, acquiring the same pair of languages, shows an MLU of 1.74 in Cantonese and 2.33, giving a differential of –0.59 and indicating dominance of English (Yip and Matthews 2007: 80).

Table 4. MLU differential of Sophie and Charlotte

	Sophie (1;06;00–3;00;09)	**Charlotte (1;08;28–3;00;03)**
MLU (Cantonese)	2.58	1.74
MLU (English)	1.73	2.33
MLU differential	0.85	–0.59
MLU ratio (%)	149	75

Upper Bound (UB) is a measure of the longest (and presumably most complex) utterance in a sample. UB is used alongside MLU by Bernardini and Schlyter (2004) to quantify the difference between Swedish as the stronger language and French or Italian as the weaker language in the children studied.

3.3 Investigating code-mixing

To pursue qualitative and/or quantitative analysis of code-mixing, it is necessary to identify and extract instances of code-mixing from a corpus. Again, this can be done by hand, but tagging of mixed items allows for efficient automated searching.

In CHAT format, a postcode @s may be added following each code-mixed expression. In Yip and Matthews's (2016) study, examples of code-mixing were extracted from the corpus by using the Key Word and Line (KWAL) command of the CLAN program to search for items marked by the postcode '@s' in the CHAT transcripts. For example, in (9) the Cantonese verb-object compound 沖涼 *cung1-loeng4* 'take a shower' inserted as the complement of *want* is marked by the postcode '@s':

(9) I want 沖涼@s (Alicia 2;06;13, English context)
I want Shower
'I want to take a shower.'

Since the principal language of this transcript is English (as stated in the 'header' at the beginning of the transcript) the Cantonese expression 沖涼 'take a shower' is tagged with a postcode @s. By quantifying the cases extracted in this way, Yip and Matthews (2016) showed that code-mixing rates are asymmetrical: mixing is more prevalent in the Cantonese than the English recording context. By conducting similar searches among adult utterances in the corpus, this asymmetry can be shown to be a property of the input to children: parents are more likely to insert English items in a Cantonese utterance than vice versa.

A more complex coding is used in Deuchar, Donnelly, and Piercy (2016). In a corpus with Welsh as the default language, English items are tagged with the postcode @s:eng. Some items are of indeterminate status: since they could be English words or loan words, these are coded @s:cym&eng (Welsh and English). A sample line of transcript reads:

(10) *JAQ: mi ges i heddiw # crackers@s:cym&eng # a
egg@s:eng mayonnaise@s:cym&eng
%gls: PRT get I today crackers and egg mayonnaise
%eng: Today I had crackers and egg mayonnaise

The word *egg* is clearly code-mixed, whereas *crackers* and *mayonnaise* exist as loan words in Welsh and thus cannot be assigned to English or Welsh.

3.4 Input analyses

With the development of usage-based theories, it is especially important to compare performance data from children and caregivers. If input from a child's parents or regular caregivers is represented in a transcript, such comparisons are straightforward. For example, in Ge et al. (2017), Cantonese-English children were found to produce utterances instantiating right-dislocation such as (11):

(11) Very nice, this one. (Alicia 4;02;20)

It is not obvious whether children hear such utterances in their English input, or create them modelled on Cantonese, where a parallel structure is possible. Although few grammars of English recognize the type of dislocation in (11), it does exist in British English, and Ge et al. (2017) found that the structure was attested in the corpus in the input from the child's native English-speaking parent.

In many corpora, the adult input represented is from researchers who interact with the child only in data collection sessions. Although it forms part of the actual input to the child, such input may not be representative of the regular input the child received from caregivers. Such data may serve as a proxy for caregiver input, or at least as samples of child-directed speech.

4. Limitations of corpora

Like other methodologies, using corpora to study bilingual development has some limitations which should be mentioned. Certain features of a target language are unlikely to appear in corpus data, if only because of their low frequency. A case in point is relative clauses, structures of great theoretical interest which are virtually absent from some corpora. Relative clauses are particularly infrequent in Chinese child language corpora. The extensive corpora used in Yip and Matthews (2007) provided virtually no usable examples of relative clauses. Analyses of the development of relative clauses were only possible by using diary data, in which the parent-linguists recorded infrequent structures of interest such as relative clauses. Alternatively, relative clauses may be elicited experimentally, as in Kidd, Chan and Chiu (2015) and Lau (2016).

Right-dislocation (RD) as in (10) above is also infrequent, especially in English. Notley et al. (2007) found no examples of RD in the adult English input in the corpus they used. Ge et al. (2017) calculated that in monolingual children's English, RD occurred in 0.016 to 0.083% of utterances, that is, less that the once per thousand utterances. In order to assemble sufficient examples for quantitative analysis, it was necessary to combine corpus and diary data.

Deeper issues involve constraints on interpretation. Even the richest corpus cannot show whether a child knows, for example, that a reflexive such as *herself* requires an antecedent in the same clause, whereas the Chinese equivalent *ziji* does not. Such questions cannot be answered using corpus data, but call for experimental approaches (see Blom & Unsworth, 2010).

5. Conclusions

The CHILDES archive has revolutionized the study of bilingual development. By disseminating a common standard for transcription and coding, it has facilitated comparison between bilingual children acquiring diverse language pairs, as well as between bilingual and monolingual children acquiring the same target languages. While English and other Indo-European languages remain over-represented, coverage has grown steadily and increasingly over diverse language pairs. The linguistic diversity of language pairs will open up new windows into the processes of bilingual and multilingual development. The more diverse the language combinations, the more windows we have into the possible developmental trajectories and interactions between languages. The CHILDES archive also offers monolingual baseline data for most of the target languages represented in the bilingual corpora.

The software available for use with CHILDES data facilitates quantitative analyses such as computation of MLU which can serve as an index of language dominance. It also facilitates qualitative analysis, notably by generating concordance data for items of interest.

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PART III

Adult bilingualism

CHAPTER 10

Syntactic representations in late learners of a second language

A learning trajectory

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Several studies have shown that syntactic structures can be primed between the different languages of a bilingual. Bilingual production models put forward by Hartsuiker, Pickering, and Veltkamp (2004) and Pickering and Hartsuiker (2008) therefore assume that bilinguals share syntactic structures between languages as much as possible. In this paper, we discuss a model for the development of these shared syntactic structures in late learners of a second language (Hartsuiker & Bernolet, 2017). More specifically, we discuss evidence for three central claims of the model, namely that (1) L2 syntactic representations move from being item-specific to being more abstract, (2) L2 representations become more and more integrated with existing L1 representations, and (3) L1 influences on syntactic processing and production in the L2 occur in early and late phases of L2 syntactic development. Summarizing, syntactic representations in L2 learners differ according to the L2 proficiency of the learner and the syntax of his/her native language.

1. Introduction

Acquiring the syntax of a language is a very complex and multi-faceted process: A learner needs to learn the meaning of lexical items, form syntactic categories, and distill the complete set of rules and processes that govern the structure of sentences from the input in order to learn how syntax reflects the relation between the different elements in a sentence. Children learn their native syntax (or syntaxes, if they are native bilinguals) quite rapidly, and without explicit instruction: In a year's time, their utterances evolve from two-word phrases like "Bye-bye daddy" and "Doggy sit" to complex sentences as "Can I have some milk, please, mommy?". For late learners of a second language, the acquisition of syntax is a stumbling block: It requires much effort and attention, and often some kind of explicit instruction.

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The learning context is in some cases very different for native syntax learning and the late acquisition of second language (L2) syntax: While native syntax is picked up implicitly from interactions with speakers in the child's direct environment, second language syntax may be formally taught when children learn a foreign language at school. Another important difference between native syntax learning and late learning of second language syntax is that in the latter case, the syntax of the first language (L1) is already fully acquired. General metaknowledge of syntactic concepts and systems might aid second language learning, but it could also hinder learners. The knowledge of L1 syntax might lead to 'educated guesses' for the comprehension and production of L2 syntax (e.g. using the same cues for L2 comprehension as for L1 comprehension, see Bates, McNew, MacWhinney, Devescovi, & Smith, 1982), which might require more conscious thought and effort than the 'trial-and-error-processing' that characterizes the acquisition of L1 syntax, but doesn't always lead to fewer errors. Additionally, late learners might not feel as free as children do to produce ill-formed sentences in the process of learning. How do syntactic representations in the second language develop in these late learners and what is the relation between the L1 and L2 syntax? We try to answer these questions by presenting a theoretical model for the acquisition of L2 syntax in late learners of a second language (Hartsuiker & Bernolet, 2017) and discussing the different studies that led to the formulation of this model.

2. A model of the trajectory of late L2 syntactic acquisition

The production model we proposed in Hartsuiker and Bernolet (2017) is an elaboration on the bilingual production models of Hartsuiker, Pickering and Veltkamp (2004) and Pickering and Hartsuiker (2008). Hartsuiker et al. (2004) discovered that syntactic structures can be primed between both languages of a bilingual: Spanish–English bilinguals were more likely to describe pictures in English (L2) using passives when they had just processed a Spanish (L1) passive prime sentence (*El camión es perseguido por el taxi [The truck is being chased by the taxi]*), than when they had processed Spanish actives (*El taxi persigue el camión [The taxi chases the truck]*) or intransitive sentences (*El taxi acelera [The taxi accelerates]*). Hartsuiker et al. (2004) concluded that Spanish–English bilinguals use the same syntactic rules when comprehending and producing Spanish or English passives and activate the same memory representations from both languages. Hence they proposed a lexical-syntactic model for bilingual sentence production in which syntactic information is shared between languages as much as possible. In their model, which is based on Pickering and Branigan's (1998) model of lexico-syntactic representations, information about syntactic structures is represented in combinatorial nodes, which are connected to lemma nodes in a single integrated lexicon. Thus, the lemmas of all Spanish and English transitive verbs are connected to a shared categorical node indicating that these verbs can be combined with two noun phrases in order to form a passive sentence.

In the last few years, numerous studies have shown between-language syntactic priming using a variety of language pairs, constructions, and paradigms (Bernolet, Hartsuiker, & Pickering, 2011; Cai et al., 2011; Kantola & Van Gompel, 2011; Salamoura & Williams, 2007; Schoonbaert, Hartsuiker, & Pickering, 2007; Shin & Christianson, 2012), suggesting that syntactic representations are indeed shared between languages as much as possible. Pickering and Hartsuiker (2008) made the additional assumption that, according to a lexicalist model with fully shared syntax, priming between languages should be of comparable magnitude to priming within a language, because both languages would use one and the same node. In a recent paper we argued that this is probably not true for all bilinguals (Hartsuiker & Bernolet, 2017). Hartsuiker et al.'s (2004) and Pickering and Hartsuiker's (2008) models might capture important aspects of syntactic representations in native bilinguals, who simultaneously developed syntactic representations in both of their languages, and of syntactic representations in late learners of a second languages that have reached a very high level of L2 proficiency. These bilinguals can be expected to show abstract structural priming of comparable magnitude within- and across-languages. For bilinguals who did not yet reach this level of L2 proficiency, we expect between-language priming to be weaker than within-language priming, because their L2 syntactic representations are still under development. In order to be able to make predictions about the L2 syntactic output that can be generated by L2 learners and about the strength of within and between-language priming through the development of L2 syntax, we proposed a developmental model with 5 consecutive stages. In this model, learning is determined by two principles, namely representational specificity and economy: The learning system aims to capture all relevant differences between linguistic representation, but, at the same time, it tries to minimize the number of representations by sharing what can be shared. We assume that explicit memory processes play a large role in the early phases of acquisition, and that longer term learning is caused by Hebbian learning or by the error-based learning of syntactic structures (Chang, Dell, & Bock, 2006).

The different stages of our developmental model for the representation of L2 syntax are depicted in Figure 1. The model shows the learning trajectories for the English s-genitive (s-gen: the boy's doll) and the English post-modified noun phrase (N RC: the ball that is red), structures that can both be combined with the nouns *pop* [doll] and *bal* [ball]. For simplicity's sake, the model only shows two lexical nodes and two combinatorial nodes, while leaving out the other nodes to which these nodes are connected (e.g., the conceptual nodes, the language node, the word category nodes, etc.). The representations of the English of-genitive and the English pre-modified noun phrase are also left out, though we assume that these develop together with their syntactic alternatives, the English s-genitive and post-modified noun phrase. Given that the model represents the stages of late L2 syntactic acquisition, the L1 syntax is already fully represented in the first panel of the figure, which represents the initial stage of acquisition for both structures. We assume that, in this initial stage, L2 acquisition begins with learning of lexical representations without firm connections to syntactic information. A Dutch learner of English as an L2 might have learned simple nouns like 'doll' and 'boy', but might not know which English constructions can be used to express that the doll is owned by the boy (*the doll of the boy/the boy's doll*). If this learner wants to express a possessive relation between both nouns, she can only rely on her knowledge of L1 genitive structures to do the job. Transferring the L1 syntax can lead to transfer errors such as "*It's the doll from the boy (Het is de pop van de jongen)*" and "*It's the boy his doll (Het is de jongen zijn pop)*", but also to correct productions "*It's the doll of the boy (Het is de pop van de jongen)*". Another strategy that learners can use at this stage, is to imitate structures that are produced by more proficient speakers. Production is in this case rather reproductive than creative: A question like "*Shall I wear the red dress or the blue one?*" is likely to elicit parallel responses like *"the blue one"* and *"the red dress"*, but no creative response like *"the red one"*. We assume that these imitations are based on the retrieval of the example sentences from explicit memory. Hence, these repeated or minimally edited L2 utterances only appear quickly after the learner perceived an example sentence. To summarize, in this initial stage of the acquisition of L2 syntax production is characterized by L1 transfer and primed L2 structures in immediate conditions when there is a high lexical overlap between consecutive sentences. Comprehension of L2 syntax is also guided by L1 syntactic preferences at this stage, as no L2 syntactic representations are available yet.

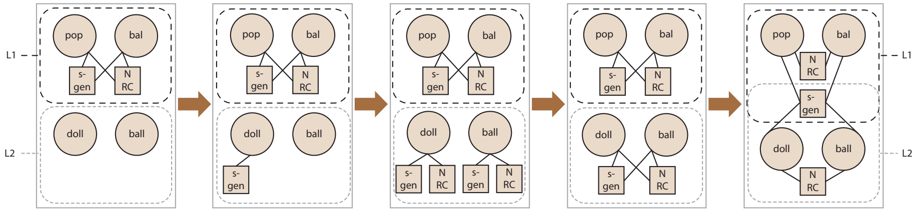

Figure 1. Developmental model. The L1 lexicon is depicted in the upper part of the model, the L2 lexicon in the lower part. To save space only lexical and combinatorial nodes are shown. *pop* and *bal* are nouns in L1 and *doll* and *ball* are nouns in L2; 'S-gen' and 'N RC' are combinatorial nodes. Consecutive model states during different points of the L2 syntactic acquisition trajectory are shown from left to right

Panels 2, 3 and 4 show the development of syntactic structures in the L2. Panel two shows the stage that immediately follows after the initial contact with a new structure in the L2. We assume that, after a limited number of exposures, L2 learners start to form item-specific representations of L2 syntactic structures. These representations can be structured, if they developed from lexical items (*doll, ball*) that got connected to a syntactic representation (*s-genitive*), but they can also represent formulaic expressions in the L2: Learners might, for example, know that "*We did it!*" indicates success, without knowing that the phrase contains two pronouns and a verb in the past tense. From the moment that a lexically specific syntactic representation is formed, learners will show lexically specific syntactic priming in L2 for this structure, even if prime and target structures do not immediately follow each other, because the priming effects are now based on residual activation of lexically specific structural nodes or the strengthening of syntactic procedures. The explicit memory of the prime structure can, however, still boost the production of the L2 structure, resulting in stronger priming in immediate conditions. As learners are no longer dependent on explicit memory for the production of the new L2 structure, they can produce it spontaneously, without being primed.

Panels 3 and 4 show how the process of abstraction takes place within the L2 lexicon. First, several lexically specific syntactic representations are added to the L2 lexicon, and then syntactic structures are formed that abstract across multiple words in the L2. Thus, we assume that L2 syntactic representations develop separately from L1 syntactic representations in these stages, even though the representations in both lexicons might be quite similar. Based on only a few exposures to a structure with a particular lexical item the second language acquisition system cannot tell how item-specific this structure is in the L2: After encountering one English dative verb in a DO dative construction that is similar to the Dutch DO dative construction, a Dutch learner of English cannot be sure whether this construction can be used for all other dative verbs as well. As the syntactic representations that are formed are still language specific, learners do not show between-language priming for these structures yet. When learners move from stage 3 to stage 4, however, they will start to show lexically mediated and abstract syntactic priming in the L2, as priming will now also result from residual activation of abstract structural representations. Since these representations are generalized across all lexical items they can be used with, learners will be able to use syntactic structures productively from now on, so also with lexical heads they have never perceived in combination with that specific syntactic structure. Note that this process of abstraction is driven by the type and token frequency of syntactic structures in the L2. Abstract syntactic representations will thus emerge earlier for more frequent structures than for structures that are less frequent. Consequently, it is possible that there is an intermediate state between the third and fourth state in our model, in which, for example, the s-genitive is already shared between 'doll' and 'ball', while there are still item-specific representations for the post-modified noun phrase.

Finally, when they have reached a high level of proficiency in the L2, L2 learners get to the final stage of syntactic development, which is represented in panel 5. The situation depicted here is a bit different from the situation depicted in the final panel of the model presented in Hartsuiker and Bernolet (2017). Here, we wanted to make clear that not all syntactic structures are shared eventually: L2 syntactic structures that have no corresponding syntactic structure in the L1 or that are not completely equivalent to their L1 counterpart may keep their language-specific representation in the L2. We assume that that is the case for the representation of post modified nouns in English in the Dutch-English bilingual lexicon. In a study investigating within- and between-language syntactic priming for noun phrases (*the red sheep* vs *the sheep that is red*) in Dutch-English bilinguals, we found no between-language priming for these structures, while we did find within-language priming in Dutch and English (Bernolet, Hartsuiker & Pickering, 2007). We attributed the absence of between-language priming to the word order difference in Dutch and English relative clauses (*het schaap dat <u>rood is</u>* – *the sheep that <u>is red</u>*): Because of this difference in word order, Dutch and English post modified nouns do not share a syntactic representation across languages. [The fact that we did obtain between-language priming between Dutch and German noun phrases, which use an identical word order for pre modified (*het rode schaap* – *das rote Schaf*) and post modified nouns (*het schaap dat <u>rood is</u>* – *das Schaf das <u>rot ist</u>*) lends support to this hypothesis.] Hence, in the last panel of the bilingual syntax model that is depicted here, only the s-genitive is represented in the part of the model that contains the shared syntax. This representation is connected to all nouns in the L1 (Dutch) and L2 (English) lexicon. For post modified noun phrases, the model contains a language-specific syntactic representation (N RC) in the L1, which is connected to all nouns of the L1, and a language-specific syntactic representation in the L2, which is connected to all nouns of the L2. Note, however, that we assume that structures are shared between languages as much as possible, so language-specific representations in the final stage of development should be the exception, rather than the rule. When structures are shared between languages, learners show equivalent syntactic priming within and between languages (but see Cai, Pickering, Yan & Branigan, 2011, who showed an advantage of within-language over between-language syntactic priming). Even in very proficient L2 users, explicit memory mechanisms can co-determine syntactic choices. As we assume a larger role for explicit memory mechanisms when there is a large overlap between consecutive sentences, and because the overlap within languages is always larger than the overlap between languages, stronger within-language priming might be observed in conditions with related head nouns.

3. Key claims of the model

With this model, we made a number of specific claims about the development of L2 syntactic structures in late second language learners. Firstly, we assume that, contrary to syntactic acquisition in L1, L2 acquisition in late learners begins with the learning of lexical representations without firm connections to abstract syntactic information. These item-specific lexical representations become more abstract with increasing proficiency, with abstraction taking place across words within the L2, and eventually also between languages. Our second claim is thus that, across the learning trajectory, L2 representations become more and more integrated with existing L1 representations. Consequently, syntactic processing and production in the L2 becomes more similar to L1 syntactic processing and production as learners become more proficient. Finally, we expect L1 influences on syntactic processing and production in the L2 to occur in two different phases in L2 syntactic development: In the earliest stages, when new syntactic structures of the L2 are first encountered, and in the final stage, when similar syntactic structures are fully shared between the L1 and the L2. In the following sections, we discuss evidence for these three claims.

3.1 L2 syntactic representations in late learners move from being item-specific to being more abstract

As we mentioned before, we assume that L2 learners start out with lexical representations of nouns and verbs, without firm connections to syntactic information. As no L2 syntactic information is available at this stage, learners have to rely on their knowledge of L2 lexical items and L1 syntactic structures for the comprehension of novel sentences in the L2. For the production of a new syntactic structure L2 learners can use two different strategies: Transferring syntax from the L1 or imitating syntax from more competent speakers. The latter mechanism is based on the retrieval of sentences from explicit memory (see Bernolet, Collina, & Hartsuiker, 2016). Consequently, these L2 sentences, which are exact repetitions or minimally edited repetitions of earlier sentences, are only produced immediately after a more proficient speaker has used the 'example sentence'.

In the next stage of acquisition, item-specific representations of L2 structures start to emerge. As we will discuss below, several studies suggest that representations for new L2 syntactic structures can be formed after limited exposure to these structures (Kim & McDonough, 2008; Nitchske, Kidd, & Serratrice, 2010). While the frequency of a specific verb/noun + structure combination determines how quickly an item-specific syntactic structure is represented in memory, the number of different verbs or nouns with which a specific structure is encountered determines how quickly an abstract representation of that structure is formed. Consequently, it is possible that specific verbs are initially only used with structure X, but not with structure Y (second panel Figure 1), and that more frequent syntactic structures in the L2 are abstracted across lexical items earlier than less frequently encountered structures. From the moment that a structure is generalized across lexical items, L2 learners can be primed within L2 to use the syntactic structure in conditions with and without lexical overlap. Eventually, they will be able to use the L2 syntactic structure productively, i.e. in unprimed conditions and with syntactic heads they have not necessarily encountered with this structure before.

Evidence for this abstraction process within the L2 can be found in different studies investigating learning of English as a second language (ESL) by McDonough and colleagues (Kim & McDonough, 2008; McDonough; 2006; McDonough & Mackey, 2006). In 2006, McDonough and Mackey presented an intervention study that was carried out in a group of Thai university students studying English. The L2 learners were all selected to be at the same stage (stage 4) of Pienemann's developmental sequence for ESL question formation (Pienemann, Johnston, & Brindley, 1988, see McDonough & Mackey for further information), so they had a comparable level of proficiency in the formulation of English questions. During the intervention, the L2 learners carried out a series of communicative tasks together with native speakers of English (three sessions in two weeks). These native speakers were either instructed to provide feedback on the learners' production in the form of *recasts* (responding with more targetlike forms whenever the learners produced nontargetlike question forms) or to abstain from giving feedback. Across 3 posttests (immediately after treatment and 3 and 6 weeks later), the results showed a significant effect of recasts on question development: While 23 out of 29 learners in the recast group had advanced to a higher stage in the developmental sequence for question formation, only 2 out of 19 learners in the no feedback group produced more advanced question forms.

Importantly, the investigators classified the learners' responses to the recasts in two different categories. Immediate and exact *repetitions* of the recast in the following turn (see Example 1a, taken from McDonough & Mackey: 705) were discriminated from *primed productions*, in which the learner used the question form of the recast productively to form a new question within 6 turns of the recast (see Example 1b). Further analyses showed that while primed production had a strong positive influence on the odds of development, the mere repetition of recasts in the next turn was not significantly correlated with ESL question development. We suggest that the repetitions could have been based on the retrieval of the recast from explicit memory: They were identical to the recast provided by the native speaker and immediately followed it. Consequently, the structure of these repeated questions did not necessarily have to be represented in memory. Primed productions of question forms, on the other hand, could only have been produced by learners who had already formed abstract representations of these question forms (because they were only called primed productions if they were new questions with different content words using the primed question structure), which is why only primed production during the intervention predicted the spontaneous production of advanced question forms at posttest. To summarize, this study shows that in the very early stages of acquisition learners can use novel sentences in the L2 even if they have no representation for the structure of these sentences by copying (reproducing) prime sentences that are explicitly recalled.

(1) a. Repetition of a recast

[61] Learner: when it happen?	Stage 3 question
[62] NS: when did it happen?	Recast (stage 5)
[63] Learner: when did it happen?	Repetition (stage 5)

b. Primed production (delayed)

[23] Learner: where where where you work this job?	Stage 3 question
[24] NS: Where did I work?	Recast (stage 5)
[25] Learner: yeah	
[26] NS: I worked in America/it was my part time job during high school for three years	
[27] Learner: why did you like it?	Primed production (stage 5)

In a different study, McDonough (2006) investigated the production of dative constructions in a within-language syntactic priming experiment with speakers of English as an L2. The participants in this study were advanced learners of English with a variety of different L1s (Chinese, Korean, Farsi, Portuguese, Serbian, Sinhala, Spanish, Thai and Turkish). The results of the first experiment in this study showed syntactic priming for the PO structure, but not for the DO structure. In fact, the DO structure was very infrequently used overall and when it was used, it was only in combination with a few verbs: The participants produced over half (63%) of the double-object targets with only two verbs, *ask* and *teach*, and did not produce any double object targets with eight of the given verbs (*bring*, *cook*, *cut*, *knit*, *make*, *pass*, *pour*, and *toss*). For comparison: the same participants produced at least 8 PO datives with every single one of the 39 dative verbs in that experiment. According to McDonough, the DO dative is a developmentally more advanced form that is typically dispreferred by English L2 speakers. Consequently, it is possible that most of the L2 learners in the study did not have an abstract L2 representation for the DO structure yet, leading them to only produce item-specific instances of this structure. In order to test whether increased exposure to DO datives would cause syntactic priming for these structures, a follow up experiment only used DO primes in the priming phase. The strong preference for the PO dative was not overturned, but the number of DO responses was significantly higher in the priming phase than in a pre-experimental baseline, suggesting that DO structures could be primed because abstract representations for this structure were formed. Thus, this study is compatible with our claim that L2 learners start out with item-specific syntactic representations in the L2 and that the abstraction process from item-specific to abstract representations in the L2 is driven by the frequency of a specific structure and various verb/noun + structure combinations in the input, leading to earlier abstraction for more frequent structures.

Kim and McDonough (2008) provided additional evidence for the claim that in early stages of L2 syntactic acquisition syntactic processing relies on lexically specific representations rather than on abstract ones. In a study on transitive priming in English as a second language in a group of Korean-English L2 learners they showed evidence for structural priming as well as a lexical boost to priming. When they divided the participants in three groups of low, intermediate and high proficiency on the basis of a cloze test, they discovered that L2 proficiency was correlated with the strength of lexically based priming: All three groups showed stronger lexically based than abstract priming, but the difference between both conditions was largest in the low proficiency group. In fact, low proficiency learners hardly produced any passives when they had to use a different verb than the one used in the prime sentence, indicating that these participants still used lexically specific representations for this structure.

A final study that lends support to the claim that L2 syntactic representations evolve from being lexically specific to more abstract was a study we did on syntactic priming of genitive structures (the wizard's guitar [s-genitive]/the guitar of the wizard [of-genitive]) in Dutch learners of English as an L2 (Bernolet, Hartsuiker, & Pickering, 2013). In one of the two experiments in that study, we primed genitives within the L2 of our participants. Before the experiment, participants rated their proficiency in English on a seven-point scale, so that we could investigate the effect of L2 proficiency on syntactic priming. Importantly, the experiment presented both types of genitive structures in related conditions, in which the head noun had to be repeated in the target structure (the boy's guitar/the guitar of the boy), and in unrelated conditions, in which the head nouns of prime and target constructions were unrelated (the boy's donkey/the donkey of the boy). This way, we could verify whether our participants showed lexically mediated as well as abstract priming for genitives in their L2. The less proficient bilinguals showed very strong lexically mediated, but hardly any abstract priming; more proficient bilinguals showed strong lexically mediated and abstract priming. Because the low proficient bilinguals produced s-genitives only in the repeated noun condition, when the prime construction could be almost completely copied to describe the target picture (as only the owner of the object differed), we concluded that these bilinguals might have several item-specific representations for this construction, instead of a representation that is generalized over different L2 nouns. Because the low proficient participants actually showed stronger priming than more proficient participants in the repeated noun conditions, we additionally assume that explicit memory processes might have played a bigger role in the lower proficiency participants' priming effects than in the priming effects observed for more proficient participants, who generated their responses from scratch.

3.2 Across the learning trajectory, L2 representations become more and more integrated with existing L1 representations

As we mentioned, the final stage in our developmental model represents the situation that Hartsuiker et al. (2004) described in their model. In this final phase of development, abstract syntactic representations in the L2 are merged with abstract syntactic representations in the L1, if the representations are similar enough. From this moment on, the same syntactic representation or syntactic rule is activated and updated during processing in L1 and L2. Consequently, language-specific syntactic preferences may be merged into preferences that generalize across languages. As we will discuss in section 3, the activation of shared syntactic representations might also lead to transfer errors. In any case, complete syntactic sharing, which characterizes the final stage of our developmental model, leads to equivalent abstract syntactic priming within and between languages. Before syntactic structures are shared, however, between-language syntactic priming does not occur, leading to stronger priming within L1 and L2 than between these languages.

Many studies have shown syntactic priming between languages in order to make a case for syntactic sharing in bilinguals (for an overview of this literature see Hartsuiker & Bernolet, 2017 and Pickering & Hartsuiker, 2008). Here we focus specifically on those studies which provide evidence for the claim that L2 learners use language specific strategies and representations for the comprehension and the production of L2 syntactic structures before they move on to the use of strategies and representations that are shared between their L1 and L2.

First of all, there are several neuroimaging and ERP studies which have shown increasing overlap between brain areas recruited for syntactic processing in L1 and L2 with increasing L2 proficiency (see Van Hell & Tokowicz, 2010, for a review of ERP-studies and Van Heuven and Dijkstra, 2010, for a review of neuroimaging data). The general pattern observed in most of these studies is that highly proficient bilinguals show native-like patterns for L2 processing, while low proficient bilinguals show very different patterns for the two languages. In an fMRI study with late French-English bilinguals, for example, left prefrontal activation peaks – which the authors assumed to signal syntactic processing – were found to be much closer during syntactic production in L1 and L2 in more compared to less grammatically proficient bilinguals (Golestani, Alario, Meriau, Le Bihan, Dehaene, & Pallier, 2006). Thus this study suggests that L2 learners only move to a stage in which similar syntactic processing takes place in L1 and L2 after they have had sufficient exposure to the L2 syntactic structures that are being learned. Before that moment, L2 specific representations guide comprehension and production in the L2.

Evidence for the claim that L2 proficiency influences syntactic sharing was also found in a between-language syntactic priming experiment with Dutch and English genitive constructions (Bernolet et al., 2013). In this experiment, which was the between-language priming analog of the priming experiment discussed in the previous section, we used spoken Dutch genitive constructions to prime the use of English genitives (the boy's guitar [s-genitive]/the guitar of the boy [of-genitive]). Also in this experiment, both types of genitive structures were presented in conditions with related head nouns, in which the head noun of the target sentence was a translation equivalent of the head noun of the prime sentence (Example 2 a&b), and in unrelated conditions, in which the head nouns of prime and target constructions were unrelated (Example 2 c&d). Overall, we obtained significant between-language priming for genitives and a translation equivalence boost to this effect: Stronger priming was observed in the related condition (23% priming) than in the unrelated condition (6% priming). More importantly, the priming effects in both conditions were modulated by participants' self-rated L2 proficiency: The more proficient the participants were, the stronger the priming effect. In fact, the participants with the lowest proficiency did not show any between-language priming at all, indicating that they had separate representations for English and Dutch s-genitives: Though the low proficiency participants sometimes used English s-genitives (mainly in the beginning of the experiment), the Dutch primes had virtually no effect on the response patterns.

(2) TARGET: wizard holding a green guitar

a.	De gitaar van de jongen is groen [The guitar of the boy is green]	of-genitive, related
b.	De jongen zijn gitaar is groen [lit. The boy his guitar is green (boy's guitar)]	s-genitive, related
c.	De ezel van de jongen is groen [The donkey of the boy is green]	of-genitive, unrelated
d.	De jongen zijn ezel is groen [The boy his donkey is green]	s-genitive, unrelated

Recently, we reanalyzed syntactic priming data of Schoonbaert et al. (2007) in order to verify whether the influence of L2 proficiency on syntactic sharing could be generalized to other structures (in this case L2 datives) as well (Hartsuiker & Bernolet, 2017). English genitives are quite hard to learn for Dutch-English bilinguals like the ones who participated in our 2013 study (Bernolet et al., 2013), as the spoken form of the Dutch s-genitive differs from its English counterpart in terms of morphological realization: Whereas the Dutch genitive uses a possessive pronoun that takes the gender and the number of the possessor it refers to (zijn [his]/haar [her]/hun [their]), the English variant uses the same bound morpheme ('s) for all nouns and possessors it combines with (see Examples 2b & d above). This difference in the realization of the possessive element increases the risk of making transfer errors (e.g. *the nurse her shoe is green* was one of the 42 transfer errors observed in our between-language priming experiment), which might lead to a longer learning trajectory for English genitives than for structures like datives, for example, where the Dutch and English variants are literal translations. As Dutch-English bilinguals might need less exposure to English dative structures to go through all of the developmental stages in our model, we hypothesized that effects of L2 proficiency on between-language priming would be smaller or even non observable in Schoonbaert et al.'s (2007) data on between-language priming for datives. Nevertheless, we found clear effects of L2 proficiency: In the related condition, in which the head verbs of prime and target constructions were translation equivalents (geven-give), as well as in the unrelated condition, the between-language priming effects increased together with the participants' self-rated proficiency in their L2. Even though the DO and the PO dative are much more similar between Dutch and English than of- and s-genitives, lower proficiency L2 speakers do not seem to have abstract, language-independent representations yet for this structure. Thus, the results of our reanalysis of the Schoonbaert et al. (2007) data suggest that the proficiency effects in the production of English genitives are not structure-specific, but rather reflect a strategy by which new syntactic representations in L2 are kept separated from their L1 counterparts in the early stages of L2 syntactic acquisition.

Finally, a study by Runnqvist, Gollan, Costa, and Ferreira (2013) provided evidence for the claim that the evolution from language-specific to shared syntactic representations entails that language-specific syntactic preferences are merged into preferences that generalize across languages. In this study, response times for the initiation of English transitives and genitive constructions were measured for three different groups of participants: English monolinguals, Mandarin-English bilinguals, and Spanish-English bilinguals. Crucially, the genitive constructions that were used in their study (the woman's stroller is pink/the stroller of the woman is pink) have different relative frequencies in Spanish, Mandarin, and English. In English, both alternatives are used for the possessive, but pre-modified possessive NPs (s-genitives) are more frequent than post-modified possessive NPs (of-genitives). In Mandarin, however, possessive NPs are always pre-modified, while in Spanish all non-pronominal possessive NPs are post-modified. The English monolinguals in this study were faster to initiate pre-modified NPs than post-modified NPs. In comparison with the monolinguals, Mandarin-English bilinguals showed a significantly larger frequency effect in English, but Spanish-English bilinguals did not, a pattern that can only be explained by assuming that the frequencies of syntactic structures accumulate across languages: The Mandarin pre-modified NP boosts the frequency of the structure that is already more frequent in English, but not that of the competing post-modified NP, leading to a larger frequency effect. In Spanish, the post-modified NP adds to the frequency of the structure that is least frequent in English, bringing the frequencies of both constructions closer together and minimizing the frequency effect. Note, however, that inheritance of syntactic preferences across languages is not always found: Flett, Branigan & Pickering (2013) showed that German-L1 and Spanish-L1 proficient speakers of English produced comparable proportions of DO and PO datives, even though Spanish only allows PO datives.

To summarize, several studies have shown that bilinguals evolve from using specialized memory representations and procedures to comprehend and produce L2 syntax to using the same representations and procedures for syntactic processing in L1 and L2. Because in this final stage the same memory representations are activated during processing in L1 and L2, sentence comprehension and production shows generalized priming (equally strong priming within and between languages) and frequency effects.

3.3 L1 influences on syntactic processing and production in the L2 occur in the earliest phase as well as in the final phase of L2 syntactic development

As we already mentioned, we assume that learners rely on their combined knowledge of L2 lexical items and L1 syntactic structures for the comprehension of novel sentences in the L2, because in the initial stage of L2 syntactic acquisition, only lexical representations of L2 nouns and verbs are available. In this initial stage, it is not unlikely that L1 syntactic representations are used for the comprehension and the production of L2 sentences. When the L1 and the L2 are closely related (like, for example, Dutch and English) syntactic transfer from the L1 will often lead to correct interpretations and productions. When the L1 and L2 structures are not completely identical, however, this kind of transfer leads to a syntactic error. We assume that these kinds of errors might trigger the separation between L1 and L2 syntactic representations in the following stages of acquisition. After a learning phase in which transfer errors don't occur, because separate memory representations are used for L1 and L2 syntactic processing, transfer errors might pop up again as a consequence of syntactic sharing. In this case, it is not the general syntactic structure that is transferred, however, because this is assumed to be shared between languages. Rather, the error arises because language-specific features of a shared syntactic structure are transferred between languages. In any case, we assume that L2 syntactic development is characterized by early and late transfer errors, with an error-free phase in between.

Evidence for early transfer of L1 syntax is provided in a study by Nitschke, Kidd and Serratrice (2010), which investigated L1 transfer and syntactic priming through comprehension in L1 and L2 speakers. The critical structures used in this study were German and Italian RC structures that are ambiguous between subject and object interpretations (German: *Hier ist die Frau, die das Mädchen küsst*; Italian: *Ecco la donna che bacia la ragazza*), but which are structurally identical to unambiguous RC structures in English (object RC: *Here is the woman that the girl kisses*; subject RC: *Here is the woman that kisses the girl*). These structures allowed the researchers to investigate whether there is an influence of L1 syntactic preferences in the comprehension of L2 German and Italian: The preferred reading of both the German and the Italian sentence is one in which the woman is assigned the subject role. Because an SOV reading of the German sentence is not possible in English, however, the researchers expected a higher preference for the object reading (the girl kisses the woman) in English-German bilinguals than for native Germans. For the Italian sentences they predicted low proportions of object readings for native Italians and English-Italian bilinguals, as an SVO reading is preferred both by speakers of English and Italian. The results of a picture selection task indicated that the English-German participants had a higher preference for the object reading than all other participant groups, indicating that L1 English syntactic preferences influenced the comprehension of L2 German sentences. A priming phase in which participants were only primed with sentences that allowed an object reading resulted in increased proportions of object readings for German L1s, English-German bilinguals and English-Italian bilinguals in the priming phase and in a posttest. This indicates that, while the L1 syntactic preferences initially guided comprehension, these preferences were overridden by increased exposure to L2 syntactic structures.

As mentioned above, we found many L1 transfer errors in our study on within- and between-language priming of English genitives (Bernolet et al., 2013). Errors like *the nurse her shoe is green*, in which a possessive pronoun is used in an English s-genitive, occurred more frequently in our between-language priming experiment (4% of all responses) than in our within-language priming experiment (2% of all responses). Because – especially in our between-language priming experiment – the majority of s-genitives was produced by more proficient participants, most of the transfer errors were also produced by more proficient participants. Transfer errors were more frequent in same meaning conditions than in different meaning conditions and they often occurred in contexts where, in Dutch, adding an s-morpheme would have to be avoided (*the nurse's shoe* contains three sibilants in a row). This led us to conclude that these errors might be a side effect of having a shared syntactic representation for Dutch and English s-genitives: If the same syntactic node is activated during the processing and the production of Dutch and English s-genitives, there is a risk that the morpho-syntactic rules for the formation of the Dutch s-genitive 'intrude' into the s-genitive that is used to describe the target picture.

Further evidence for late transfer errors or co-activation errors is provided in two ERP-studies by Thierry and Sanoudaki (2013) and Vaughan-Evans, Kuipers, Thierry and Jones (2014). Thierry and Sanoudaki (2013) compared the comprehension of adjective-noun and noun-adjective pairs in English between English monolinguals and native Welsh-English bilinguals. The results of their experiment indicated that the bilinguals expected an adjective following a noun in an English sentence, even though this word order is illegal in English. In Welsh, however, this word order can be used, alongside the adjective-noun order which is used in English. Thierry and Sanoudaki (2013) concluded that Welsh-English bilinguals might have shared representations for the modification of nouns in Welsh and English, which led them to expect an erroneous word order in English, in contrast to the monolingual participants, who only expected adjective-noun combinations. Vaughan-Evans, Kuipers, Thierry and Jones (2014) showed intrusions of Welsh syntax in the comprehension of English syntax by presenting Welsh-English bilinguals with English sentences that ended in nonwords. The nonwords were English words (e.g. patients) of which the initial consonant was either aberrant (e.g. datients) or followed a Welsh mutation rule (e.g. *batients*). The results of the experiment indicated that English words that were mutated according to Welsh mutation rules were more easily integrated into the sentence context (they showed a smaller phonological mismatch negativity) when they were presented in a context that warranted the rule in Welsh than in a nonmutation context.

The two studies mentioned above both studied native or very early Welsh-English bilinguals. In these bilinguals, the syntactic representations developed simultaneously in the languages they know. Hence, our developmental model might not capture the syntactic development these Welsh-English bilinguals went through. What we can say, is that, even as native bilinguals, they ended up with syntactic representations that are fully shared between languages. Hence, these studies show that, even for bilinguals with a very high proficiency in both of their languages, syntactic sharing can lead to the production of erroneous syntax, or non-native-like processing strategies.

4. General discussion

In the previous sections, we sketched a possible account of L2 syntactic acquisition in late learners (Hartsuiker & Bernolet, 2017) and discussed the studies on which the core assumptions of this account are based. On the basis of the studies that were discussed, it seems quite plausible to assume that the L2 syntactic representations evolve in the way that is put forward in the model: There is evidence for an abstraction process within the L2, for more syntactic sharing with increasing proficiency, and for early and late co-activation of L1 syntactic rules during L2 syntactic processing. A problem is, however, that none of the studies discussed above tested participants through the complete learning trajectory of a specific syntactic structure in the L2. Additionally, it is difficult to compare the L2 proficiency of the L2 learners across studies. Consequently, we cannot be sure that L2 learners go through all of the 5 stages proposed in the model. Studies with longitudinal designs that follow participants from their first encounter with a syntactic structure in the L2 until the moment that the syntactic structure is completely mastered could shed light on this.

Another shortcoming of Hartsuiker and Bernolet's (2017) model, is that the learning mechanisms are underspecified. As we mentioned, the process of abstraction within the L2 and, eventually, across the L1 and the L2 could be driven by a form of Hebbian learning – if two nodes are always active together they might become functionally equivalent to a single node. The general principles of specificity and economy we assume are, however, also compatible with distributed theories (e.g. Chang et al., 2006) which assume error-based learning of syntactic rules. Both learning principles make different predictions concerning the strength of priming: Whereas Hebbian learning causes stronger priming for structures that are more frequent, error-based learning predicts the opposite pattern. A comparison of between-language priming effects in the L1 caused by non-native syntactic primes from a second and a third language might help to clear out this issue.

To conclude, we have proposed and discussed a possible account of L2 syntactic acquisition in late learners. More research is needed to refine our account of what happens during the late learning of L2 syntax, and what learning mechanisms are involved.

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CHAPTER 11

First language attrition and bilingualism

Adult speakers

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A considerable amount of research has been devoted to exploring how bilinguals accommodate their languages. Since it has long been assumed that the native language, once completely acquired, would be immune to change, this research has mainly been focused on L2 development and L1 interference in the process of L2 learning (Gass & Selinker, 1992; Kecskes & Papp, 2000; Mitchell et al., 2013; Ringbom, 1987). However, psycholinguistic and neurolinguistic investigations into the bilingual mind have consistently demonstrated that interaction between languages is two-way and that bilinguals use and process their native languages differently than monolinguals (Cook, 2015; Green & Abutalebi, 2013; Pavlenko & Jarvis, 2002). While the precise nature of this phenomenon and the linguistic and psycholinguistic determinants involved have not been completely explored, the symptoms ascribed to first language attrition are unanimously characterized as a natural part of the developmental process in bilingualism. As attrition research has considerably advanced our knowledge on the impact of later-learned languages and bilingualism on the L1 and the loss of L1 skills, this has led to the realization that L1 attrition forms a vital component of research into bilingualism. This chapter will present a synthesis derived from the findings of previous studies on first language attrition in adult speakers in an attempt to explain the extent to which native language knowledge can become compromised, and how. It will also demonstrate how including these speakers in bilingualism investigations may help us explore the limits and possibilities of our language capacity and provide additional insight into controversial issues in second language acquisition research such as maturational constraints and the nature of L2 knowledge in late learners.

1. Introduction

With the acquisition of a second language, competing entries and categories are established in the brain for items, features or rules which already exist in the native language. These competitors represent the way in which the same communicative

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intent is realized in the L2, but in a fashion that can range from the almost identical to the completely different. The pre-existing processing strategies and representations of the L1 initially influence the way in which the new competitor is represented, processed and used; with practice and increasing proficiency, this L1-to-L2 transfer can be reduced or minimized. Also, features or rules can similarly and increasingly come to be affected by cross-linguistic interference in L1 attrition.

Attrition refers to situations where the speaker of a language (an L1 or a later learned second or foreign language) can no longer do something which s/he had previously been able to do, and this is not caused by a deterioration of the brain (e.g. due to age, illness or injury) but triggered by disuse, and pressure from another language due to a change of the linguistic environment (Köpke & Schmid, 2004). This chapter is focused on people who have learnt an additional language in their adulthood (not simultaneous or early bilinguals) and lived in this language environment for an extended period of time. While their native language system has been stabilized through practice, literacy and education into adulthood, even for such people, it is possible to lose some of their productivity and creativity in their native language, make occasional lexical and grammar errors and speak with a foreign accent.

It should be noted that while the term 'attrition' seems to be perceived as a synonym for language loss or total forgetting, a language cannot be stated as lost in the psychological sense of the term (Köpke, 2004). Attrition researchers have frequently drawn attention to the difficulties in controlling the two linguistic systems rather than restructuring or loss of the L1 system (Cook, 2003; Schmid, 2009; Seliger & Vago, 1991; Sharwood Smith, 1989). They have pointed out that the languages of the bilingual coexist in a state of competition for a finite amount of memory and processing space in the mind of the speaker (Seliger & Vago, 1991). As a consequence, not only may bilinguals' processing of their L1 slow down, but also their L1 may be influenced by L2 leading to difficulties in their performance and eventually slight changes in L1 knowledge (Schmid, 2016).

While language interference as a two-way process was conceptualized as early as 1953 by Weinreich (1953: 1), the majority of research have previously focused on the acquisition of L2 knowledge with the (often implicit) underlying assumption that the L1 is a mature, stable and invariant baseline, and 'development', in any language, was thus conceived of as a unidirectional process, where proficiency continues to increase until a plateau is reached at which the language user then remains indefinitely. Several theoretical approaches to bilingualism had been previously focused on providing an explanation for the phenomena which can be witnessed in the language which is being acquired and which becomes increasingly more target-like. This view of the developmental process was based on the underlying and implicit assumption that cross-linguistic interaction is a one-way street and that, while the L2 is linked to and influenced by the L1, the reverse was not true or not important.

The inauguration of research on what happens to native languages of bilinguals (or those who speaks more than two languages) has taken place after the UPenn Conference in 1980 (Lambert & Freed, 1982). Since then, various symposia and conferences, graduate workshops, collected volumes and special issues in journals have contributed to the visibility of attrition research (see Köpke & Schmid, 2004 and Schmid, 2016 for a historical overview of the subsequent research). In particular, since Cook (1991) dubbed his view of bilingualism as 'multicompetence' which takes into account the additional cognitive demand of managing more than one language system, there has been considerable development towards such a view. Most notably psycholinguistic approaches to bilingualism have often made the point that bilingualism is not the simple addition of language but a special configuration of interacting languages within a unified super-system within which all languages potentially affect each other (see Cook, 2015 for review; Grosjean, 2008; Pavlenko & Jarvis, 2002).

In this view, knowing about the development of one language in isolation would not be enough to understand the linguistic system of the bilingual. It is important to establish what characteristics of linguistic knowledge or rules contribute to their learnability and govern the acquisitional process in both languages and also examine what makes it easy or difficult to maintain them in the L1 once an L2 competitor has been established. Factors such as age of acquisition, frequency, complexity etc. have often been invoked in trying to provide accounts of what is hard and what is easy to acquire in L2 acquisition. Extending these predictions to cover the process by which knowledge that has been acquired may deteriorate under disuse or be affected by later-learned knowledge provides an important opportunity for theory-building and validation. Investigating processes of back-transfer or deterioration can help shed light on fundamental questions about the architecture of linguistic knowledge in general and the bilingual mind in particular.

2. First language attrition and interplay between languages

Forgetting a later-learned language, such as a foreign language studied at school, is something that most L2 learners would agree is common, but having difficulties in one's native language (a process referred to as first language attrition, henceforth simply attrition) is often assumed to be close to impossible. If a speaker does experience attrition in the native language, the immediate assumption is that this person must have high command of another language and have lived in another language environment for a long time. In fact, attrition is not a rare phenomenon but common to many people who routinely use more than one language (Cook, 2003). All speakers living in bilingual contexts experience a certain amount of change to their L1, partly through non-use (loss of accessibility) and partly through interference from the dominant contact language (competition).

It should be emphasized that some cross-linguistic or interaction phenomena which are widespread among bilinguals do not necessarily constitute (structural) loss or deterioration. For example, bilinguals might borrow elements from the L2 and integrate them phonologically and/or morphologically; extend the meaning of an L1 word to capture the meaning of its L2 translation equivalent or converge the L1 term with its L2 meaning. They may also experience shift away from L1 structures to approximate those of the L2 (Pavlenko, 2011). These occurrences do not indicate that corresponding L1 features are lost but they simply arise as a natural outcome of becoming bilingual (Schmid, 2013).

Psycholinguistic investigations have abundantly provided evidence for a two-way interaction between the languages, which begins at the initial stages of learning (see Coderre, 2015 for review). For example, in word production, cross language cognates are usually named faster compared to non-cognate items (Friesen et al., 2014; Hameau & Köpke, 2015) whereas auditory distractors that are phonologically related to the L1 translation of an item can delay the response in the L2, indicating that the L1 translation is active at the same time (Macizo, 2016; Roselli et al., 2012). These findings have been attributed to the fact that speakers can never switch off either language entirely; that is, both[1] languages are simultaneously activated regardless of the language which has been selected for production (Starreveld et al., 2014). This makes the management of the bilingual language system cognitively more demanding and bilinguals may take extra time and effort to resolve cross-linguistic influences (Green & Abutalebi, 2013).

Co-activation is not limited to the lexical domain but can also affect syntactic processing and phonology. It has, for example, been argued that structures which share the same word order are shared across languages (Bernolet et al., 2007; for a review of non-selective syntactic activation see Sanoudaki & Thierry, 2015). Hopp (2016) investigated whether cross-linguistic syntactic activation of the L1 word order is affected by lexical activation of the L1 by virtue of cognate words in German-English bilinguals using eye-tracking experiments and observed lexical cognate facilitation and syntactic co-activation of L1 word order. Similarly, the way in which bilinguals carve up the phonetic space appears to differ from that of monolinguals, affecting both perception and production in either language. In

1. We use the example of a bilingual speaker as most of the research has focused on bilingual language processing; however, it has also been reported that in case of multilinguals, all languages are activated to varying degrees (Dijkstra, 2003).

his classical study on phones, Flege (1987) demonstrated that the French-English bilingual speakers merged L1 and L2 categories as evidenced by their intermediate pronunciation of some phones in both languages, and similar findings have often been reported since (for a recent overview see Bergmann, et al., 2016).

The cognitive impact of speaking two languages has been shown to extend beyond crosslinguistic interaction at these linguistic levels. It has been proposed that bilingual experience can transform the way people think as a result of restructuring at the conceptual level in some of the classical Whorfian dimensions of categorization of colours, objects and events (see Bassetti & Cook, 2011 for review; Jarvis & Pavlenko, 2008) as well as gesturing about events and motion whenever these properties are encoded differently in the L2 (see Athanasopoulos et al., 2011 for review). It thus seems evident that the difference between the bilingual and the monolingual mind encompasses all levels of linguistic representation, production and cognition. The findings from the above studies strongly suggest the presence of an integrated bi(multi)lingual super-system in which both languages are affected by the other one at all levels and therefore, first language attrition is a natural and logical outcome of becoming bilingual (Cook, 2003; Grosjean, 2016; Kroll & Fricke, 2014).

3. Scope and limitations of attrition effects

Since the early 1980s, researchers have been seeking to identify the indicators of attrition and determine those linguistic areas vulnerable to attrition (Köpke & Schmid, 2004; Seliger, 1991; Seliger & Vago, 1991; Weltens et al., 1986). A large number of investigations of particular lexical and grammatical features have been conducted in a variety of attrition settings within various frameworks (e.g. the Principles and Parameters approach: Gürel, 2002; McCormack, 2001; the Minimalist program: Montrul, 2008; Tsimpli, 2007; Tsimpli et al., 2004; and the 4-M Model: Gross, 2004; Schmitt, 2004; for overviews see Köpke & Schmid, 2004; Schmid, 2016). Attrition is now a widely-recognized phenomenon which implies a weakening of language skills and habits caused by a limitation in use and input of the native language due to moving into an environment where another language is dominant. It can manifest itself in a variety of phenomena in the L1, such as interferences from the L2 at all linguistic levels (lexicon: Ecke & Hall, 2013; Köpke, 2002; Pavlenko, 2009; Schmid & Jarvis, 2014; Yılmaz & Schmid, 2012; morphosyntax: Gross, 2004; Gürel, 2007, 2013; Schmid, 2009; Stolberg & Münch, 2010; Tsimpli, 2007; Yılmaz, 2011; phonetics: Bergmann et al., 2016; de Leeuw et al., 2017; Major, 1992, 1993; Mayr et al., 2012; pragmatics: Chamorro et al., 2016; Dewaele, 2004; Pavlenko, 2002); a simplification or reduction of the L1 system (Seliger & Vago, 1991; Yılmaz & Schmid, 2012); or disfluent speech with a high proportion of pauses and self-repairs (Bergmann et al., 2015; Köpke, 1999; Schmid & Beers Fägersten, 2010). As was pointed out above, however, these phenomena need not be evidence of structural loss or (permanent) change, but may be due to the on-line competition of languages. Sharwood Smith (1989, 2007) approached this question from a psycholinguistic point of view, suggesting that attrition can affect the underlying linguistic knowledge and/or the control of this knowledge which is still present intact in the mind (e.g. qualitative divergence and/or retrieval and processing issues). It has often been hypothesized that the properties that belong to the core grammatical system are less susceptible to change whereas peripheral grammatical domains are affected first and more easily in language contact situations (Chamorro et al., 2016; Domínguez, 2013; Gürel, 2004; Köpke, 1999; Sorace, 2011).

In one of the key publications on first language change in adult bilinguals, Cook (2003) put together individual investigations on verbal and case morphology, word order, prepositions and the pronominal domain, among others. He reports that changes observed in the languages investigated are generally related to reduction in morphologically marked categories and simplification of costly syntactic operations. He proposes that it is natural for L1 morphosyntax to be open to influence from L2 because languages residing within the same mind form a super-system at some level and operate together (p. 1–2). Most of the initial studies of attrition have dealt with production rather than perception, which makes it hard to determine whether the speakers' deep level knowledge has diverged from the native norms or whether any differences found can simply be ascribed to difficulties in online speech due to retrieval and processing problems (Ammerlaan, 1996; Cherciov, 2011; Dostert, 2009; Hulsen, 2000). Studies that did employ tasks which tap into underlying knowledge have often failed to demonstrate any dramatic signs of grammatical restructuring or loss in competence, suggesting instead that attrition is a largely on-line phenomenon (but see Kasparian et al., 2016). For example, one research group led by Monika Schmid and colleagues (Bergmann et al., 2015; Schmid, 2013) is currently conducting studies using ERPs in German and Dutch speakers immersed in an English-speaking environment, as well as different groups of early/late L2 learners. The responses of the L1 attriters were observed to be nativelike in both non-finite verb form violations and gender agreement violations and they outperformed L2 speakers while there was an increase in hesitation markers in the online speech data. The evidence so far, indicates that the mechanisms involved in accessing, integrating and producing information in real-time has somewhat become compromised due to sharing memory and processing resources while the deep knowledge has remained intact (Bartolotti & Marian, 2012; Green, 1986, 2011).

Kasparian et al. (2016) is the first study that reported change in the real-time processing of L1 morphosyntax of attriters. They have detected P600 effects in the number agreement processing in Italian whereas Monika Schmid and her collaborators who had primarily focused on the P600 effect reported no significant amplitude or latency/duration differences between attriters and non-attriting monolingual controls (Bergmann et al., 2015; Schmid, 2013). Kasparian et al. state that determiner-noun agreement could be a part of lexicalized knowledge (without an inflected intervening adjective in Dutch and German) and may not be as sensitive as the number mismatch in complex Italian sentences (manipulated on subject, verb and modifier). It is also important to mention that the informants in this experiment were recruited because of their self-reported attrition experiences which might have superficially inflated the difference between the experimental and control groups.

Other findings similarly suggest that attrition is a phenomenon that is largely located at the interfaces between grammar and other linguistic modules, rather than a phenomenon that will affect the deep structures or central syntax at the core grammar. For example, Perpiñán (2013) compares the production and comprehension of Spanish subject-verb inversion in two contexts (one where inversion is syntactically obligatory and one where it is optional and regulated by pragmatic and phonological considerations) among Spanish-English bilinguals. The speakers have been living in the US for more than five years and using their L1 frequently. She finds that, in the production task, the optional condition is affected while the obligatory one remains native like. In the comprehension task, on the other hand, the bilinguals behave like the monolingual natives in both conditions.

Similar findings concerning the selectivity of attrition processes are presented by Gürel and Yılmaz (2011), who investigate the binding properties of Turkish pronouns in Turkish-Dutch bilinguals living in the Netherlands. The Turkish overt pronoun *o*, unlike the Dutch pronoun *hij/zij* or the English pronoun *he/she*, cannot be coreferential with the sentential subject (*Murat*$_i$ *onun*$_{*i/j}$ *sinemaya gideceğini söyledi/ Murat*$_i$ *zei dat hij*$_{i/j}$ *naar de bioscoop zou gaan*/Murat$_i$ said that he$_{i/j}$ would go to the movies), while the overt pronoun *kendisi* as well as the null pronoun allow both a bound and a disjoint reading. As was predicted, the interpretation of *o* had slightly shifted for the bilinguals towards the L2, who allowed a bound reading in sentences such as the one above at a higher percentage than the *monolingual controls*; but they seem to have maintained the properties of null pronoun and *kendisi* to a larger extent.

Such findings regarding the selective nature of attrition are said to be compatible with Sorace's (2005, 2011) argument that attrition affects the structures which involve interfaces between syntax and other modules (e.g. syntax-discourse) and core syntactic features are impervious to attrition. While in the studies that have reported syntactic attrition, there seems to be little evidence for an actual restructuring of the language system (Dahlman & Kupisch, 2016; Gürel, 2002, 2013; Montrul, 2008; Romano, 2017; Tsimpli et al., 2004), their results cannot be taken as full empirical support for this argument because it is almost impossible to find purely syntactic features that do not interface with any other grammatical modules (Gürel, 2011).

Grammatical categories are not the only linguistic features that may shift towards the values of the L2 in the process of L1 attrition. A similar process of the adaptation of some of the settings of the linguistic system of one language towards those of the other can be witnessed in the phonetic domain. One of the most influential theoretical approaches to L2 phonology, Flege's Speech Learning Model (Flege, 2002; Flege et al., 2003) assumes that similar phones in a bilingual's two languages exist in a shared phonetic space (similar to Cook's (2003) notion of a linguistic super-system), and that within this space, they will mutually influence each other. A number of investigations in speech production, have shown that this is indeed the case and that the process of adaptation can be witnessed in both of a speaker's languages. Flege's (1987) original findings on shifts in Voice Onset Time have since been replicated in studies of Brazilian Portuguese and English (Major, 1992); English and Dutch (Mayr et al., 2012; Schmid et al., 2014) and English and Korean (Chang, 2012). Bidirectional changes have also been found for the production of some vowels (Bergmann et al., 2016), the production of lateral /l/ in German-English bilinguals (de Leeuw et al., 2012), rhoticity (de Leeuw et al., 2012; Himmel & Kabak, 2016; Ulbrich & Ordin, 2014) and suprasegmentals (Mennen, 2004). At the same time, a range of studies on perceived global foreign accent finds that attriters are not reliably identified as native speakers by native raters (Bergmann et al., 2016; de Leeuw, et al., 2010; Hopp & Schmid, 2013 among others).

Apparently, attrition in the phonetic domain is possibly more prevalent than other types of attrition, as attriters themselves often report that they are recognized by the way they speak when they return to their country of origin (Boeschoten, 2010; Yılmaz & Schmid, 2012; but see Genevska-Hanke, 2016). Nevertheless, an investigation tapping the ability to 'perceive' the foreign accent in the native language of the attriters revealed that underlying phonetic abilities are intact (Major, 2010). Brazilian Portugese speakers who were long term residents in the US were able to determine the native speaker speech samples with high accuracy and tended to accept more variants of nonnative samples as native, implying that their native speech spectrum has been widened due to their being exposed on a daily basis to a larger range of different variants of their L1 in an L2 environment (e.g. other attriters, heritage speakers, speakers of other dialects of their L1 and L2 speakers).

Taken together, the findings suggest that attrition is partially triggered by psycholinguistic pressures of bilingualism due to the growing presence of the L2 and is primarily a consequence of slowed down mechanisms involved in speech processing primarily a processing- or control-related phenomenon which manifests itself in performance related problems. It is possible that attrition may eventually affect the structure of language knowledge; however, the degree of linguistic atrophy among adult bilinguals is minimal.

4. Factors in attrition

Quantitative investigations of L1 attrition often reveal differences between attriters and nonattrited controls at the group level on measures such as grammatical complexity and accuracy, lexical diversity and sophistication, fluency and perceived native-likeness in speech as well as in their performance on experimentally controlled tasks. However, attriters' performance at the individual level is often less consistent, with some speakers performing within the native range and others failing to reach native levels. It is also often not the same speakers within any one investigation who fall outside the native range on different tasks (e.g. Bergmann, 2017). Some appear to have maintained their knowledge across the whole range of measures while others' performance is affected variably at different linguistic levels (e.g. decreased lexical accessibility but intact morphosyntax). This is further complicated by the fact that attriters themselves tend to form extremely heterogeneous groups with respect to the context and frequency of use of their languages and the degree of bilingualism. Further contributing or confounding predictors include personal background factors such as age of acquisition, education and length of residence in the L2 country; as well as social and psychological variables linked to attitude, motivation and affiliation. Given the fact that most, if not all, individual predictor factors interact with others, leading to a complex web of interrelated factors (de Bot, 2007; Herdina & Jessner, 2013), it has been a real challenge for the attrition research to identify the factors that determine the development of attrition or retention.

The factor that is usually assumed to be the most important by researchers relates to the amount of L1 use in daily life (de Bot, 1998; de Bot et al., 1991; Herdina & Jessner, 2002; Köpke, 1999; Laufer, 2003) and in particular in domains outside the home (Hulsen, 2000). However, most early studies determined the amount of L1 use in a simplistic and often dichotomous way, e.g. by asking participants if they used more or less L1 or if they made frequent or infrequent use of their L1. This has led to the establishment of a more fine-grained measure of language use in the Language Attrition Test Battery developed by Schmid (2011) (available at language-attrition.org). Part of the test battery is a sociolinguistic questionnaire containing a set of items on interactive language use in different contexts. This instrument was subsequently used in a number of studies, which – rather surprisingly and somewhat counter-intuitively – revealed the impact of language use in informal settings on language maintenance to be much smaller than previously assumed (e.g. Cherciov, 2011; Dostert, 2009; Opitz, 2011; Varga, 2012; Yılmaz, 2013). This could be because fellow L1 speakers in the community may have developed their own variety and frequent contact with other immigrants does not help maintenance (Grosjean & Py, 1991). It is only L1 use for professional purposes which apparently has the potential to slow down the rate of attrition (Schmid, 2007; Schmid & Dusseldorp, 2010).[2]

A possible explanation for these rather surprising findings is proposed by Schmid (2007), who argues that the native language of a monolingual speaker may reach a certain level of stability or 'saturation threshold' at some point in the process of language acquisition, due to its very frequent activation. Once this 'resting level' has been reached, frequency of use may become less relevant for the maintenance of the language system, and online attrition effects may be more indicative of unsuccessful inhibition of the L2 than of failure to access the L1 values or settings. Following Grosjean (2001), Schmid further suggests that variability in attrition phenomena are related to the use of language in different modes (i.e. monolingual and bilingual mode) and on how these modes impact on language inhibition. In her investigation, frequency of use of the L1 in bilingual mode contexts played no role in protecting language against attrition, which she ascribes to the fact that code-switching is acceptable and frequent in such settings, making strong inhibition of the L2 unnecessary. However, speakers who use their L1 for professional purposes, i.e. in intermediate mode settings where code-switching is inappropriate, did score higher on lexical skills and fluency measures. Schmid ascribes this to higher levels of practice in suppressing the L2 – an account that receives support from recent psycho- and neurolinguistic investigations and theories, such as Green's behavioral ecology of bilingualism, which also links the development of inhibitory skills to the frequency of code-switching (Green, 2011; Green & Abutalebi, 2013).

Among the other suggested predictors associated with attrition are affective factors related to cultural and language identity and motivation. In general, speakers who have a strong desire to immerse themselves in the L2 society and for whom the L1 loses its practical and symbolic significance would be expected to experience more L1 attrition because they would not be motivated to make an effort to maintain their L1 (Hammer & Dewaele, 2015). However, the role of attitudes has been extremely difficult to establish in empirical studies, including the ones that considered wider community level factors such as language prestige and community support (Hulsen, 2000; Waas, 1996; Yağmur, 1997). For example, Turkish-English bilinguals

2. It should be noted here that a potential problem for such investigations relates to the fact that L1 use can only be assessed through self-evaluations, which may not always be accurate reflections of linguistic behaviour.

in Australia (Yağmur, 1997) and Dutch-English bilinguals in New Zealand (Hulsen, 2000) were found to be significantly different from the control groups. There is a dramatic difference between these two populations and the value which they assign to their respective native language and culture: for the Turks, it was associated with a high symbolic value, while the Dutch tended to orientate themselves towards the L2 society and language, to the degree that even the second generation of immigrants are often not bilingual (i.e. the migrant parents did not teach their own native language to their children). The fact that attrition effects were evident in both these populations suggests that a high level of attachment to the L1 is not as protective as one might assume, and neither does an outlook which favours full integration necessarily lead to a deterioration of the L1. Likewise, in a number of recent studies carried out in different settings, the impact of attitudes on attrition turned out to be limited (Opitz, 2011; Schmid & Dusseldorp, 2010; Varga, 2012; Yılmaz & Schmid, 2012; but see Bylund & Ramírez-Galan, 2016).

Again, one of the problems with respect to investigating the impact of attitudes on L1 attrition relates to the fact that these can be measured only by means of self-assessments, that is, through questionnaires and interviews where the participants are asked to evaluate the relative importance of the languages and cultures in their life and the attitudes they hold towards them. Arguably, such a snap-shot measurement cannot reliably determine linguistic and cultural affiliation, as individual attitudes fluctuate with time and are too dynamic to directly account for a process such as language attrition, which takes place slowly over decades (Cherciov, 2013). The only study to date which takes a different approach to assessing attitudes is situated in a unique historical context, as it investigates language attrition and maintenance among German-Jewish Holocaust survivors (i.e. Holocaust survivors) (Schmid, 2002). The participants in this study were grouped according to the time interval (between 1933 and the outbreak of World War II) at which they left Germany and settled in Anglophone countries. Based on this classification, Schmid was able to establish a link between the severity of the persecution measures that individual speakers had experienced and the degree of L1 attrition. A later study carried out by Ben-Rafael and Schmid (2007) provides further indirect support for the role of attitudes when they can be determined reliably at the group level. Their comparison of Russian and Francophone immigrant groups in Israel revealed distinct interferences in their L1 as a function of prevailing national language policies and their orientations towards the host society. It does appear, therefore, that attitudes, motivation and attrition are closely linked, but that it may be difficult to isolate the impact of these predictors in studies which try to assess it exclusively on the individual level and through self-reports.

In the remaining of this section, we will present the findings on the impact of the length of residence in the host country (the time elapsed since immigration), level of education and age of onset of attrition (age of arrival in the host country). Extended residence would be assumed to progressively impact the language skills through nonuse and pressure from the L2 but its influence on attrition is unclear except the perceived foreign accent (Flege & Fletcher, 1992). While most studies have reported a lack of relation between attrition effects and time spent in the L2 country (Bergmann et al., 2015; Köpke & Schmid, 2004; Lubińska, 2011; Schmid & Jarvis, 2014), length of residence did appear to play a role to some extent when the speakers had little opportunity to use their L1, indicating an interaction between contact and time (de Bot et al., 1991; Schmid, 2011). It is possible that the results in other studies could show variation depending on the language area tested and the type of test administered and attrition might have then passed unnoticed (Köpke & Schmid, 2004). We also do not know how attrition progresses in the first ten years as many studies have chosen a minimum of ten-year residency in the L2 country. It has been proposed that attrition largely takes place during the first decade and then slows down or stops completely (de Bot & Clyne, 1994; Waas, 1996).

It was predicted that speakers with a higher level of education would be affected to a lesser degree by attrition because higher levels of education are linked to literacy (which reinforces language by providing additional representation) as well as the use of more complex words and structures (de Bot & Makoni, 2005; Herdina & Jessner, 2002). It has been proposed that the factor education can also have an indirect impact on attrition since highly educated people are more likely to read in the L1 and can afford frequent travels to home, which provides them with more practice (Jaspaert & Kroon, 1989) and then seem to be protected from attrition (Opitz, 2011; Schmid, 2002; Yağmur, 1997 but see also Dostert, 2009; Köpke, 1999). It may also be the case that highly educated informants may be more familiar with specific test settings and therefore perform better in certain tests (metalinguistic judgement tests) (Yağmur, 2004).

With respect to age effects in attrition, all available evidence indicates a major change in susceptibility to attrition around puberty (see Genesee & Delcenserie, 2016 and Montrul, 2016 for an overview). Studies which compared pre- and post-puberty migrants (Ammerlaan, 1996: 0–29 years; Bylund, 2009: 1–19 years; Pelc, 2001: 8–32 years) found that age of arrival in the L2 country was one of the most significant predictors of L1 proficiency. If native language exposure ceases in childhood or before puberty, the L1 system is affected at dramatic levels as evidenced by structural changes or loss of certain grammatical features (Kim et al., 2010; Schmitt, 2004; Silva-Corvalán, 1991). Total forgetting has only been reported in the studies of international adoptees who no longer had any contact with their native language after their arrival in their new homes between the ages of 3 and 10 (Pallier et al., 2003; Ventureyra et al., 2004). On the other hand, among bilinguals, who have moved to a second language environment after the age of 15 or later (who therefore have stabilized their language knowledge until then) no age-related attrition has been reported (Köpke, 1999: 14–36 years; Schmid, 2002: 12–29 years; Schmid, 2007: 17–51 years; Yılmaz, 2013: 15–62 years).

To sum up, the findings from the studies reported here suggest that external factors (i.e. language exposure, positive motivational attitudes and higher educational level) would help preserve the native language; however, the exact degree to which they can be predictive of language maintenance in different levels of linguistic knowledge still needs to be verified by more research.

5. Contribution of attrition studies to bilingualism research

Research on bilingualism has mostly been carried out on L2 learners who are usually dominant or proficient in their L1 and researchers have been preoccupied with issue of L1 interference on L2, which is (often) weaker than L1. As the research findings presented above indicate, first language system does not stay stable but is susceptible to change and cross-linguistic influence. L1 attriters are bilinguals with the reverse linguistic configuration whose L2 is gradually becoming the stronger language and L1 may slow down and also become influenced by L2 (Grosjean & Li, 2013). An important question in this respect is what the extent of these attrition effects is, and if the attrited system can come to structurally resemble that of an (advanced) L2 speaker to a greater degree than that of a native speaker. Resolving this issue would have important implications regarding the maturational limitations on language development and constraints to ultimate attainment in L2 learning.

While all normally developing children reach full native speaker proficiency, late learners of second and foreign languages rarely do. It has been debated whether the differential effects are due to language specific maturational factors (e.g. biological or neurological processes) or to more general cognitive abilities (e.g. competition between languages and processing limitations in the bilingual mind). While findings undisputedly report correlation between age and ultimate attainment (Bylund et al., 2013; De Keyser et al., 2010; but see Muñoz, 2014), the impact of age as an independent factor cannot be proven in such studies that compare learners with varying ages of onset. Investigations can compare two populations who both have to cope with the competing/interfering effects of another language which resides in the same brain, and thus have the potential of isolating those grammatical features or structures which become substantially more difficult to acquire later in life. Data from L1 attriters may constitute a more appropriate baseline in order to make a fair comparison (Hopp & Schmid, 2013; Schmid, 2014). As attriters predominantly use their L2 and also continue to use their L1, they experience cross-linguistic transfer to their L1; however, maturational constraints do not apply to them since they acquired it in childhood. Therefore, findings from attrition studies on the restructuring versus preservation of the L1 system can help disentangle age-at-onset effects from other factors such as cross-linguistic interference.

If L1 has a privileged status and hard-wired in the brain due to early exposure and becomes deeply entrenched into adulthood (Newport, 2002), adult attriters (who lived in the L1 environment until adulthood) should differ less from nonattriting native speakers than young attriters (who changed their linguistic environment at an earlier age) (Tokowicz & MacWhinney, 2005). Not only has this been supported by empirical evidence (Köpke & Schmid, 2004; Schmid, 2016) but also studies of L1 loss or extreme case of L1 attrition have been reported in individuals who were adopted earlier than puberty. These individuals did not show evidence of residual knowledge of their L1 and were indistinguishable in their brain activation patterns from L2 controls (Ventureyra et al., 2004; Ventureyra & Pallier, 2004; but see Pierce et al., 2014). From these findings, it has been suggested that L1 attrition is subject to maturational constraints (see Pallier, 2007; Schmid, 2011). Including attriters in the group of bilinguals would allow us to investigate whether early-exposure to language guarantees native-like attainment or whether language knowledge is modulated by other factors such as frequency of use, proficiency and competition.

Another highly disputed issue in L2 research concerns the question of whether monolinguals and bilinguals diverge from one another quantitatively or qualitatively (Bylund et al., 2013; DeKeyser, 2013). It has not been clarified yet whether L2 learners have the same underlying knowledge as the L1 speakers and just fail to apply it consistently due to cognitive demands of bilingualism or they have a representational deficit conditioned by neurobiological and maturational processes. A major problem in this comparison is the fact that these groups of speakers are inherently different from one another due to a two-way assimilatory processes across all linguistic levels in bilinguals (Cook, 2015; Grosjean, 1989, 2016; Jarvis & Pavlenko, 2008). The fact that bilinguals can have problems in their L1 due to computational limitations of the linguistic-cognitive system seems consistent with the models of bilingual production such as the Missing Surface Inflection Hypothesis (MSIH) (Goad et al., 2003; Prévost & White, 2000). What has been observed in studies of attrition can be associated with problems due to processing load and cross-linguistic interaction (e.g. surface level deviations). Unlike the MSIH, Representational Deficit approaches to L2 acquisition (Hawkins & Chan, 1997; Tsimpli & Dimitrakopoulou, 2007) propose that L2 acquisition is maturationally constrained and learners have difficulty in establishing some grammatical features (which are not present in the L1) (De Cat et al., 2015; White et al., 2012). Comparisons between late learners and monolinguals would not allow us to investigate the nature of L2 knowledge because monolinguals do not have any representational deficit or experience cross-linguistic influence and the observed differences could be accounted by either effect. In order to solve this dilemma, too, attriters have been proposed to be a more appropriate point of reference since they experience similar competition effects and processing limitations due to L2 (Hopp & Schmid, 2013).

To date, very few studies exist which carry out comparisons between late L2 learners and L1 attriters of the same language (Gürel, 2002; Hopp & Schmid, 2013; Schmid, 2014). One of the earliest studies investigated L2 acquisition and L1 attrition of binding properties of Turkish overt and null subject pronouns (Gürel, 2002). Participants included native English-speakers living in Turkey (end-state L2 Turkish speakers) and native Turkish-speakers living in North America (end-state L2 English speakers). The analyses revealed that both groups had similar difficulties with the acquisition and preservation of binding properties of the overt pronoun *o*, while the referential properties of the overt pronominal *kendisi* for which English has no corresponding form, and null pronoun were acquired and maintained well by both groups. Interestingly, level of language proficiency or amount of language use and exposure did not yield any significance and the language outcomes are attributed to the subset condition between Turkish and English. When the influencing language is the superset of the affected target language, L2 acquisition of the target language is harder as L1 transfer persists and, L1 attrition of the target language is more likely as there are more signs of L2 in the L1 grammar.

Another comparative examination of L2 acquisition and L1 attrition attempts to disentangle the age of acquisition and bilingual effects (Hopp & Schmid, 2013). Advanced or near-native L2 learners (of German with English or Dutch as L1s) and long-term attriters (native speakers of German who are post-puberty emigrants to Anglophone Canada or the Netherlands) were rated for native-likeness and the ratings revealed that L2 speakers were outperformed by attriters implying that late bilingualism leads to stronger foreign accents in the L2 than in the L1. At the first sight, then, the findings suggest that it is easier to retain a language learnt in the childhood across an extended period of non-exposure than to attain it at a later age. However, a closer look at the populations reveal a sizable overlap between L1 attriters and L2 learners: 72.5% of the attriters and 37.5% of L2 learners fall within the range of predominantly monolingual native controls. Moreover, neither age of onset nor length of residence yielded significant correlations. Among the other external variables, use of the L2 turned out to be important for L2 learners and time spent in a German speaking environment and language aptitude correlated with foreign accent for both bilingual groups. It is concluded that acquiring a language from birth does not ensure sustained native-likeness in speech production.

Schmid (2014) investigates how advanced/near-native late L2 learners of German (L1 English) and L1 German attriters (L2 English) perform in German morphology and grammar. The results showed that attriters are almost indistinguishable from the monolingual controls and L2 speakers are similar to the L1 attriters in some domains (e.g. verb phrase morphology and word order); however, some grammatical categories, most notably noun phrase agreement features, appear to remain more problematic for a proficiency-matched population of L2 speakers than for L1 attriters. These findings show that L2 speakers differ from both bilingual and monolingual natives in certain areas of grammar where their L1 is less complex (e.g. noun phrase morphology in English as opposed to German) and this is interpreted as consistent with the view of maturational limitations on ultimate attainment in L2.

More such investigations are needed to understand if late learners are qualitatively different from child learners. Future studies should replicate previous experiments and integrate investigations of attriters with studies of bilingualism. These in return would help provide insight into what is difficult and what is easy in either L2 acquisition and L1 attrition and the results from these studies should then feed back into the theoretical frameworks.

6. Conclusion

Native languages are not stable: any speaker who becomes bilingual can experience changes in how his/her L1 is accessed, processed and produced, and with prolonged and intensive exposure to another language, these changes may become more pronounced. Attrition has long been a neglected area of bilingualism research, possibly because it is a less 'rewarding' area of investigation: unlike in L2 acquisition, it can take a long time for these changes to become overtly visible, necessitating more sophisticated investigation and elicitation methods. The long incubation period, alongside the fact that human lives and human contacts are often messy and circumstances change all the time, has furthermore made it difficult to relate the development of attrition to language internal and external conditions. However, this in no way makes it less worthy of investigation. Attrition studies have contributed considerably to our understanding of the complex dynamics of language development under challenging conditions and made it possible for researchers to recognize the uniqueness of the bilingual mind. In particular, they have helped challenge the notion that monolinguals are an appropriate baseline for comparison – a perspective which Cook has compared to trying to fit a quart into a pint bottle (Cook, 2015: 10). An in-depth perspective on attrition offers new insights and approaches for contested issues in bilingualism research. Therefore, one of the primary objectives of the bilingualism research should be to integrate investigations of L1 and L2 development (Köpke & Schmid, 2011; Schmid, 2014).

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CHAPTER 12

Different situations, similar outcomes

Heritage grammars across the lifespan

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The rise of scientific inquiry focusing on bilingualism over the past few decades has also borne witness to an increase in the study of individuals and communities who speak a native language that is not the sociolinguistically dominant language of the environment in which they grew up. While it is common practice to refer to these diverse groups and individuals as "heritage speakers", it is unclear whether it is appropriate to classify all of them under the same terminology. In this chapter, we take a closer look at three different groups: (i) children, (ii) young adults, and (iii) elderly, moribund bilinguals who have all been referred to as heritage speakers in the literature. After exploring aspects of phonological, (morpho)syntactic, and semantic/pragmatic developments, we show that a great deal of symmetry exists between them, thus justifying the cohesive, overarching label of "heritage speakers" to all three sub-groups. Finally, we outline what this broader definition of heritage speakers means for long-standing debates in the literature, such as those that concern the acquisition, development, and maintenance of the heritage grammar across the lifespan.

1. Introduction

The main goal of this chapter is to provide the reader with a broad overview of research and theory in the field of heritage speaker bilingualism. Moreover, as the title indicates, we also aim to provide new insights emerging from our efforts to unify current research on child, adult, and moribund heritage grammars (HGs), which, until recently, have been considered different research programs with different goals and approaches. For this overview to be maximally successful, the topic first begs for definitions of a heritage language (HL) and a heritage speaker (HS). Herein, we will adopt Rothman's (2009) definition:

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> A language qualifies as a *heritage language* if it is a language spoken at home or otherwise readily available to young children, and crucially this language is not a dominant language of the larger (national) society. Like the acquisition of a primary language in monolingual situations and the acquisition of two or more languages in situations of societal bilingualism/multilingualism, the *heritage language* is acquired on the basis of an interaction with naturalistic input and whatever in-born linguistic mechanisms are at play in any instance of child language acquisition. Differently, however, there is the possibility that quantitative and qualitative differences in *heritage language* input and the introduction and influence of the societal majority language, as well as differences in literacy and formal education can result in what on the surface seems to be arrested development of the *heritage language* or attrition in adult bilingual knowledge. (Rothman, 2009: 156)

On the basis of this definition, and for the purpose of our discussion, we would like to emphasize three aspects. First, that HS linguistic competence may be (quantitatively and qualitatively) different from expected outcomes in monolingual acquisition,[1] but not necessarily incomplete or deficient. Second, that HL acquisition is child language acquisition in a bi/multilingual environment. And third, that although the term HS has typically been used to refer to *adult* bilingual populations, it applies to bilingual children, adolescents and even elderly populations (i.e., 4th and 5th generation speakers who often represent the final generation of (highly) proficient speakers of the HL) provided the bilingual context under which the native HL developed meets the sociolinguistic aspects of the definition above for each group. In fact, as interest in researching bilinguals has grown in the last decades, it has come to our attention that there are a number of communities and individuals who have acquired, and in some instances, maintained their HL under different conditions. Quite often, the term HS is applied rather loosely to different populations, and in this chapter, we explore the differences and similarities between three of these sub-groups. Particularly, we take a closer look at three groups of bilinguals; namely, (i) children, (ii) young adults, and (iii) elderly moribund speakers, who, in the literature, under the right conditions, have all been classified as HSs. We examine the extent to which this can actually be considered a unified research program by taking a closer look at related linguistic phenomena (e.g., phonology, morpho-syntax, semantics/pragmatics) in these three bilingual populations.

1. Capitalizing on the monolingual-bilingual comparison, and in light of the differential outcomes generally observed (e.g., Montrul, 2008, 2016), the idea that development in the HL is somehow obstructed or arrested as a result of a shift to the societal language has been generally referred to as *incomplete acquisition* (Montrul, 2008). We acknowledge, yet put aside, the discussion in the current literature with respect to this term. For more on this issue, we refer the reader to Pascual y Cabo and Rothman (2012), Putnam & Sánchez (2013), Meisel (2014), Kupisch & Rothman (2016).

Foreshadowing, we argue that, not only do these individuals fit the label of 'heritage speakers' (again, assuming Rothman's (2009) definition cited above), but they also show important similarities.

Before continuing with this discussion, however, we need to clarify the labels we use. By L1 acquisition, we mean the monolingual acquisition of a language from birth, while 2L1 acquisition is generally used with reference to the acquisition of two (native) languages from birth.[2] We distinguish between simultaneous bilingual acquisition and early second language acquisition (eL2). The first refers to the acquisition of two languages between the ages of 0–3 years; the second implies that one language is acquired from birth and the second after the age of 3 but still during childhood. Both are possible scenarios for heritage bilinguals. With respect to the latter we will also use the labels heritage speaker (HS), heritage language (HL), and heritage grammar (HG). Concerning "moribund" grammars, here we apply this label to individuals who are considered to be the likely final generation of speakers of a given HL with both production and comprehension skills. When referring to influence from one language to another, be it uni- or bidirectional, we will use the term cross-linguistic influence (CLI). We definitively do not assume, however, that CLI in bilingual development, adulthood or moribund grammars, can automatically be equated with "attrition".

2. Child HS development

As noted earlier, the term HS has typically been used in the literature to refer to bilinguals investigated in (young) adulthood, potentially leaving the impression that work on child developing heritage bilinguals does not exist. Indeed, looking for work on child bilinguals labelled as "heritage speakers" will yield comparatively few hits, because until recently the label had been used scarcely in research on bilingual development (see Aalberse & Hulk, 2016; Kupisch, 2013; Kupisch & Rothman, 2016). Instead, developing bilinguals have typically been called *sequential* or *simultaneous bilinguals*, depending on whether they come from families who speak *only* the minority language at home (both parents being native speakers of the HL) or from families where only one parent was a native speaker of the HL, while the other spoke the majority language. In our overview we will therefore include these two populations when the sociolinguistic environment meets the criteria for heritage language acquisition.

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2. In stating this, we want to clarify that we use (monolingual) L1 acquisition exclusively as a means of comparison. Agreeing with Rothman and Treffers-Daller (2014), we also classify HSs as native speakers.

Two further points on child bilingualism research should be noted. First, there has not always been an explicit focus on the HL, but often both languages have been considered. Nonetheless, these studies are of course insightful to HL development. Second, instances of complete societal bilingualism where both (or more) languages are co-dominant, official languages are not treated as a special case, although there seem to be different views on whether these can or should be considered HSs. Examples include, for instance, French-English bilinguals in Canada, or autochthonous minorities, such as Catalan speakers in Spain. An argument in favor of considering both types to be HSs would be their similar learning conditions. In fact, even in countries or regions which are officially bilingual, such as Quebec, not everyone necessarily speaks both languages fluently (see also Puig-Mayenco et al.'s, 2016 work on Catalan-Spanish bilinguals).[3]

Although research on child bilinguals dates further back, interest in bilingual development had increased substantially by the end of the 1970s, notably after Volterra and Taeschner (1978) put forward the claim that bilingual children learn language differently from monolinguals, i.e., by first developing some kind of hybrid or unitary language system (Stage I), then separating the lexicons (Stage II), then separating the grammars (Stage III) (see also Burling, 1959; Leopold, 1953; Vogel, 1975). Although this *Unitary/Fused System Hypothesis* has been criticized over the years, on both theoretical and empirical grounds, subsequent work must be seen in relation to it. Thanks to this proposal, awareness has increased that the issue of unified vs. separate systems was timely. It provoked critiques (e.g., Genesee, 1989; Meisel, 1989) and motivated systematic case studies of bilingual children. As pointed out by Genesee (1989: 165), "in order to uphold the unitary-system hypothesis, one would need to establish that, all things being equal, bilingual children use items from both languages indiscriminately in all contexts of communication." Clearly, this turned out not to be the case, giving rise to the *Autonomy Hypothesis*, i.e., the idea that bilingual children develop two independent language systems.

A considerable amount of empirical research followed this debate, tracking children for several years in their two languages.[4] This research is largely representative

3. Even speakers of dialects might be considered HSs, e.g., in Italy where Standard Italian is the majority language and where the local dialect can vary enormously from the Standard and is often passed on by the grandparents.

4. It is by no means restricted to English as the dominant language, but includes also German-French (e.g., Meisel, 1990, 1994; Müller, 1993), Spanish-Basque (e.g., Almgren & Barreña, 2001), French-Swedish (e.g., Granfeldt, 2000, forthcoming; Schlyter, 1993), French-Dutch (e.g., Hulk, 2004), Portuguese-German (e.g., Flores & Barbosa, 2014; Santos & Flores, 2016), German-Italian (e.g., Kupisch, 2007) and Italian-Swedish (e.g., Bernardini, 2003), Spanish-German (e.g., Lleó, 2016 for an overview) or Turkish-German (e.g., Bayram et al., 2017).

of children who have heard one or two languages *regularly* from birth. It might be typical for children in these studies that their HL develops more slowly, but there are also cases of relatively balanced bilinguals as well as cases where – at between birth and age 3 – the societal language develops more slowly (e.g., Kupisch, 2007; Schlyter, 1993). It goes without saying that not all children who grow up with exposure to two languages will end up being active bilinguals. For instance, De Houwer (2002) points out that out of 1,728 children in Flanders who heard two languages at home, only 14% also spoke both languages. In the following overview, we will focus on research on children who spoke both languages actively.[5]

2.1 Phonology

When Volterra and Taeschner (1978) proposed their Three Stage Model, they did not discuss phonology, though it seemed implicit that the phonologies of the two languages are separated when a separation of the lexicon occurs, i.e., before the separation of syntax. As Ingram (1981) argued, however, it is equally plausible to assume that the phonologies of the two languages separate from one another later. A relevant case study was Vogel (1975), who investigated the phoneme inventories of an English-Romanian child at age 2;0. She found few differences between the two languages concluding that the child, at that stage, had only one phonological system. A later study with an English-Italian child of the same age led Ingram to conclude the opposite, that is to say, that separation may occur very early, possibly already during the acquisition of the first 50 words (Ingram, 1981: 50).

After the 1990s, the Unitary System Hypothesis had been largely discarded, mostly based on morpho-syntactic studies. Most scholars took the early separation of phonology for granted, asking instead to what extent and under which conditions the two languages may influence each other. Many papers took Paradis and Genesee's (1996) proposal as a starting point, assuming that CLI can manifest in three possible ways: *acceleration*, *delay* (or *deceleration*), and *transfer*. For example, Lleó et al. (2003) found that the acquisition of Spanish codas in German-Spanish bilinguals is accelerated with respect to monolingual Spanish children due to a positive influence from German, where codas are relatively more common. Kehoe (forthcoming) has shown a comparatively early acquisition of the Spanish alveolar tap and trill in German-Spanish bilingual children. There are also many examples of delayed acquisition. For instance, Kehoe (2002) found that the production of

5. We focus on morpho-syntax and phonology. There is also relevant work on the development of the lexicon but we excluded this aspect for a lack of space (see, e.g., De Houwer, 1995 for an overview).

target-like vowel duration in the German of German-Spanish bilingual children was delayed due to influence from Spanish, which does not distinguish between short and long vowels on a phonemic level.

While acceleration and delay exemplify cases in which language contact leads to *quantitative* differences between bilinguals and monolinguals, e.g., in the number of omissions, there is also evidence for transfer, which in this research tradition is considered a case of *qualitative* differences with respect to monolinguals. In other words, bilingual children do things that monolinguals would never do, e.g., producing the Spanish voiceless consonants /p,t,k/ with a long lag VOT due to influence from German, where /p,t,k/ are produced with a long lag (Kehoe et al., 2004). Lleó (forthcoming) has provided evidence for another type of qualitative differences, namely *empty transfer*, i.e., the *non-implementation* of a rule that is absent in the other language of the bilingual. For instance, Spanish-German bilinguals did not apply assimilation rules in Spanish because these rules do not exist in German.

In contrast to much of the research cited above, Vihman (2015) recently argued that experimental studies and spontaneous cross-linguistic speech errors in bilingual adults and older children support the view that unconscious processing draws on both languages throughout the lifespan, suggesting that the emphasis on 'separate systems' (from birth or later) may be misconceived. Vihman's view may be subject to debate since the occurrence of CLI does not preclude the existence of separate systems. Yet, recent work on acquisition outcomes in simultaneous bilinguals does suggests that phonology is relatively more vulnerable to CLI than other aspects of language (e.g., Kupisch et al., 2014b). We will revisit this claim throughout this paper, exploring which domains of grammar may be more vulnerable to CLI.

2.2 (Morpho-)syntax

Morpho-syntax is probably the best studied area in bilingual language acquisition. Initially, much of the research occurred in response to the Unitary System Hypothesis. Studying German-French bilinguals in their two languages, Meisel (1986, 1989) showed that certain word-order patterns only appear in one or the other of the two languages, indicating that children follow different developmental paths in their two languages. Paradis and Genesee (1996) studied the acquisition of finiteness, negation, and subject pronouns in French-English children. Similar to respective monolingual children, these children acquired finiteness earlier in French than in English, they used subject pronouns differently in the two languages (with and without finite verbs in English; only with finite verbs in French), and they used negation with finite verbs post-verbally in French but pre-verbally in English. There are numerous other examples showing that bilingual children behave differently in their two languages and in accord with monolingual children (see e.g., De Houwer, 1995; Meisel, 2004; Serratrice, 2013 for overviews and Meisel, 1990, 1994 for a collection of relevant papers), which gave rise to the generally accepted view that bilingual children develop their two languages autonomously.

By the turn of the century, the tone changed again, with more and more researchers pointing out that, despite separation, the two language systems of bilingual children may influence each other. The idea of bilingual bootstrapping implied that bilingual children can pool out their resources, taking what is available to them from both languages, e.g., constructing relatively complex sentences in their lesser developed language with the help of more complex structures that they had already acquired in their other language (Bernardini & Schlyter, 2004; Gawlitzek-Maiwaldt & Tracy, 1996). While bilingual bootstrapping was argued for in the context of mixed and monolingual utterances, the notion of 'CLI' was generally restricted to investigations of influence phenomena in *monolingual* utterances. Like in phonology, many studies provided evidence that bilingual development can be accelerated or delayed compared to monolingual development. For example, Kupisch (2007) studied the acquisition of articles in German-Italian children, finding accelerated acquisition of German articles compared to monolingual German children and slightly delayed acquisition of Italian articles compared to monolingual Italian children. CLI may be related to language balance: it is often bidirectional in balanced bilinguals, depending on the phenomenon itself, but unidirectional from stronger to weaker language in more unbalanced bilinguals. However, there are also cases where language dominance plays a minor role: Hulk and van der Linden (2010) studied the acquisition of gender in Dutch-French and Dutch-Spanish children (age 3–6 years) in Holland, finding that the acquisition of Dutch gender was accelerated compared to monolingual Dutch children, the idea being that exposure to the Romance languages, where gender is more transparently marked, increased the children's awareness of grammatical gender in Dutch. A similar positive effect has been found from Greek to Dutch in Dutch-Greek bilinguals (Egger et al., forthcoming). In both cases, the influencing language was the HL. At the same time, the Dutch-Spanish bilinguals in Hulk and van der Linden's study were affected in their sensitivity to grammatical gender in Spanish, where they were slightly delayed, similar to the French-German and Italian-German children studied by Kupisch et al. (2002). A number of other studies have reported minor delays with respect to monolinguals, e.g., in the acquisition of clitic object pronouns in French, Italian and Portuguese (Flores & Barbosa, 2014; Müller & Hulk, 2001; Pérez-Leroux et al., 2009). It has been debated whether CLI is restricted to *quantitative* effects, i.e., acceleration or delay. Meisel (2007), in particular, has defended the idea that bilingual children proceed through the same acquisition stages as monolinguals and they make the same type of developmental errors, although they might go through these stages at faster or slower rates. However, recent studies also reported qualitative differences between monolinguals and bilinguals in the acquisition of morpho-syntax. For instance, bilingual Russian children have been shown to reduce their three-way gender system to a two-way gender system (Rodina & Westergaard, 2017).

2.3 Interfaces with semantics and pragmatics

Research related to semantic and pragmatic aspects of bilingual child (heritage) language has focused on the connection between meaning and structure (i.e., morpho-syntax and its interfaces with semantics and pragmatics). These studies contribute to the broad consensus that grammars are more vulnerable to CLI when there is an interaction between two modules of a grammar (see, e.g., Hulk & Müller, 2000; Müller & Hulk, 2001; Platzack, 2001; Sorace, 2011). For instance, the placement of adjectives in the Romance languages is determined by lexical and contextual factors. While most adjective classes follow the noun, e.g., Italian nationality and colour adjectives, e.g., *la macchina rossa* 'the red car, *la macchina italiana* 'the Italian car', some adjective classes may be used pre- or postnominally and the position of the adjective will determine its meaning, e.g., *l'uomo grande* 'the tall man' vs. *il grande uomo* 'the great/famous man'. By contrast, Germanic languages only allow prenominal adjectives. Several studies have shown that children acquiring a Germanic and a Romance language simultaneously pass through a stage during which they overuse the prenominal position in Romance where postnominal placement would be appropriate (e.g., Bernardini, 2003). Nicoladis (2006) even reported that some French-English bilinguals use postnominal adjectives in English, thus transferring the more frequent word order of French that is ungrammatical in English. Unlike reversals in Romance, where both orders exist, reversals in English could be classified as *qualitative* differences with regard to monolinguals because English has no postnominal adjectives.

A well-studied phenomenon at the syntax-semantics interface is article use in children acquiring a Romance and a Germanic language. German and English generally use bare plural nominals to express a generic reading, e.g., *In general, sunflowers are yellow*, and definite articles to express a specific reading, e.g., *The sunflowers (in the picture) are blue*. By contrast, most Romance languages use definite articles for both readings: *I girasoli sono gialli* 'The sunflowers are yellow' can refer to specific sunflowers or sunflowers in general, while bare nominals are ungrammatical (It. **Girasoli sono gialli*). In various studies, children have been shown to accept ungrammatical bare nouns in Romance and to prefer specific readings for Romance definite articles, although generic readings are perfectly acceptable too (Kupisch & Pierantozzi, 2010; Serratrice et al., 2009), suggesting influence from Germanic.

Finally, perhaps the most frequently studied phenomenon at the interfaces with pragmatics is the null subject parameter. While bilingual children acquiring one pro-drop language and one non-pro-drop language show different subject omission patterns in their two languages, as expected under the Autonomy Hypothesis, they nevertheless overuse overt pronouns in Romance in contexts where they are pragmatically inappropriate (e.g., Paradis & Navarro, 2003; Serratrice, 2007; Sorace & Serratrice, 2009). Importantly, these findings on interface vulnerability cannot be generalized, as there are also studies showing that bilinguals develop exactly like monolinguals (e.g., Ezeizabarrena, 2002).

2.4 Section summary

After the proposal and subsequent rejection of the Unitary System Hypothesis, research during the 1990s focused on demonstrating that bilingual children develop their two languages separately. The general tone during those times was that there are more similarities between monolinguals and bilinguals than there are differences. By the turn of the century, a new research trend emerged showing interaction of the two language systems. Research on morpho-syntax predominated, but there was a growing interest in phonological development as well as in the syntax-semantics and syntax-pragmatics interfaces, which were claimed to be more vulnerable. Interfaces played a relatively minor role in phonology, where the discussion centered more on factors such as dominance and markedness (see Lleó, 2016). Another debate concerned the question of whether influence was merely quantitative or not, with more and more evidence accumulating that qualitative differences are possible, though not the norm. An interesting question is whether those areas that have been identified as being particularly vulnerable to CLI and qualitative differences to monolinguals mirror those that are affected in adult bilinguals and moribund languages.

3. Adult HL bilingualism

Interest in the formal/theoretical study of adult HL bilingualism is relatively new, with most of the research appearing in the last two decades or so. The term HS, earlier referred to under other names such as "semi-speakers" (Dorian, 1977, 1981), gained currency in the late 1990s and early 2000s mostly in the context of the United States. Since then, converging evidence derived both from controlled experimental studies and face-to-face naturalistic research (e.g., conversational speech) has indicated that adult HS linguistic competence tends to differ from expected outcomes in monolingual acquisition, a finding that has been often referred to in the literature as “incomplete acquisition” (e.g., Montrul, 2008, 2016). Considering the theoretical quandary, it presents, i.e., how naturalistic acquisition from birth can result in divergent grammatical outcomes in adulthood as compared to monolingual speakers of the same language, it is not surprising that great efforts have been dedicated to trying to understand said outcomes and the implications that logically follow. The significance of these observations become particularly interesting in view of those previously reported for child HSs (§2). To contribute towards a better understanding of what this all means for linguistic theory, our goal in this section is, therefore, to provide the reader with a panoramic view of the field of adult HS bilingualism. To this end, we will pay due attention to adult HS linguistic outcomes in a variety of areas (e.g., phonology, morpho-syntax, as well as the interface between syntax and semantics/pragmatics) and will attempt to make our discussion central to issues of current relevance, such as age of onset of bilingualism and transfer selectivity.

3.1 Phonology

As noted earlier, because HS competence demonstrates that even naturalistic acquisition from birth can result in comparatively divergent grammatical outcomes in adulthood, the study of HS bilingualism has forced us to (re)examine and (re) consider age as being a (or the most) determinant factor of linguistic ultimate attainment. This is not to say that age is not an important factor since, clearly, it confers HSs with some advantages. For example, in a study assessing phonological and morpho-syntactic differences between late Spanish L2 learners and HSs (i.e., overhearers of the HL during childhood), Au and colleagues noted that while the two groups were comparable in terms of accuracy and reaction time for morpho-syntax, the HSs were much better in the phonological domain (Au, Knightly, Jun, & Oh, 2002). This finding was taken to indicate that early childhood language experience results in measurable benefits of language acquisition into adulthood, at least for phonology (Au et al., 2002). And while individual properties can be acquired in a monolingual-like fashion (e.g., Lein et al., 2017 for Voice Onset Time (VOT) in French), a number of recent studies have shown that adult HSs, when compared to monolingual speakers of the same language, also tend to exhibit differences and high degrees of variation. For example, differences have been found with regards to production of Spanish rhotics (Henriksen, 2015), VOT in voiceless stops (Amengual, 2012 for Spanish; Kupisch & Lleó, 2017 for Italian), a more approximant pronunciation of Spanish bilabial voiced stops (Rao, 2014), a tendency to centralize unstressed vowels (e.g., Alvord & Rogers, 2014; Ronquest, 2012, 2013), as well as a global foreign accent in HSs of Italian, French, German

(Kupisch et al. 2014a), Turkish (Stangen et al., 2015) and Portuguese heritage returnees (Flores & Rato, 2016).

3.2 (Morpho-)syntax

Similar to L1 (heritage) acquisition research, (morpho)-syntax has been the most thoroughly investigated domain of HL adult grammars. However, not all findings in this domain are consistent, nor has there been agreement on how to interpret them. On the one hand, HSs' patterns of language use have been documented to exhibit a number of non-standard features and to diverge to various degrees from age and socio-economical matched monolinguals. For example, in a study of Spanish language change in Los Angeles, Silva-Corvalán (1994) found that HSs developed strategies that eased the balancing of the two languages and reported evidence of grammatical simplification and language loss with regards to subjunctive modality, verbal morphology, and more. Similarly, in a study examining acquisition of the morphological and semantic distinctions associated with aspect in Spanish, i.e., preterit (perfective-bound interpretation) vs. imperfect (imperfective-bound interpretation), Montrul (2002) found differences in the verbal systems of adults HSs depending on their age of onset of bilingualism. Montrul's results, obtained from a series of production and judgment experiments, showed that age of onset of bilingualism as well as amount of exposure to the majority language play a definite role in ultimate attainment. Comparable findings have also been reported in a variety of languages and properties, such as verb and gender agreement in Spanish (e.g., Montrul, Foote & Perpiñan, 2008), inflected infinitives in Brazilian Portuguese (Rothman, 2007), differential object marking in Hindi, Romanian and Spanish (e.g., Montrul, Bhatt, & Girju, 2015), aspectual distinctions in Russian (Polinsky, 2006), word order, agreement, and possession in Egyptian and Palestinian Arabic speakers (Albirini, Benmamoun, & Saadah, 2011), as well as knowledge of clitics in European Portuguese (e.g., Rinke & Flores, 2014).

On the other hand, a number of studies have also shown that HSs can and do behave like monolinguals and/or 1st generation immigrants in certain grammatical aspects of language (see Kupisch & Rothman, 2016 for review). For example, in a study examining French as a heritage language (with German as the majority language), Kupisch and colleagues found that article use, adjective placement, gender marking, and use of prepositions were largely unaffected even under reduced input conditions (Kupisch et al., 2014b). Similarly, in an eye-tracking study examining Spanish HL mood distinction (subjunctive vs. indicative) in ambiguous contexts, Villegas (2014) found that monolinguals, HSs, and 1st generation immigrants similarly accessed lexically-encoded information in the main verb to anticipate the presence of an embedded clause with a subjunctive verb.[6] Also, Pires and Rothman (2009) found that HSs of European Portuguese in the US performed just like monolingual controls with regard to the morpho-syntax and semantic entailments of inflected infinitives.

A relatively new line of investigation, that complements efforts to understand HGs, attempts to examine the actual source of HS linguistic differences. Currently this research program is exploring five distinct possibilities: (i) *language attrition at the individual level* (Schmid, 2011), that is, the erosion of a previously acquired property to various degrees or possible loss (e.g., Polinsky, 2011); (ii) *incomplete acquisition* (e.g., Montrul, 2008; Polinsky, 2006), whereby reduced exposure and use of the HL result in an arrested development of the grammatical system; (iii) *missing input competence divergence* (Pires & Rothman, 2009), whereby the delimited nature of the input in qualitative terms HSs receive in the HL plays a deterministic role in their linguistic development, for example, when L1 attrition in the immigrant generation affects the quality of input the HSs receive (Pascual y Cabo, 2013; Pascual y Cabo & Rothman, 2012; Sorace, 2004); (iv) *alternative developmental paths* (Putnam & Sánchez, 2013), whereby HGs are assumed to develop on a path that leads to grammatical systems, even if divergent outcomes result; and (v) *lack of exposure to formal education in the HL* (Bayram, Pascual y Cabo, & Rothman, forthcoming; Rothman, 2007). An example of this research program is a study conducted by Pascual y Cabo (2013), who cross-sectionally explored knowledge and use of dative experiencer predicates (i.e., *gustar*-like verbs) in Spanish as a HL. In his study, Pascual y Cabo analyzed data from child and adult HSs and compared them to that of age-matched control child and adult monolingual speakers as well as 1st generation immigrants, an important and necessary group if one aims to address not just the issues of acquisition and development, but also those of input quantity/quality. His findings showed that all bilingual groups (HSs and 1st generation immigrants alike) displayed significant omission of dative marker 'a' in obligatory contexts. As a consequence of this omission, Pascual y Cabo noted that HSs had reanalyzed the semantic and syntactic constrains associated with these verbs, which resulted in a number of emerging optionalities that are ungrammatical in monolingual Spanish environments (e.g., acceptance of passives with *gustar*-like predicates). Monolingual Spanish speakers, on the other hand, displayed a high degree of accuracy both in terms of production and comprehension of all the properties associated with these verbs. Somewhat similar methodologies have been employed to examine a variety of properties such relative clauses in Russian (Polinsky, 2011) or differential object marking in Spanish (Montrul & Sánchez-Walker, 2013).

6. Alternatively, Villegas (2014) production results did show differences between these groups.

3.3 Interfaces with semantics and pragmatics

Perhaps the most prevalent theoretical attempt to explain how CLI works has been the *Interface Hypothesis* (*IH*, Sorace, 2011). As a brief summary of the core tenets of the IH, Sorace (2011: 5) and colleagues initially suggested that grammatical knowledge that required the 'interface' between the narrow syntax and other cognitive domains would promote "emergent optionality" (in L1 attrition) and/or "protracted indeterminacy" (in bilingual L1 acquisition).[7] Coming to a consensus of an exact definition of an "interface" has proven to be difficult in both experimental and theoretical models of grammar and cognition; however, here we highlight the result of research that shows restructuring effects associating syntax with other aspects of grammar. Similar to what we reported on developing HSs in Section 2, much evidence from research on adult HSs has accrued in support of this view. For example, a number of studies in Spanish as a HL such as Silva-Corvalán (1994), Montrul (2004), and Zapata, Sánchez, and Toribio (2005), among others, showed that while the core syntactic features related to subjects and clitic objects remained intact, those features associated with their discourse/pragmatic distribution, i.e., topicalizations and clitic left dislocations, were more problematic and exhibited higher degrees of variation and non-standard uses. Similar findings have also been reported with other HLs, such as Russian (e.g., Ivanova-Sullivan, 2014) and Korean (Kim, Montrul, & Yoon, 2009). But evidence against the Interface Hypothesis has also been reported. Leal, Rothman, and Slabakova (2014), for example, used an offline grammaticality judgment task to examine knowledge of the discourse-appropriateness of Clitic Right Dislocation in Spanish HSs and in dominant Spanish native speakers. Their findings revealed no differences between the two groups, which suggest that HSs do not necessarily have problems with the syntax-discourse interface when there are no time constraints. In a related study, Cuza (2013) examined the effects of CLI in the acquisition of subject-verb inversion in Spanish matrix and embedded *wh*-questions,[8] a syntactic property devoid of discourse/pragmatics restrictions and found that HSs have more difficulties with embedded questions than with matrix questions, which was taken to indicate that the syntax proper can also be affected by crosslinguistic influence. Similarly, Pascual y Cabo and Gómez Soler (2015) examined Spanish HSs' knowledge and use of

7. Granted, as pointed out to us by Jason Rothman (p.c.), recent developments in attempting to model and predict CLI in bilingual grammars acknowledge that, to some degree, there are very few instances when only one domain of grammar is activated and isolated from other 'interfaces'.

8. Briefly put, Spanish and English differ with regards to raising verbs in interrogatives (i.e., inversion), particularly in the case of embedded *wh*-questions in which English exhibits neither raising nor do support.

preposition stranding,[9] a core syntactic property that is grammatical in English but not in Spanish. Interestingly, their findings revealed more target-like results from sequential HSs than from simultaneous HSs, which led them to conclude that not only are core syntactic properties vulnerable for CLI, but that the timing of first exposure to the dominant language is also a contributing factor to HL outcomes. In other words, they contended *à la* Putnam and Sánchez (2013) that the presence of the two languages from birth may create a path of acquisition that diverges from the monolingual path allowing for emerging HS options.

A number of studies have also investigated CLI at the interfaces between syntax and semantics. For example, Montrul and Ionin (2010) and Kupisch (2012) examined the interpretation of definite articles in Spanish and Italian HSs, with English and German as the respective dominant languages. The results of both studies showed a tendency to (over)accept bare nominals with generic interpretations, a context in which the two Romance languages require articles while respective dominant languages, i.e., English and German, allow or even require article drop. Kupisch et al. (2017) have investigated definiteness effects in Turkish HSs in Germany in their two languages. The definiteness effect differs in the two languages in that Turkish, but not German, allows definite DPs in negative existentials. It turned out that the bilinguals performed differently in their two languages and in accord with each of the respective target-systems. The study showed language separation and maintenance of the properties of the target languages, despite some minor differences with regard to Turkish monolinguals. In summary, there are studies showing vulnerability of both interfaces, but at the same time studies showing monolingual-like performance, making it difficult to maintain claims about the general (exclusive) vulnerability of the interfaces and especially the syntax-pragmatics one.

3.4 Section summary

Given space limitations, our overview of the literature on adult HGs had a narrow scope and was limited by recent studies on phonology, morpho-syntax, and the interfaces of syntax with semantics and pragmatics. Briefly put, for decades, the consensus has been that HSs' linguistic outcomes across domains differ significantly from those of monolingual speakers of the same language. It is worth noting that these findings set apart the linguistic outcomes observed between the developing trajectories of child heritage grammars and the apparent competence outcomes for adult HSs. Taken together, this is especially significant since the process of

9. Or the possibility to extract noun complements from prepositional phrases.

HL acquisition in both cases takes place in early childhood and naturalistically. Interestingly, however, some recent findings and discussions have indicated that once the playing field is levelled for monolinguals and HS bilinguals in terms of input differences, opportunities to use the HL, and access to education in the HL, that such differences either do not result at all or are significantly lessened (see Kupisch & Rothman, 2016 for a review).

4. Moribund HL bilingualism

The third group of individuals often classified as HSs are those individuals and communities who are the final or penultimate generation of speakers (in most cases, the 4th or 5th generation since initial immigration) who have a relatively high degree of proficiency in the HL (Schmid & Köpke, 2007; Seliger & Vago, 1991). As noted earlier, these individuals have been referred to as "semi-speakers" or "semi-linguals" (Dorian, 1977, 1981; Hansegård, 1968), given that early research suggested that their grammars were, in some ways, 'deficient' when compared with a monolingual standard, a common thread that links all three HS groups. As we demonstrate below, the assertions that these groups of HSs exhibit radically deficient grammars when compared with other types of HSs are patently false, given the wealth of evidence that now exists that demonstrates differences to be sure, but along with the maintained complexity in many domains of these moribund heritage grammars. Here we restrict our discussion primarily to heritage varieties of Germanic languages spoken throughout the world, sometimes referred to as enclaves, language islands, or *Sprachinseln* (e.g., Boas, 2009; Johannessen & Salmons, 2015; Page & Putnam, 2015; Putnam, 2011) simply because most of the available work has focused on diasporic Germanic languages, although research on other moribund varieties such as Finnish (Virtanen, 1979) and French (Bullock, 2009) in the USA can also be found in the literature. HSs of these varieties usually share the common traits that they are rural, possess little if any literacy in the HL, and are elderly. Remaining consistent with the two previous sections, here we focus on select studies that address phonological, (morpho)-syntactic, and semantic-pragmatic aspects of grammar. Research conducted among these populations of bilinguals is accompanied with particular challenges, most notable among them is the fact that these individuals are almost exclusively elderly and who find experimental tasks to be particular challenging and cumbersome. As a result, the majority of these studies include a relatively low number of participants when compared with the previous groups of HSs discussed in the previous sections and the experimental tasks deployed in these studies are somewhat limited in scope and design due to other mitigating factors (e.g., age, illiteracy, task anxiety, etc.). While acknowledging these differences in research on moribund, elderly HL-speakers, what we show below is that, in spite of these potential confounds, we empirically observe grammatical systems that are as equally complex in most instances as the grammars found in the two aforementioned groups of HS.

4.1 Phonology

Phonological systems are generally considered to be relatively stable and resistant to large-scale decay and/or encroachment from the dominant L2 phonology (Bullock & Gerfen, 2004). Although some shifts and changes have been observed in HSs of these varieties, these changes do not represent considerable changes in their phonological systems. Allen and Salmons (2015) explore the acoustic differences in production of obstruents by heritage Norwegian (L1) and American English (L2), both of which are 'aspiration' languages, but different in other ways. Allen and Salmons found subtle differences in the way that final laryngeal distinctions are realized in the speech of these bilinguals with respect to the voice/voiceless and lenis/fortis quality of these consonants. For example, they show that heritage Norwegian speakers in the Upper Midwest "have retained a Norwegian-like method of marking final laryngeal distinctions, relying less on vowel length than is otherwise reported for English" (Allen & Salmons, 2015: 111). Although the phonology of heritage Norwegian remains relatively stable, there are instances when bidirectional influence (albeit asymmetric) exists between both grammars (see Schmid & Köpke, 2007), although Allen and Salmons (2015: 113) acknowledge that the intrusion of aspects of these respective phonological systems into one another is "relatively modest".

Joo et al. (to appear) investigated the status of the /a/ ~ /ɔ/ merger in Moundridge Schweitzer German (MSG), a Palatinate-based moribund variety of German spoken in South Central Kansas. Although the regional variant of American English (L2) spoken by the heritage MSG speakers (L1) has the /a/ ~ /ɔ/ merger (i.e., the traditional 'cot' ~ 'caught' merger), MSG, based on its Palatinate heritage, should retain this contrast. Joo et al. examined the speech of two native speakers of MSG and focused on the following factors to determine whether or not convergence in the HG phonology had taken place. In their study, no evidence of convergence was found for the phonetic realizations of /a/ and /ɔ/. Although the phonetic realizations of both languages by these speakers were generally separate and unique, the apparent merger of /a/ ~ /ɔ/ for one of the two informants suggests that the phonemic contrasts in this heritage grammar may be less stable and can potentially be susceptible to change and restructuring. The results of Joo et al.'s study suggest that the sound systems of the heritage and dominant language remain in principle independent from one another. This is consistent with Bullock and Gerfen's (2004) analysis of the phonological inventory of Frenchville-French, a moribund variety of French spoken in Pennsylvania. Beyond, phonemic inventory, additional studies such as Geiger and Salmons's (2006) treatment of VOT-times in the Kölsch dialect spoken in Dane County, Wisconsin shows that, although the L1 dialect remains relatively consistent since the 1940s, they observed trends in the English spoken in the area by both these bilinguals and other monolinguals that suggest that the heritage L1 has had a lasting effect on the L2 (English). Finally, pilot research by Déhe (2017) on the intonation of polar questions in North American (NA) Icelandic, spoken in Manitoba, shows prosodic traits associated with both L1 Icelandic and L2 English. Déhe also notes bidirectional influence in her study, concerning the inclusion of L1-Icelandic prosodic patterns in polar questions in English by these bilinguals.

4.2 (Morpho)-syntax

As was also the case for child and young adult HSs, perhaps the most intensely studied domain of these HSs is the morpho-syntax and word order in these dialects. Concerning gender in American Heritage Norwegian, Lohndal and Westergaard (2016) show that the three-gender system of Norwegian remains intact in a subset (n = 50) of these remaining speakers; however, there seems to be a trend towards overgeneralization of masculine forms. It is interesting to note that in their sample that declension classes markers – such as definite suffixes – remain largely unaffected by this shift. In this domain, detailed research on the case system of German dialects abounds (see Keel, 2015 for an overview). In most instances, the observed number of cases and inflections is reduced. As an example, Johnson's (1994) study of the grammar of the Volga German dialect of Schoenchen, Kansas (Ellis County) documents the reduction of a three-way distinction (e.g., nominative, accusative, and dative) in the definite and indefinite articles to a predominantly two-case distinction (e.g., nominative and oblique). The reduction of inflectional case paradigms is not only unique to those German-language enclaves in constant contact with English, but has also been observed in dialects found in the former Soviet Union (see e.g., Berend & Jedig, 1991 for an overview). Although at first glance the reduction in morphosyntactic case distinction may appear to be a simplification of the grammar, recent work by Keel (2015) and Yager et al. (2015) challenge this assumption. Firstly, Keel notes that another Volga German dialect spoken in Ellis County, Kansas (in the community of Victoria (Herzog)), shows the emergence of an ablative/prepositional case for singular masculine and neuter nouns. These emergent patterns contrast with standard German norms as well as those that appear in the Palatinate mother dialect, thus indicating that they are a neologism (data from Keel, 2015: 135):

(1) a. *Der Mann is* ***in + den*** *Wasser gefall.*
the man is in + the.$_{\text{ABL}}$ water fallen
'The man fell into the water.' (Standard German = ***in + das***)

b. *Der Man hot* ***in + den*** *Wasser gestand.*
the man has in + the.$_{\text{ABL}}$ water stood
'The man stood in the water.' (Standard German = ***in + dem***)

The inflection of the definite article in the prepositional phrase in (1a) and (1b) is identical, however, these nuances are not found in either Standard German or the mother dialect region of Victoria (Herzog) German (i.e., Palatinate region). Additionally, as noted by Yager et al. (2015), the retention of a 3-case distinction in pronominal systems seems to reflect a trend similar to Differential Object Marking (DOM) effects commonly found in other languages such as Spanish. In a survey of Wisconsin Heritage German, Texas German, and Misionero German (e.g., the Palatinate-based German dialect spoken in the Misiones Province of Argentina), Yager et al. contest the widely held assumption of paradigmatic attrition in favor of the notion of restructuring involving semantic and pragmatic context.

The concept of restructuring – as opposed to attrition or loss – of forms can also be observed in the domain of syntactic word order. All Germanic languages (except for English) in matrix declarative clauses adhere to a strict verb-second (V2) rule, whereby the inflected verb occupies the second position in the matrix clause. In contrast, in subordinate clauses, German exhibits a verb-last (V-last) rule, accordingly to which the inflected verb occurs in the final position. The V-last rule in global heritage varieties of German largely remains intact. In a study on word order in MSG, Hopp and Putnam (2015) tested the durability of the V-last rule in subordinate clauses. In their elicited narrative data, a bifurcating trend was observed where the complementizers *weil* 'because' (8/9 = 89%) and *dass* 'that' (15/17 = 88%) licensed the V2-order, whereas relative clauses (19/25 = 79%; that begin with the generic relative pronoun *wo*) and the temporal complementizer *wenn* 'when' (22/25) preferred V-last ordering. This situation in MSG can be viewed as a complexification of the grammar given that both options are available and are largely dependent on the selection of the complementizer. In a similar vein, Larsson and Johannessen (2015) document and discuss variation in the placement of finite verbs in heritage Scandinavian (Norwegian). In contrast to the expected order of Neg-V found in Mainland Scandinavian languages, they explore recent variations in embedded clauses where the opposite ordering (V-Neg) is consistently realized. Here we again observe the trend where even though these grammars are moribund and not commonly spoken anymore, there still exists a significant degree of complexity. Importantly, the fact that this grammar system still exhibits these changes and some degree of variability indicates that it is very much still alive. It is also important to note that the changes observed here cannot easily be attributed to incomplete acquisition or even attrition; rather, restructuring and redistribution of elements in the HG seems to be the most accurate description of these findings. In contrast to developing (children) and adult bilinguals discussed in the previous sections, these observed changes seem to occur at a slightly more rapid pace, but the end results appear to be remarkably similar.

4.3 The interface with semantics and pragmatics

The (morpho)-syntactic interfaces with semantics and pragmatics respectively have been heralded as perhaps the most vulnerable domain in the maintenance of HGs (Sorace, 2004). Again, we issue caution in appealing to the narrative of language attrition and loss here, given the restructuring of the case systems treated in Yager et al. (2015). While keeping this in mind, studies focusing on semantic-pragmatic aspects of these moribund HSs do show a high degree of reduction of form and function. For example, Putnam and Arnbjörnsdóttir (2015) investigate whether long-distance anaphoric binding persists in North American (NA) heritage Icelandic spoken in Eastern Manitoba. In Mainland Icelandic, logophoric binding is only possible when the embedded clause possesses a verb that inflects for subjunctive mood. In their data, Putnam and Arnbjörnsdóttir show that not only is logophoric binding no longer viable in NA Icelandic, but there is also a widespread loss of morphophonological inflections designated for subjunctive mood. The binding properties of NA Icelandic thus now strongly resemble those found in English. Turning to passive voice, Putnam and Salmons (2013) note the reduction and loss of passive voice in the MSG-dialect. In place of passive voice constructions, the remaining MSG-speakers commonly opt for an unspecified agent in subject position:

(2) ***Ebber*** *callt* *mich*. (intended 'I am being called.')
someone calls me
'Someone calls me.'

Finally, building on previous work on discourse particles in German-language heritage dialects, Weilbacher (2011) investigates the usage of English-origin discourse particles *of course*, *see*, and *now* (Examples (3) and (4) from Weilbacher, 2011: 468, 470).

(3) *Ich glaub in Corpus un Galveston da baut er seine*
I believe in Corpus and Galveston there builds he his
Schlitterbahn ***of course***.
S of course
'I think in Corpus and in Galveston he's building his Schlitterbahn of course.'

(4) ***See*** *der is da dort in der Schule gegang in Deutschland*
see he is there there in the school gone in Germany
fier so-was.
for so-such
'See, he had actually gone to school in Germany to study [carpentry].'

Although the debate remains open whether the usage of these English-origin discourse markers actually reduce the cognitive load of speech planning (as claimed by Weilbacher), their existence does raise the questions concerning the nature of the pragmatic/discourse system of these HL moribund dialects, i.e., does an increased usage of these elements indicate a switch to a primarily English-based pragmatic/ discourse structure? In parallel to bilingual bootstrapping, as observed in developing bilinguals, these examples may simply indicate that bilinguals have more linguistic tools at their disposal. Having access to two language systems enables them to express meaning distinctions that they could not express by drawing on only one language. In summary, when compared with studies focusing on the phonology and (morpho)syntax of these German-language speech islands, it appears that the semantic-pragmatic component of grammar is altered the most over the course of the lifespan.

4.4 Section summary

Our brief survey of phonological, (morpho)syntactic, and semantic-pragmatic aspects of moribund Germanic HGs reveals the following: First, these findings challenge the common narrative that moribund HGs often resemble a simplified version of the monolingual standard (e.g., the semi-speaker / semi-lingual designation). The studies referenced above demonstrate that this is not the case for most of these grammars in spite of the discontinuous input and lack of opportunities to actively use (or passively hear) the HG. Second, as pointed out by Putnam and Sánchez (2013), it is difficult to argue that these individuals and groups – much like other HSs – possess end state grammars that are the result of some sort of incomplete or truncated acquisition process. This forces us to revisit these observed changes and classify them as instances of systemic restructuring. There are particular challenges associated with conducting research with these individuals, e.g., cognitive aging, lack of literacy of the HL, unfamiliarity with tasks, observer's paradox, low number of remaining speakers, geographical remoteness, etc. These caveats notwithstanding, we can see that some of these challenges exist when researching HSs in the other two populations previously discussed in this chapter. With respect to aging and cognition, research on these HSs stands to make strong contributions to ongoing research on bilingualism and aging (Goral, 2014; Ivanonva et al., 2016; Keijzer & Schmid, 2016; Rossi & Diaz, 2016). This combined research (i.e., bilingualism and aging and attributes of moribund grammars) stands to extend our current knowledge in both of these domains. For example, continued exploration of these HSs from a united approach will reveal what additional information is difficult to retrieve beyond mere lexical retrieval (Goral, 2007) and whether certain aspects of the grammatical system can be enhanced and reactivated after long periods of dormancy (de Bot & Stoessel, 2000).

5. Conclusion

Although (sometimes) substantial differences exist when comparing the demographics of these three sub-groups, our brief survey here shows that their similarities – at least with respect to their grammars – far outweigh any significant differences. Not only do they meet the standard definitions of HSs, but they also show noticeable parallels. The importance of this is non-trivial; moving forward, we can call upon data from these populations – both in isolation and in combination – to test hypotheses on bilingual development across the lifespan. For example, fruitful research could include a comparison of the same phenomenon in similar language combinations across the three groups. Of equal importance, research on moribund grammars must move beyond the traditional, and often incorrect, supposition that speakers of these variants have undergone (significant) attrition in their L1 system. In fact, in spite of certain noted differences that distinguish these moribund HSs from the previously discussed sub-groups in this chapter, the grammatical outputs and general restructuring processes at work appear to share important similarities with other HGs. Admittedly, current and future research with these elderly moribund communities must strive to unite grammatical and cognitive aging research to achieve a more comprehensive understanding of forces at play, which shape these grammatical systems over the course of the lifespan. This certainly does not diminish or limit their contributions to our understanding of the continuous development of bilingual grammars from childhood through adulthood to later stages in life.

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PART IV

Bilingual cognition, neuroscience and impairment

CHAPTER 13

Bilingualism and executive function

What's the connection?

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This chapter examines the idea that much of the confusion and contradictory evidence about the relation between bilingualism and executive function can be traced to an over-simplification of the two main terms. Using more nuanced definitions for "bilingualism" and "executive function", research examining the effect of bilingualism on cognition in infancy, childhood, and adulthood is reviewed. The sum of the evidence is then used to attempt to extract a common "mechanism" for the diverse effects that is consistent with a broader definition of the main concepts of bilingualism and executive function. The conclusion is that a continuous notion of "executive attention" in which there is a linear relation between degree of bilingualism and degree of executive function demands provides a good fit with the empirical evidence and a plausible explanation for the modifications found in the brain and behavior of bilinguals across the lifespan.

1. Introduction

The first evidence that bilingualism might impact nonverbal cognitive functioning was reported by Peal and Lambert (1962) but the issue was not systematically investigated for more than 25 years after that original report. It was not until patterns began to appear from studies examining metalinguistic awareness in monolingual and bilingual children, a separate research question, that the notion of nonverbal cognitive implications of bilingualism became feasible. Following early evidence that bilingual children outperformed monolingual on metalinguistic tasks (e.g., Ben-Zeev, 1977; Cummins, 1978; Feldman & Shen, 1971; Tunmer & Myhill, 1984), it became clear that these language group differences were found on only certain tasks. In a series of studies, Bialystok (1986, 1988) showed that metalinguistic tasks that depended primarily on grammatical knowledge were performed equivalently by all children but that those that additionally required controlled or selective attention to avoid interference from conflict were performed better by bilingual children.

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This difference was not based on the linguistic demands of the task but rather on the underlying cognitive requirements.

The explanation for why bilingual language use should have an effect on cognitive processing follows from substantial behavioral and neuroimaging evidence showing that both languages in the bilingual mind are jointly activated during language use (review in Kroll, Dussias, Bice, & Perrotti, 2015). For this reason, fluent language performance that is confined to the target language without unwanted intrusions from the other language requires a rapid and efficient selection mechanism. The proposal is that this selection mechanism is part of the domain-general executive function system, a set of processes that reside in the frontal lobe (with support from subcortical regions) and is responsible for such effortful processes as shifting, inhibition, updating, and selecting. Because of its constant involvement in language selection, aspects of this executive function are modified, changing the way the system functions across a wide range of activities (review in Bialystok, Craik, Green, & Gollan, 2009). Thus, bilingualism leads to an *adaptation* in the executive function system that is evident through performance on certain executive function tasks and examination of the brain networks engaged by them.

This argument has become the basis for a large body of research that is aimed at investigating its primary claim, namely, that bilinguals will outperform monolinguals on executive function tasks. However, the results of the studies produce conflicting results, creating considerable confusion. The present argument is that the inconsistencies stem from an oversimplification of the main concepts in the hypothesis, namely, bilingualism and executive function. Unlike much research in Psychology where independent variables are tested for their influence on dependent variables, both bilingualism, the independent variable, and executive function, the dependent variable are nuanced constructs that have a complex relation to each other. Simple binary definitions of bilingualism and summary measures of performance will not reveal this complexity.

2. Defining the terms

Languages are a big part of living in a global society and it is difficult to completely avoid encounters with other languages. Formal education typically includes language courses as part of degree requirements, beginning from very early grades. The population diversity in many urban centers makes exposure to other languages both frequent and inevitable. An immigrant past may impart knowledge of a language spoken at home or by grandparents, even though the language is no longer part of one's life. In none of these examples does an individual necessarily have full proficiency in another language but in all cases there is familiarity and some degree of comprehension. At what point do these experiences determine that an individual is bilingual?

The standard research methodologies used in Psychology for comparing performance across groups (between-groups designs) depend on the reliability with which individuals are assigned to the groups and the assumption that the relevant variable that distinguished between the groups is the only source of systematic variation. These assumptions are problematic for bilingualism: there is no agreed cutoff point determining when knowledge of another language is sufficient to designate "bilingualism", thereby introducing large variation into each group. Inevitably, bilinguals and monolinguals, however defined, often differ on a range of lifestyle and background variables that may themselves affect performance. These are immense challenges for conducting research on bilingualism. The essential problem is that bilingualism is not a categorical variable (Luk & Bialystok, 2013), so interpretation of results requires detailed knowledge about the criteria for constructing the groups. In a study by Luk (2008; described in Bialystok, 2016), 150 young adult participants were divided into five groups on the basis of detailed information provided in a language use questionnaire and objective vocabulary testing. The resulting groups were monolinguals and four bilingual groups that differed in their degree and type of bilingualism. Participants completed a series of executive function tasks, and the results showed that the most bilingual group performed these tasks significantly better than did the monolingual group. The outcomes for the other three groups were stratified between these endpoints in order of degree of bilingualism, but none of the pairwise contrasts were significant. In other words, small variations in degree of bilingualism did not lead to significant differences in performance on these executive function tasks; only the comparison between the most bilingual and the most monolingual group produced this result. This study points to the importance of defining the groups carefully. All four bilingual groups were bilingual in a real sense, but they had different degrees of experience and these differences determined the results. Therefore, it is impossible to compare results across studies without knowing the criteria by which bilingualism was determined.

The second central construct in this research is executive function. There are many proposals for the correct model of executive function, each with its own set of tasks that assess the features of that view. The most influential such model in this research has been the unity and diversity view proposed by Miyake and colleagues (Miyake et al., 2000). The model is based on three independent but interrelated components – shifting, updating (working memory), and inhibition. Much of the bilingualism research has proceeded on the basis of the tasks proposed by Miyake and colleagues and attempted to confirm the componential structure of that model but the results have been mixed. However, Miyake and colleagues (2000) reported in their original study that the intercorrelations across components were low, so it is not surprising that the model has not provided an effective framework for identifying the relevant processing differences between monolinguals and bilinguals. Other conceptions of executive function take a different approach. For example, Engle and Kane (2004) propose a view of executive function that is based on a continuum of attention, leading to the notion of working memory capacity. This interpretation is fundamentally different from the Miyake view and would lead to different hypotheses about the relation between executive function and bilingualism, although this view has not been the basis of much research in bilingualism. Therefore, in the absence of a clear operational definition of executive function, definitive evidence for a relation between bilingualism and executive function ability remains elusive. What, then, is the evidence connecting bilingualism to modifications in executive functioning?

3. Research with infants

The notion that bilingualism could have generalized consequences for nonverbal cognitive ability originated in research with children (Peal & Lambert, 1962) but now covers the lifespan. The presentation of the main findings in this body of research will be organized in terms of the chronology of lifespan development.

The first type of evidence with infants comes from studies of visual attention to faces as a source of linguistic information in the first year of life. In addition to maintaining attention to phonetic distinctions, infants in bilingual environments are also able to use visual cues to determine when a speaker has switched to speaking a different language, even in the absence of auditory information. Monolingual infants can detect such changes until about 7 months old, but evidence from infants watching silent videos shows that bilingual infants continue to be able to notice when a speaker switches languages on the basis of these visual cues up to one year old. This finding has been demonstrated for French-English bilingual babies watching a video of a speaker switch between English and French (Weikum et al., 2007) and Spanish-Catalan bilingual babies watching the same video of a speaker switch between English and French (Sebastian-Galles, Albareda-Castellot, Weikum, & Werker, 2012), two languages they have never heard. Thus, their response is based on a coherent concept of a language system and not on an association to a particular language with which they are familiar. In both studies, monolingual babies failed to detect the language switch. Thus, infants who are building up representational systems for two languages are also learning that they are distinct and can be discriminated. Corroborating these results Pons, Bosch, and Lewkowicz (2015) used eye-tracking to show that from 8- to 12-months old, bilingually-raised infants pay more attention to the mouth of a talking face than the eyes whereas monolingually-raised babies generally pay more attention to the eyes. Mouth movement provides more relevant linguistic information than does information from the eyes, and in the first year, infants raised with more than one language attend to the more informative source. A recent study by Ayneto and Sebastian-Galles (2017) showed that this bias for bilingual infants to focus on the mouth by bilingual children extended beyond linguistic information and also characterized attention to emotional state in adult faces; 8-month old bilingual infants focused on the mouth more than monolingual infants but by 12 months this difference was no longer found.

The second type of evidence extends the research beyond language and examines responses of infants to nonverbal stimuli. Two studies by Kovacs and Mehler showed that bilingually-raised infants at 7-months (2009a) and 12-months old (2009b) were able to override a habitual response to look to one side to receive a visual reward (dancing clown) and replace it with an eye movement to the opposite side when the position of the reward changed. Infants raised in monolingual environments continued to look to the original location even when the reward no longer appeared there. Similarly, a study of 6-month-old infants engaged in a visual habituation task demonstrated better stimulus encoding and recognition memory by infants raised in bilingual environments than for their monolingually-raised counterparts (Singh et al., 2015). Like the Kovacs and Mehler studies (2009a, b), these results indicate better flexibility of attention for infants with bilingual experience.

The third source of evidence from infants moves further into cognitive systems and reveals differences between language environments in the ability to generalize memory for events in the first year of life. Infant memories are largely specific to the stimuli and context in which they were formed (Hayne, 2006) but this specificity limits concept formation and learning. The development of memory and cognitive systems requires generalizing across cues and contexts, an achievement that begins to emerge at around 12 months. In a series of studies, Brito, Barr and colleagues examined memory generalization in infants being raised in monolingual or bilingual environments. Infants in the experimental condition observed a puppet perform three simple actions and then spent 30 minutes playing with toys. Infants in the control condition did not observe the initial actions and began the experiment by playing with the toys. In the test phase, a different puppet was presented and the question was whether or not children would generalize the actions that had been performed by the first puppet to the new puppet. The results showed that bilingual children made this connection significantly more often than monolingual children, and that none of the children in the control condition performed these actions on the new puppet. The results indicate memory generalization across cues by bilingual infants than monolingual infants at 6 months (Brito & Barr, 2014) and at 18 months (Brito & Barr, 2012). Moreover, these results were replicated for 18-month old infants whose home languages included two similar languages, two typologically different languages, or three languages; all three groups outperformed comparable monolinguals on this task (Brito, Sebastian-Galles, & Barr, 2015). This language group difference in memory generalization was replicated in a study of 24-month old infants, with better performance by the bilingual group, but there were no differences between infants in the two language groups on cued recall, working memory, emotional responsiveness, or productive vocabulary (Brito, Grenell, & Barr, 2014). Thus across all these experiments, bilingual infants showed greater memory generalization than monolingual infants, with no other differences between groups.

These studies examining detection of language switches, visual response to spatial position for reward, and memory generalization converge on the interpretation that in the first two years of life infants being raised in multilingual environments display different patterns of visual attention from those raised in monolingual homes. This research provides an important constraint on the explanations for bilingual effects on cognition because these infants have extremely limited productive proficiency in language, so the group differences cannot be attributed to language use. Instead, these findings suggest that early exposure to a bilingual environment promotes the earlier development of a flexible attention system.

4. Cognitive processing in childhood

There is a large body of literature examining the cognitive consequences of bilingualism in young children (review in Barac, Bialystok, Castro, & Sanchez, 2014; meta-analysis in Adesope, Lavin, Thompson, & Ungerleider, 2010) so only highlights of that literature will be discussed here. The majority of the research presents young children with tasks that involve various kinds of conflict or require some form of switching between tasks or responses. The general finding is that bilingual children perform these tasks better than monolingual children, although there are exceptions that will be discussed.

Because the Miyake model has been so influential in framing this research, most studies have used tasks that follow from his model and are considered to be tests of the specific components of that model. One of the most common tasks of this type is the flanker task introduced by Eriksen and Eriksen (1974). This task was the basis for the attention network task (ANT; Fan et al., 2002) to distinguish among three attention networks, namely, executive control, alerting, and orienting and was subsequently adapted by Rueda et al. (2004) to create a children's version. Children see a horizontal line of fish and the task is to "feed" the center fish by pressing a response key indicating whether the fish is facing left or right. As with the standard flanker task, the manipulation is that the four flanking fish can be pointing in the same (congruent trials) or opposite (incongruent trials) direction relative to the center fish.

In one of the early studies with this task, Yang, Yang, and Lust (2011) presented the children's ANT to 4½-year-olds who were bilingual English-Korean children in the US and compared their performance to monolingual English speakers in the US and monolingual Korean speakers in both the US and Korea. The bilingual children outperformed the two monolingual groups on both speed and accuracy; in a follow-up study, 5½ -year old Korean-English bilingual children in the US obtained accuracy scores that were comparable to adults (Yang & Yang, 2016). Importantly, there was also a small but reliable effect of culture in which monolingual Korean children in Korea were more accurate but slower than the two groups in the US demonstrating that, not surprisingly, factors in addition to bilingualism also influence performance on these tasks.

Also using the ANT, Yoshida, Tran, Benitez, and Kuwabara (2011) studied 3-year-olds and found that bilingual children outperformed monolinguals and that better ANT performance was related to better word learning. Kapa and Colombo (2013) tested children across a wide age range who averaged 10-years old and showed that bilinguals performed the task significantly faster than monolinguals but that accuracy was equivalent in the two groups, possibly because the task was too easy for the older children. Engel de Abreu et al. (2012) reported a study with 8-year-olds in which both monolingual and bilingual children were from very low socioeconomic backgrounds and again, bilingual children outperformed monolinguals on this task. Similarly, Mezzacappa (2004) studied 6-year olds with a range of backgrounds and found faster performance on the ANT by bilinguals than monolinguals and by children with high socioeconomic status than children with lower socioeconomic status. Pursuing the involvement of culture as a factor, Tran, Arredondo, and Yoshida (2015) administered the children's ANT to 3-year-olds children from three countries (USA, Argentina, and Vietnam) who were monolingual and bilingual and found that bilingualism and certain cultures were both associated with better performance: bilinguals outperformed monolinguals and Eastern children outperformed Western children irrespective of bilingualism. Finally, some studies have used the standard adult version of a flanker task in which the stimuli are arrows or chevrons and reported similar effects. Poarch and Van Hell (2012) tested 7-year-olds and found that bilinguals performed the task faster than monolinguals (in most conditions) and Poarch and Bialystok (2015) tested 9-year olds and obtained a similar result.

A task similar to the flanker task but used less often in this research is the Simon task. Like the flanker, incongruent trials introduce a cue that interferes with the correct response. Stimuli are associated with a key press, with each response key positioned on one side of the display monitor. The stimuli are presented on one side of the display such that half the time the stimulus display position corresponds to the position of the response key (congruent trials) and half the time it does not (incongruent trials). Effortful attention and control are required to overcome the tendency to respond on the same side as the stimulus presentation. Bilingual children have been shown to perform this task better than monolinguals at 5-years old (Martin-Rhee & Bialystok, 2008), 5 ½-years old (Morales, Calvo, & Bialystok, 2013), 6-years old (Bialystok, Martin & Viswanathan, 2005), 7-years old (Poarch & Van Hell, 2012), and 5–9 year olds who varied in their degree of bilingualism (second-language proficiency) with a greater degree of bilingualism associated with better performance (Tse & Altarriba, 2014).

Some studies using executive function tasks such as flanker or Simon have not found these effects. Carlson and Meltzoff (2008) tested 6-year-olds who were monolingual, bilingual, or attending a language immersion program and found no significant difference in performance on the flanker task, although they did show better bilingual performance on other conflict tasks in their battery. Two studies by another group also failed to find performance differences attributable to language background on the children's ANT (Anton et al., 2014) or a Stroop task (Dunabeitia et al., 2014). These studies both included children over a 6-year age range from approximately 6- to 12-years old (possibly the same children in both studies reducing the independence of the contributions), and the unusually wide age range might be part of the reason that the results are different from those found in other studies. The inevitably large variance attributable to age can overwhelm the necessarily smaller variance attributable to bilingualism unless the model contains sufficient power. Similarly, Gathercole et al. (2014) reported data from a large sample that covered the entire lifespan (3-year-olds to older adults) representing four language "configurations" based on language dominance and home language in English-speaking communities. They found better performance by monolinguals and English-dominant participants, although only for some of the comparisons. However, the structure of the sample in terms of the language configurations was largely uncontrolled and no information was provided about participants in terms of social class, education, or other relevant measures, except that monolinguals were from England and all other groups were from Wales. In an early criticism of the research on the possible role of bilingualism in cognitive development, Morton and Harper (2007) argued that the effects found in the research might be attributable to differences in socioeconomic status rather than bilingualism. Their study showed no language difference in performing a Simon task, but the study was severely underpowered with only 17 children in each group so the results must be treated cautiously. It is uncontroversial that SES is associates with cognitive performance on executive function tasks (see discussion below) but that association does not preclude the role of other factors such as bilingualism from also having an effect.

The flanker and Simon tasks are generally considered to be assessments of inhibition, but other tasks that measure a different aspect of inhibition show different results. In both the flanker and Simon tasks, the need for inhibition is in the requirement to avoid attending to a distracting cue (the flanking stimuli or the irrelevant position) in order to attend to the cue relevant for the response (the central stimulus or the stimulus color). However, another group of executive function tasks that are also classified as inhibition tasks require the inhibition of a prepotent response, and for these tasks, the results are different. Tasks of this type include such paradigms as gift delay (refrain from opening an attractive gift box when left alone), go/no-go paradigms (resist pressing a key when a specific stimulus appears), and to some extent, day-night tasks in which the child must name a picture (e.g., sun) with an opposite name ("night") and inhibit the overlearned association to respond with "day". These tasks generally do not show performance differences between monolingual and bilingual children (Barac, Moreno, & Bialystok, 2016; Bonifacci, Giombini, Bellocchi, & Contento, 2011; Carlson & Meltzoff, 2008; Engel de Abreu et al., 2012; Esposito, Baker-Ward, & Mueller, 2013; Martin-Rhee & Bialystok, 2008) although in all those studies, bilinguals did outperform monolinguals in tasks that assessed the type of inhibition involved in the flanker or Simon tasks.

Another task that has been used in this research is the Dimensional Change Card Sort Task developed by Zelazo, Frye, and Rapus (1996). Children are asked to sort a set of two-dimensional cards (e.g., red trucks) by one dimension (e.g., color) then resort the same cards by the other dimension (e.g., shape). The ability to perform the post-switch classification emerges gradually from about 3- to 5-years old. Although the task requires some type of executive function, the requirement is not clearly attributable to any individual component of the Miyake et al. (2000) model. Instead, children need to selectively attend to the relevant dimension, inhibit attention to the other feature, hold a sorting rule in mind and update it for the post-switch phase, and override the response established in the pre-switch phase to individual stimulus cards. Several studies have demonstrated better performance in this task by bilingual children than by their monolingual peers (Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008; Kalashnikova & Mattock, 2014; Okanda, Moriguchi, & Itakura, 2010).

Almost all these studies use between-groups comparisons that require assumptions about the equivalence of the groups. Four studies have taken a different approach and examined the relation between bilingualism and executive function performance within the same children as a function of their level of bilingualism. The first is a longitudinal study that tested children at 24 months and 31 months and found that children who became more bilingual over this period showed the largest advantage over monolingual children performing a battery of executive function tasks at 31 months (Crivello et al., 2016). The second is also a longitudinal study that studied children over a one-year period between 9- and 10-years old and showed that level of bilingualism predicted the increase in level of executive control within the same children (Riggs et al., 2014). Third, in a sample of low socioeconomic status bilingual children who were 8- to 10-years old, degree of bilingualism predicted performance on executive function tasks with no contributing prediction from any other background variable (Thomas-Sunesson, Hakuta, & Bialystok, in press). Finally, a study of children in immersion education programs also indicated that performance on executive function tasks from about 7- to 10-years old was predicted by their degree of bilingualism (Bialystok & Barac, 2012). In all these cases, better performance on the tasks was associated with higher degree of bilingualism. This kind of evidence supports the interpretation that the effects found in the between-groups studies are experience-dependent, since more experience leads to greater outcome. Considering all these results, the interpretation is that bilingual experience leads to changes in the executive function system that support better performance on these tasks.

5. Effects of bilingualism in adulthood

The first study to investigate the cognitive consequences of bilingualism in adulthood compared monolingual and bilingual adults who were middle-aged (mean age 43 years) or older adults (mean age 70 years) performing a Simon task (Bialystok, Craik, Klein, & Viswanathan, 2004). Bilinguals outperformed monolinguals at all ages, a finding that set in motion a large amount of research and drew widespread attention to bilingualism. However, when the study was repeated the next year and included a group of young adults, no differences between monolingual and bilingual participants were found for the young adults (Bialystok, Martin, & Viswanathan, 2005). Subsequent researchers conducting similar experiments have also found it difficult to find this effect for young adults.

The results of studies using executive function tasks with young adults continue to be inconsistent. Studies with young adults by Bialystok (2006) and Costa, Hernandez, Costa-Faidella, and Sebastian-Galles (2009) showed that there were language group differences only on the most difficult conditions of an executive function task, with equivalent performance on simple conditions in the same study. Nonetheless, other studies show better performance by bilingual young adults more broadly (Bialystok, Craik, & Luk, 2008; Bialystok, Craik, & Ryan, 2006; Blumenfeld & Marian, 2011; Calabria Hernandez, Martin, & Costa, 2011; Colzato et al., 2008; Costa, Hernandez, & Sebastian-Galles, 2008; Marzecova, Asanowicz, Kriva, & Wodniecka, 2013; Prior & MacWhinney, 2010; Treccani, Argyri, Sorace, & Della Sala, 2009; Yang, & Yang, 2016). In contrast, no language group differences were found by Paap and Greenberg (2013). They reported three studies in which young adults who self-identified as monolingual or bilingual performed four standard executive function tasks, namely, anti-saccade, Simon, flanker, and switching, and found no differences between groups. A later study following the same procedure and using the same tasks (Paap & Sawi, 2014) and a third publication that presented the combined data from the first two studies (Paap, Johnson, & Sawi, 2015) showed the same results (although these studies include the same participants so do not provide an independent contribution). Other studies have also shown no behavioral differences in executive function in monolingual and bilingual young adults (Gathercole et al., 2014; Kalia, Wilbourn, & Ghio, 2014; Kousaie & Phillips, 2012; Kousaie et al., 2014; Prior & Gollan, 2013; Scaltritti, Peressotti, & Miozzo, 2015; von Bastian, Souza, & Gade, 2016). However, there are many differences between these studies, including the way "bilingualism" is defined and the groups constructed and how the results are scored and analyzed, all of which affect the results. These issues are discussed in more detail elsewhere (Bak, 2015, 2016; Bialystok, 2016; Kroll & Bialystok, 2013). A simple decision such as whether or not data trimming procedures will be used can significantly eliminate group differences (Zhou & Krott, 2016).

Unlike studies with young adults, behavioral investigations of executive function in older adults have been more consistent in revealing performance differences between monolinguals and bilinguals (Bialystok et al., 2004, 2005, 2006, 2008; Goral, Campanelli, & Spiro, 2015; Salvatierra & Rosselli, 2010; Schroeder & Marian, 2012; Soveri, Rodriguez-Fornells, & Laine, 2011), although even here there are some exceptions (de Bruin, Bak, & Della Sala, 2015; Kirk, Fiala, Scott-Brown, & Kempe, 2014). Why would there be behavioral differences on these tasks for children and older adults but not young adults? One possibility comes from the average speed of response and standard deviation obtained for these groups. Taking the flanker task as an example, the mean RT, including congruent and incongruent conditions, is about 500 ms, a response time that is difficult to improve because of a stimulating experience. The mean RT for both children and older adults is typically longer than those for young adults allowing more room for individual differences related to a group experience to influence the outcomes. In this sense, the results from young adults for simple executive function tasks may be at ceiling levels and contain insufficient inter-individual variability for group differences to emerge. For research with young adults that attempts to understand the cognitive structures involved in executive function and the effect of task manipulations on those outcomes, it is beneficial that individual experience has little effect. That may be one reason why the task designs are so simple. However, if the question is to understand individual differences more fully, then the task needs to provide the opportunity for a wider range of performance.

6. The mechanism of cognitive change in bilingualism

Across the lifespan, there is evidence for changes in cognitive and brain structure that can be traced to bilingualism, but the extent and nature of these changes appear to be different at each stage. Differences in infancy are related to patterns of visual attention, particularly in terms of attention to faces. In childhood, bilingual children outperform monolinguals on behavioral tasks that involve conflict resolution or switching, such as adaptations of flanker and Stroop tasks. Much of the research with young adults relies on simple executive function tasks, and many (but not all) of those studies reveal no behavioral differences between groups, particularly with young adults. However, older adults performing the same tasks often do show better outcomes for bilinguals than monolinguals. What is the common core of these results?

A leading initial hypothesis was that bilingualism "trained" inhibitory control through the constant need to select the target language in the context of competition from the other language, as described above. The notion was that in selecting the target language, the competing language was actively suppressed. The explanation provided a plausible description of performance on many of the tasks used in this research. For example, in the flanker task or Stroop task, participants respond to the target and need to ignore interference from the competing cues; in some sense, then, participants inhibit attention to the flanking stimuli or color word name. Similarly, children performing the Dimension Change Card Sort Task discussed above inhibited attention to the previously relevant dimension. Fortifying this view, the inhibition explanation coincided with the appearance of Green's (1998) Inhibitory Control Model in which it was argued that bilingual language processing was based on an attention system, the Supervisory Attention System, that inhibited the unwanted language so that processing could proceed in the target language.

This speculation identified inhibition as the relevant process and argued that it was somehow enhanced through the experience of inhibiting a competing language. Such a view was consistent with the unity and diversity model of executive function proposed by Miyake and colleagues (Miyake et al., 2000) around the same time to clarify the structure of the executive function. Their model proposed that there were three core components that were moderately correlated with each other – shifting, updating (working memory), and inhibition – and contributed independently to performance on executive function tasks. This model and the tasks used by Miyake in the research investigating that model have continued to frame and provide direction for research on bilingualism. A common interpretation in the bilingualism literature, therefore, is that a component of the executive function, such as inhibition, is developed in the context of language selection and then transferred to other domains for other purposes (see e.g., Hilchey & Klein, 2011).

Several later developments, however, challenged the view that inhibition was the central mechanism for explaining better bilingual performance on executive function tasks. First, studies with children using tasks that required inhibition found different results if the inhibition were defined in terms of avoiding distraction (e.g., flanker-type tasks), for which bilinguals performed better than monolinguals or refraining from executing a response (e.g., gift delay), for which there were no language group differences (e.g., Carlson & Meltzoff, 2008; Engel de Abreu et al., 2012; Foy & Mann, 2014; Martin-Rhee & Bialystok, 2008). Although these are different aspects of inhibition, they are not distinguished in the Miyake et al. (2000) model; stop-signal and Stroop tasks, for example, are considered equivalent in their contribution to the inhibition component. At least for children, therefore, the structure of executive function in general and the role of inhibition in particular proposed by Miyake and colleagues did not correspond to behavioral evidence.

The other development was the extension of this research to include pre-verbal toddlers and infants with only rudimentary control of comprehension and essentially no language production. In both cases, if cognitive differences from bilingualism could be detected, they could not be attributed to the experience of inhibiting the non-target language. Yet, studies with children in the first year of life (Kovacs & Mehler, 2009a) and pre-school toddlers (Bialystok et al., 2010a) both found significant differences in the way in which monolingual and bilingual children performed nonverbal conflict tasks. Cognitive change is evident before productive language is established.

Third, the research with adults did not conform to the predictions from the explanatory framework based on the Miyake model in three crucial aspects. Given that the effect of bilingualism involved changes in executive function and frontal processing, studies employing many of the tasks used by Miyake to demonstrate these constructs should have revealed differences between language groups but did not. Moreover, the inhibition hypothesis predicts that group differences will be found in incongruent trials that include distraction but not in congruent trials that do not. However, the majority of the studies that reported group differences on these tasks found them equally in both trial types (Hilchey & Klein, 2011), again challenging inhibition as a likely explanation. Moreover, as Paap and Greenberg (2013) noted, there was little correlation across various executive function tasks. If executive function as specified in the Miyake model were the underlying mechanism, then the evidence should emerge on all these tasks. However, Miyake and colleagues (2000) reported in their original study that these intercorrelations were low, so it would be surprising if they became robust when applied to research on bilingualism. Overall, the inhibition model and the notion of transfer provide a poor fit to the patterns of results obtained from research on bilingualism.

An alternative to component processes in executive functioning is to consider the broader concept of attention. Baddeley's (1986) model of working memory included a central executive that moderated the function of the domain-specific slave systems through *attention*. This central executive bears striking resemblance to what others have called executive function and fits well with the notion of executive function proposed by Miyake et al. (2000) but is not fractionated into component processes. The main difference between the inhibition view and the attention view, however, is in the mechanism responsible for the "modulation" of cognitive operations. Moreover, changes in the central executive do not "transfer" to slave systems but rather modulate the performance in those systems differently. Similarly, Engle and colleagues define "working memory capacity" or "executive attention" as "the cognitive system in which memory and attention interact to produce complex cognition" Shipstead, Harrison, and Engle (2015: 1863). Unlike Miyake's view, this executive attention is a continuous construct, making it more likely to show experience-dependent adaptation than would be found for a discrete construct. No transfer is needed because the executive attention system is modified through continuous experience, influencing performance on all tasks.

This notion of executive attention is compatible with the evidence found across the lifespan for bilingualism-dependent plasticity. What unites the results from infants, children, and adults is attention, and the measures at each stage of the lifespan are invariably assessments of attention to different kinds of representations. In the first year of life, infants in bilingual environments demonstrate better control over simple visual attention than infants in monolingual environments. Attention is at the core of the executive function tasks that both children and adult are asked to perform in this research. Moreover, because it is conceptualized as a continuum rather than as a discrete process, it is easy to imagine a quantitative relation between the intensity of experience and nature of the outcomes, a finding that is again compatible with research for children (Bialystok & Barac, 2012) and adults (Singh & Mishra, 2012).

Attention is a plausible domain in which to search for a mechanism for the cognitive effects of bilingualism. A small number of studies has included both attention and bilingualism in the design. Two studies examined monolingual and bilingual young adults who did or did not have a clinical diagnosis of ADHD (Bialystok et al., 2017; Mor et al., 2015). In both studies, bilingual participants with ADHD showed significant deficits on executive function tasks compared to the other groups, suggesting that an attention disorder not only prevents bilingualism from boosting performance but possibly also adds to the burden of the disorder (but note there were no monolinguals in the Mor et al., 2015 study). In contrast, a study by Sorge, Toplak and Bialystok (2017) tested over 200 typically-developing children between 8- and 11-years old and assigned a score to each child indicating the degree of bilingualism and the degree of attention ability. Unlike the studies by Mor et al. (2015) and Bialystok et al. (2017), none of the participants were clinically impaired but rather varied in their level of attentional control within the normal range. Higher bilingualism scores and better attention ability were both associated with better performance on three executive function tasks, with little interaction between them and no additional burden for their combination. In other words, both better attention and greater bilingualism had similar outcomes. These results suggest some underlying commonality between processes involved in attention and processes affected by bilingualism. Crucially, however, these effects require that the attention system is intact, allowing bilingualism to exert influence on performance. When the attention system is impaired as in clinical ADHD, the ongoing attention demands of bilingualism, presumably for language control, overburden the system.

The current hypothesis is that lifelong bilingualism impacts a set of processes subsumed under the category of executive attention. These attention processes are modified by bilingualism in that from infancy onward, bilingual environments and bilingual language use continually place pressure on selective attention in ways that are not part of monolingual experience. Thus, executive attention is continually adapted for use in bilingual environments and as a result, the modulated attention system is better able to perform some types of tasks. The bilingual experience shapes attention throughout life.

This mechanism is different from the view in which a process, like inhibition, is used in the context of one kind of task, such as language selection, and then transferred to another domain to boost performance in those tasks, such as executive function. This configuration is shown in Figure 1a. This mechanism is the one commonly used in the training literature; a process is built up through practice in one domain and then is available to improve performance on either similar (near transfer) or different (far transfer) tasks. For example, Jaeggi, Buschkuehl, Shah, and Jonides (2014) showed both near and far transfer for working memory training, with far transfer demonstrated through higher scores on a fluid intelligence test. However, Engle and colleagues (e.g., Harrison et al., 2013) have disputed this view and argued that working memory training through the use of complex tasks (that is, tasks that require more than a single process to perform) may show near transfer but there is no evidence for far transfer, particularly to measures of fluid intelligence.

An alternative to transfer, therefore, is adaptation. This notion is illustrated in Figure 1b. The processes and brain networks involved in executive attention develop and adapt in response to bilingual experience, just as they develop and adapt in response to all experience. But to the extent the bilingualism places specific pressures on this system, notably for selective attention, the attention system takes on a configuration that is suited to carrying out those ongoing attention demands.

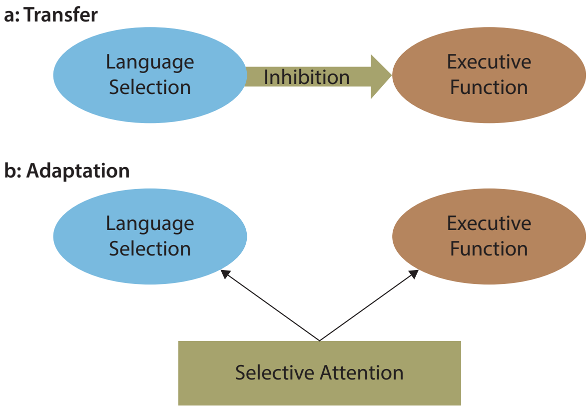

Figure 1. Transfer of skills vs adaptation of processes

Nothing is "transferred"; rather, the system has developed in the case of infants, or adapted in the case of older learners to accommodate these demands. Subsequently, all cognitive functions that recruit this executive attention system is recruiting a system with those adaptations.

How would such adaptation be evident? A reconfigured system would be shown by qualitatively (infant attention) or quantitatively (behavioral measures of executive function) different performance as a function of the experience. Both types of results have been found. Attention begins to develop at birth and evolves throughout childhood and remains malleable in adulthood, so is well positioned to provide the basis for a set of findings that extend across the entire lifespan. This is consistent with the notion of neuroplasticity, defined as "persistent changes in behavior and psychological function that occur as a consequence of experience" (Kolb et al., 2012). But the largest effect and the most important evidence comes from the accumulation of a lifetime of experience. The adapted attention system may well be the basis of growing evidence for cognitive reserve in bilinguals, expressed as the ability to maintain cognitive function in older age and cope with the early stages of dementia while cognitive functioning continues at apparently normal levels (Bialystok et al., 2016).

There is much that remains unknown about the consequences of bilingualism for mind and brain across the lifespan, but the picture is increasingly clear and coherent. At first it was necessary to establish if such consequences even existed, but that evidence is now persuasive, even in the context of inconsistencies. It is now necessary to focus attention on explaining the underlying basis for those effects, both in the service of understanding how one particular experience, bilingualism, leads to adaptations in human cognition and in harnessing that mechanism to improve cognition broadly. Incredibly, that was the conclusion made by Peal and Lambert following their report of the first credible evidence for positive effects of bilingualism on cognitive development: "The results of this study indicate the value of shifting emphasis from looking for favorable or unfavorable effects of bilingualism on intelligence to an inquiry into the basic nature of these effects. Perhaps further research may profit from this different emphasis" (Peal & Lambert, 1962: 21). This is precisely the agenda for current research.

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CHAPTER 14

Words on the brain

The bilingual mental lexicon

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In this chapter, we view the recent evidence on the bilingual lexicon that points to a dynamic view of lexical processes. In contrast to earlier assumptions that words in the bilingual's two languages were represented and processed independently, the findings of studies with both adults and children demonstrate that words in both languages are activated in parallel. Critically, the co-activation of the two languages does not depend on their structural similarity but on the very presence of the two languages themselves. The consequences of cross-language activation can be seen in language processing, not only from the first language (L1) to the second (L2) but also from the L2 to the L1. They can also be seen in the recruitment of cognitive resources in response to the demands of language processing and in the way that words come to influence language processes at the level of the grammar. From this perspective, the lexicon is far more than a collection of words but a lens into the dynamics of bilingualism.

1. Introduction

There is something magical about the elegant ease with which children acquire language. As adults, our initial amusement at mispronunciations quickly gives way to awe when we hear mere three-year-olds forming quite complex and complete sentences. Awe can quickly turn into wistful envy when these same children effortlessly navigate in and out of multiple languages: Many of us who have failed at learning a second language to a level of fluency in adulthood have longed to turn back the clock. Indeed, in the past, the assumption has been that child language learners have a corner on the market with respect to brain plasticity, whether it be in their first (L1) or a second language (L2). In fact, early research on bilingualism largely focused on testing the limits of this cognitive flexibility, attempting to identify the cut-off age at which L2 learning could no longer proceed in a native-like fashion. And while several decades of research have continued to confirm the malleability

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of the nascent brain, particularly for language, there is now a growing body of research that provides a compelling argument for continued plasticity from the cradle to the rocking chair. These findings have been particularly striking in the domain of language. With the advent of more sophisticated research methods including eye-tracking and neuroimaging techniques, we have been able to examine the language learning process and its implications for the brain to a granular level previously unimagined. The story that is now unfolding speaks of a dynamic system that is highly flexible, suggesting that the "all or nothing" approach to finding brain plasticity in research on language learning that we initially embarked on was too simplistic. In the present chapter, we examine the bilingual mental lexicon through the lens of a broadly developmental perspective, tracing how the dynamics at the level of the word play out for different learners in different contexts across the lifespan, building the argument that the source of evidence for plasticity changes over the course of time.

2. Bilingual language co-activation

We begin by illustrating the dynamic interplay of languages in the mental lexicon as a highly permeable and interactive language system. Indeed, one of the reasons we believe the bilingual mental lexicon is fundamentally dynamic in nature is because of the permeability of the system. A central finding in the bilingual literature that has been repeatedly demonstrated is that both languages of a bilingual are concurrently active to some extent, regardless of whether the bilingual is speaking, reading, or listening to speech, and even in contexts where only one language is being used (e.g., Colomé, 2001; Costa, Miozzo, & Caramazza, 1999; Dijkstra, 2005; Hermans, 2004; Spivey & Marian, 1999). Although these findings were first illustrated in adult learners, recent evidence has revealed a similar permeability in child L2 learners both in word production (Poarch & Van Hell, 2012) and word recognition (Von Holzen & Mani, 2012; for a recent review see DeAnda, Poulin-Dubois, Zesiger, & Friend, 2016), suggesting that the flexibility and interaction we see in the bilingual lexicon exists from the earliest stages of learning and development. For example, Von Holzen and Mani (2012) tested German toddlers in a bilingual German-English immersion preschool on a modified priming paradigm to investigate the extent to which both languages are activated during language processing. In the study, toddlers sat in front of a computer and listened to sentences in their L2 English (e.g., "I see a slide") and then heard a word in their L1 German (e.g., *Kleid*, "dress") while viewing two images on the screen. The German word *Kleid* labeled one of the two objects on the display, and toddlers' eye-movements were tracked to the correct image, in this case a dress. When the last word of the English sentence (e.g., “slide”), the so-called prime word, rhymed with the German target label (e.g., *Kleid*), it created an overt phonological overlap between languages, and children were quicker to look to the correct image. Recognition was therefore facilitated by the heard similarity in L1 and L2 phonology. In the critical condition, however, it was the German translation of the English prime word, a word they never heard, that overlapped in phonology with the German target label (e.g., children would hear “I have a leg” followed by *Stein*, where the German translation of “leg” is *Bein*). In this condition where the rhyme relationship exists only through translation and was not overtly heard, toddlers’ recognition of the target picture was again impacted, but was this time impaired, demonstrating that the English prime word’s L1 translation was co-activated during language processing. These findings provide strong support for co-activation at the lexical level, even in bilingual children.

In contrast to research on children, the evidence for language co-activation in proficient adult bilinguals is now legion. Earlier studies had been open to criticism for using paradigms that required the use of both languages in the experimental paradigm (see Kroll, Bobb, & Hoshino, 2014, and Kroll, Dussias, Bice, & Perrotti, 2015, for recent reviews). Since then, a series of studies have restricted the language of use in the experimental setting to one language alone and have consistently demonstrated co-activation of the L1 during L2 processing and have even found some evidence of L2 activation during L1 processing (e.g., Marian & Spivey, 2003; Thierry & Wu, 2007; Wu & Thierry, 2010; Von Holzen & Mani, 2014). To illustrate, in Marian and Spivey (2003), participants eye-movements were tracked while they looked at a display of four objects and heard instructions to pick up one of these objects. In the critical condition, the auditory L2 target label (e.g., English “marker”) sounded similar to the L1 label of one of the four objects in the display (e.g., *marka*, Russian “stamp”). They found that participants looked to the cross-language distracter significantly more than to other unrelated distracter objects, suggesting that both the L2 target label and L1 distracter label had been co-activated. When they tested the reverse direction, there was also a trend for the activation of the weaker (L2) language during L1 processing (see also Marian, Spivey, & Hirsch, 2003; Spivey & Marian, 1999). Language co-activation of the L2 in an L1-only context is known to be more difficult to observe under these conditions (e.g., Weber & Cutler, 2004) and is typically only found when there is overt phonological input from the L1 that overlaps with the L2. However, the most recent evidence from eye-tracking and neuroimaging suggests co-activation of the L2 during L1 processing, even in the absence of bottom-up activation from the L1 (e.g., Bobb, Von Holzen, Mayor, Mani, & Carreiras, in preparation; Shook, 2014). The evidence for language co-activation has been modeled in recent accounts such as BLINCS for bilingual spoken word recognition (Bilingual Language Interaction Network for Comprehension of Speech, Shook, & Marian, 2013), which captures developmental changes to the language system as a consequence of learning. Simulations showed co-activation of words from both languages previously used during training, and included phonologically as well as semantically related words.

An important observation in reviewing the research that illustrates cross-language activation is that its existence does not appear to depend on the form of the bilingual's two languages. Differences in the two languages may modulate aspects of language co-activation, but these cross-language interactions are seen for bilinguals who read and speak languages that use different written scripts (e.g., Hoshino & Kroll, 2008; Thierry & Wu, 2007), and different articulators, in the case of a spoken or written language and a signed language (e.g., Emmorey, Borinstein, Thompson, & Gollan 2008; Morford, Wilkinson, Villwock, Piñar, & Kroll, 2011). Finding that the literal form of the language does not restrict the activation of the language not in use suggests that the openness of the bilingual's two language systems to one another is a general feature of bilingualism. This is not to say that structural differences across the two languages are unimportant, but that at a more abstract level, it is being bilingual and using more than one language that creates change.

2.1 Adaptations to each language

As the research reviewed above shows, a bilingual's two languages are in effect in constant contact and points to the possibility that each language impacts the other as a result. Although it may not be surprising that the stronger L1 leaves its mark on the L2 – think of an L1 accent that can be heard when speaking in the L2 – evidence suggests that this change is bidirectional so that the L2 also impacts the more "established" L1 (e.g., Ameel, Storms, Malt, & Sloman, 2005). At the lexical level, Ameel et al. showed that bilingual speakers become less sensitive to the distinct properties within each language to label common objects, with their performance in each language changing to reflect the influence of the other language. At the level of the grammar, Dussias and Sagarra (2007) gave proficient Spanish-English speakers complex Spanish sentences to read, such as "El policía arrestó a la hermana del criado que estaba enferma desde hacía tiempo" (The police arrested the sister of the young man who was ill for some time). Native monolingual Spanish speakers would typically interpret that it is the sister who had been ill, while native monolingual English speakers would interpret that it is the young man who had been ill. The bilingual Spanish-English speakers who had significant exposure to English-speaking environments adopted the parsing strategy of their L2 English, even though they were reading in their native language Spanish. The results suggest that in-depth exposure to a second language reconfigures the language system as a whole. Although this finding was initially taken to be an indication of attrition among these L2-immersed bilinguals, their L1 performance was actually quite strong, suggesting that it instead reflects a dynamic change as a function of bilingualism, not language loss.

One might argue that this impact takes time and would only emerge after years of consistent exposure to the L2. Surprisingly, these effects of the L2 on the L1 seem to take place at the earliest stages of L2 learning. In a very recent study, Bice and Kroll (2015) asked how early these consequences might manifest. Native English speakers who were beginning to intermediate learners of Spanish were asked to complete a lexical decision task in their L1 while having their event-related potentials (ERPs) recorded. Stimuli included cognates, words that share similar meanings across languages that are spelled alike and sound alike (like English "insect" and Spanish *insecto*), and noncognate words. Typically, we find that proficient bilinguals respond much faster in deciding that cognate words are real words compared to noncognates. While the behavioral data showed no such cognate effect, regardless of proficiency, the ERPs for the intermediate group reflected a reduced N400 effect for cognate words in their L1. Strikingly, even beginning learners visually showed an emerging reduction in the ERP record although it did not reach statistical significance. The findings from this study strongly suggest that changes to the L1 take place at the neural level even before we see behavioral evidence for these alterations and take place much earlier than previously thought. The findings are consistent with neural evidence for L2 changes in brain activity at early stages of language learning, specifically after just 14 hours of L2 instruction (e.g., McLaughlin, Osterhout, & Kim, 2004) and together suggest that bidirectional change begins from the earliest moments of language contact. Interestingly, these early changes do not manifest behaviorally and require the sensitivity of neuroimaging techniques to demonstrate their emergence. One area of investigation which requires increased attention is this seeming disconnect/delay between neural and behavioral change. We suggest that a more informed study of the neural underpinnings of language learning, and in particular as it unfolds over the learning process towards increased L2 proficiency, can help guide discussions on the connection between neural and behavioral change. (See Chang, 2012, for another illustration of how L2 comes to affect L1 early in L2 learning at the level of the phonology.)

2.2 Adaptations to context

So where do these dynamic changes originate? One possibility is that the system is fundamentally adaptive, poised to respond to a linguistic landscape that is forever in flux. Under experimental or conversational conditions in which the other language may be of increased relevance, these cross-linguistic influences may be heightened (e.g., Green & Abutalebi, 2013). Studies investigating this potential interaction have frequently used words that share properties across languages, such as homographs, where words in two languages are written the same way but have entirely different meanings (e.g., "*gift*", which means "poison" in German but "present" in English). Elston-Güttler, Gunter, and Kotz (2005) found that German-English bilinguals tested in their L2 were sensitive to these cross-linguistic relationships, as reflected in a sentence priming task. In the task, participants first watched a silent movie narrated in German or in English. They then read sentences followed by a word or a nonword and had to decide whether it was a real word or not. When reading a sentence such as "The woman gave her friend an expensive gift" followed by an English word that was the translation of the German meaning ("poison"), participants were faster at identifying the word as a real word. Critically, this only happened when participants first heard a movie narrated in German. They hypothesized that German became more relevant to the English-only experimental setting after being exposed to the German narration, which in turn boosted the homophone's activation of the German meaning.

Recent evidence suggests that young bilinguals are similarly sensitive to the linguistic context around them and that they adapt accordingly. Bobb, Drummond Nauck, Altvater-Mackensen, Von Holzen, and Mani (2016) investigated the extent to which bilingual toddlers activate cohorts of words (words starting with the same consonant sound) both within and across languages. Their objective was to test the extent to which both languages of bilingual toddlers are activated during language processing. Does hearing a word such as *Becher* (German "cup") activate words with the same onset from the same language like *Bild* (German "picture"*)* and *Bahn* (German "train")? More importantly, are similar words across languages like English "broom" and "book" also activated? To test this possibility, 2 German-English bilingual groups and a monolingual control group completed an adaptation of the inter-modal preferential looking paradigm (Golinkoff et al., 1987) in which eye-movements to a visual display are recorded while a child listens to auditory stimuli. In the critical manipulation, the tested words belonged to a small phonological cohort in German, but a large cohort in English. Typical findings show interference effects for large target cohorts but a facilitation effect for small target cohorts. If only the language of context, the L1 German, was activated, priming effects should parallel those of a small cohort and show facilitation. If, however, cohorts from both languages were activated, then priming effects should be consistent with a combined, large cohort and show interference. Results showed that only when bilingual toddlers were first exposed to a German-English codeswitching story did the toddler's cohort sensitivity start to shift from a small (German only) to a large (German and English) cohort. When bilingual toddlers simply completed the priming study in their L1 German without first listening to the story, their looking behavior looked strikingly similar to that of the monolingual German control group. The results suggest that bilingual toddlers, like adults, have a flexible language system that adapts to a given linguistic context and whose cognitive flexibility can be captured at the earliest stages of L2 development. Both the work by Elston-Güttler et al. and Bobb et al. show a shift in activation in response to changes in the experimental setting, which may be acting as a top-down cue. Bilinguals, both children and adults, demonstrate a high level of mental agility, allowing in-the-moment adaptation to their surroundings.

While context appears to boost language co-activation, it can under other circumstances constrain activation, at least to a limited extent. For instance, one may think that reading a word in a sentence context would decrease activation of the unintended language because the target language is now obvious. One way to test this possibility is to again use cognates. Previous work has shown that when bilinguals are asked to read an isolated cognate word such as "piano" out loud, they are faster to do so compared to noncognate control words like "bear" (Schwartz, Kroll, & Diaz, 2007). If a sentence can restrict language co-activation, we should see this cognate facilitation effect reduced or even eliminated when naming the word after reading it in context. Previous studies (e.g., Libben & Titone, 2009; Schwarz & Kroll, 2006) have shown, however, that only when the sentence context strongly constrains the meaning of the sentence does the cognate facilitation effect diminish. While the cognate effect was reduced for high constraint sentences such as "Before playing, the composer first wiped the keys of the **piano** at the beginning of the concert," the effect remained robust for low constraint context such as "When entering the dining hall we saw the **piano** in the corner of the room." A recent meta-analysis of studies using a similar paradigm further confirmed that the degree of sentence constraint modulates the effect size of cognate facilitation, with high-constraint contexts showing significantly smaller effects (Lauro & Schwartz, in press). Recent studies further suggest that these context effects seem to act on a local level with a limited scope: Broader contexts, such as reading a book in one language, do not restrict lexical access to the target language (Cop, Dirix, Van Assche, Drieghe & Duyck, in press). Together, the results suggest that while bilinguals are sensitive to context, context may be more influential in boosting the activation of potential language candidates in the other language rather than deactivating unintended words. This pattern seems to support the idea that the language system is fundamentally nonselective and that its design is optimized to accommodate this default.

3. Changes to the lexicon as a function of bilingualism

As we have previously discussed, any change to the language system as a function of bilingualism provides evidence for brain plasticity, and this includes not only changes that may be construed as a benefit to language processing, but also those that demonstrate a cost to language access. One source of evidence for such costs comes from a series of studies using the verbal fluency (VF) task (*Controlled Oral Word Association Task*, Benton & Hamsher, 1976). In the task, participants are asked to name as many words as possible in 1 minute that either belong to a specific semantic category (*category fluency*, e.g., vegetables) or to a specific letter (*letter fluency*, e.g., words that start with *C*). Past research suggests that for *category fluency* in particular, bilinguals typically show a disadvantage in their native/dominant language when compared to proficiency-matched monolingual peers (e.g., Portocarrero, Burright, & Donovick, 2007; Roselli & Ardila, 2002; Sandoval, Gollan, Ferreira, & Salmon, 2010; but see Bialystok et al., 2008). A possible explanation that has been raised to explain this disadvantage is that bilinguals typically experience lower overall exposure to words in each of their languages, which may make lexical representations less robust and therefore more difficult to access (e.g., Gollan & Acenas, 2004; Gollan, Slattery, Goldenberg, Van Assche, Duyck, & Rayner, 2011). We see this reflected in other lexical tasks as well where bilinguals are tested on specific vocabulary knowledge, so that bilinguals are typically slower to name pictures (e.g., Gollan, Montoya, Fennema-Notestine & Morris, 2005; Ivanova & Costa, 2008; Roberts, Garcia, Desrochers, & Hernandez, 2002), and also show smaller receptive vocabularies (e.g., Bialystok & Luk, 2012). Interestingly, when bilinguals perform a letter fluency task, which requires less specific vocabulary knowledge and where they can draw on a broader network of lexical possibilities, these same disadvantages are not apparent.

True to the argument we are trying to advance in the present chapter, the dynamics seem to work both ways. Previous work with college students has shown that learners who are immersed in their L2 show decreased performance on a category VF task in their L1 (Linck, Kroll, & Sunderman, 2009). In the study, intermediate-level learners of Spanish who were studying in a classroom at their home university were compared with a proficiency-matched group of learners studying abroad in Spain. While both groups produced more words in their dominant language (English) than in Spanish, and immersed learners produced more L2 Spanish words than their classroom counterparts, the immersed group also produced fewer English words than the classroom group. Together with results from a lexical decision task, the findings suggested that immersed learners had inhibited the L1 while studying abroad.

The influence of the L2 context on the L1 can also be observed in the laboratory, where the experience of speaking the L2 appears to have immediate consequences on the ability of relatively proficient bilinguals to speak the L1. The modulation of the L1 by the L2 has been demonstrated behaviorally in the VF task (e.g., Van Assche, Duyck, & Gollan, 2013) in a paradigm in which bilinguals speak the L2 for a block of trials followed by a switch into a block of L1. An initial ERP study by

Misra, Guo, Bobb, and Kroll (2012) showed evidence for a pattern of inhibitory processing when Chinese-English bilinguals named pictures in Chinese after having named the same pictures in English. And a long series of studies following Meuter and Allport (1999) have reported language switching costs that result when bilinguals are required to make trial-to-trial switches from one language to the other. Although there has been debate about the source of these switch costs (see Bobb & Wodniecka, 2013, for a recent review and critical discussion), in many contexts the lexical costs to switching are greater for the L1 than the L2, suggesting that the more dominant of the two languages may need to be inhibited to enable spoken production in the weaker of the two languages. Other studies show that these changes to the L1 may be subtle. Blumenfeld, Bobb, and Marian (2016) tested more advanced English-Spanish bilinguals and showed a fine-grained shift in bilingual performance on VF tasks, to both the L1 as well as the L2, where bilinguals produced a larger number of cognates on VF tasks than monolinguals, and produced more cognates in their dominant than nondominant language, although overall VF scores in the L1 were comparable between monolinguals and bilinguals.

The variation in the observed consequences for the L1 has been taken to suggest that there are multiple components of inhibitory control that bilinguals engage in different contexts to enable them to regulate the dominant language (e.g., Guo, Liu, Misra, & Kroll, 2011). A question of critical interest in the current literature is to understand how these language control processes are related to domain general cognitive control processes (e.g., Prior & Gollan, 2011; 2013). However, control is achieved, what is clear is that it is not only a matter of learning to use the L2, it is also a requirement to be able to regulate the use of the L1. That regulation process may come to change the L1 so that over time, the bilingual's L1 is not identical to the L1 of a monolingual speaker. It is also a process that may impose demands on L2 learners that are not as much of a cost to dual language use but more of an adaptation that enables the two language to coexist in the same mind and brain.

4. Links between the lexicon and syntax

Recent work suggests that what happens in the lexicon may have important implications beyond the level of the word for bilingual syntactic processing as well. Hopp (2014) asked German-English bilinguals to read sentences with temporally ambiguous relative-clauses and monitored eye-movements for attachment preferences. Participants were also asked to complete several working memory and lexical decoding tasks. Only a subset of L2 learners who were faster on the *lexical* decoding task showed a native-like pattern of reading. The dynamics of interaction are thus not localized but instead have a trickle-down effect to other levels of processing as well. According to Hopp's (2014) Bottleneck Hypothesis, difficulties at the lexical level may tie up cognitive resources that then interfere with syntactic processing. This view is parsimonious with other lexical hypotheses such as the Weaker Links hypothesis (Gollan, Montoya, Cera, & Sandoval, 2008; Gollan, et al., 2011) that proposes bilinguals access each language less than a monolingual and will therefore have a functionally lower frequency in each language, which is reflected in research findings such as slower naming latencies during language production when compared to monolinguals. According to Hopp, the weaker connections in the L2 lexicon may lead to processing delays that also interfere with structure building during sentence comprehension. Non-target language use thus becomes a window into the language architecture as a whole, suggesting an interconnected nature at the heart of language.

The relation between bilingual lexical and syntactic processing has also been investigated in the realm of code switching. Many bilinguals produce intra-sentential code switches, with a shift from one language to the other in the middle of a sentence. These code switches are rule governed, and a focus of recent work has been to understand the factors that allow proficient bilinguals to anticipate an upcoming switch. For example, Broersma and de Bot (2006) describe a line of research on triggered code switching in which lexical cognates across the bilingual's two languages are thought to function as a cue to an upcoming switch of language. Using both corpus and experimental approaches, they demonstrate that a switch is more likely following a cognate, demonstrating the importance of a lexical level process in guiding a syntactically governed process. In a recent study, Fricke, Kroll, and Dussias (2016) demonstrated that subtle phonetic cues present in words that occur prior to a code switch enable bilinguals to predict the shift of language. They used corpus data to identify the phonetic cues and the visual world paradigm (see below) to ask whether listeners are able to exploit those cues when listening to code switched speech. Of interest for the present discussion is that phonetic variation at the lexical level appears to be sufficient to cue the code switch, suggesting that bilinguals tune into not only the relation between production and comprehension, but also to the relation between the lexicon and grammar.

5. Consequences of bilingualism across the lifespan

Several studies now suggest that lifelong bilingualism may confer subtle benefits with respect to linguistic and cognitive processing and that those consequences may be most dramatic as bilinguals age (e.g., Bak, Nissan, Allerhand, & Deary, 2014). Other chapters in this volume discuss the impact bilingualism has on executive functions. In this chapter, we are particularly interested in the potential link between the lexicon and broader cognitive functioning and the possibility that a bilingual's experience regulating more than one language at the lexical level may impact the cognitive system more generally. While direct evidence for this link is still mounting (e.g., Chen, Bobb, Hoshino & Marian, 2017), multiple sources have shown correlational links that make this hypothesis tenable. In a recent study examining spoken word recognition, Blumenfeld, Schroeder, Bobb, Freeman, and Marian (2016) investigated the potential relationship between nonlinguistic cognitive control and linguistic competition resolution with a particular focus on changes over the lifespan. They used an approach dubbed the "visual world paradigm" in which participants' eye-movements are tracked while they hear and then identify the referent from among four pictures: a target picture (e.g., *cab*), a phonological competitor picture (e.g., *cat*) and two unrelated filler pictures. Typically, results show interference from competitor pictures, with longer looks to competitors over unrelated fillers. In Blumenfeld et al., picture trials were then followed by priming probes, that is an empty grid where one gray asterisk and three black asterisks replaced the pictures. Participants had to identify the position of the gray asterisk by pressing a key corresponding to the grid location. In previous research, Blumenfeld and Marian (2013) had shown that there is spillover interference when the gray asterisk appears in the space previously occupied by a phonological competitor picture. The priming probe task can thus be used to assess residual activation and inhibition of target and competitors. In addition to the visual world and probe task, participants in the Blumenfeld et al. study also completed a Stroop task, a non-linguistic test measuring the ability to navigate interference. Results suggested that for bilinguals, but not for monolinguals, the probe task recruited a type of inhibition similar to that indexed by the Stroop task.

These results fit with a broader pattern of results where we typically see stronger links between performance on language tasks and nonverbal cognitive tasks in bilinguals than monolinguals (e.g., Blumenfeld & Marian, 2011; Linck, Hoshino & Kroll, 2008; Prior & Gollan, 2011). Findings from neuroimaging studies with bilinguals similarly show cortical activation for areas involved in language control and those responsible for general cognitive functioning (Abutalebi & Green, 2008; Gold, Kim, Johnson, & Smith, 2013) but not for monolinguals (Garbin et al., 2010). Together, the results strongly suggest that linguistic experience, in this case proficiency in another language, recruits and reshapes more domain-general cognitive functioning (see also Wu & Thierry, 2013, for an example of how changes to executive function can be "caught on the fly" as bilinguals perform a lexical level task).

To what extent to lexical level processes contribute to the broader range of cognitive consequences that have been reported for bilinguals? As our review suggests, it is difficult to separate lexical processes to determine their unique contribution, but it seems clear that the initial assumption that the constant "juggling" that the bilingual does between alternatives in the two languages is too simple a characterization of the issue. Bilinguals do indeed "juggle" the presence of the two languages (see Kroll, Dussias, Bogulski, & Valdes-Kroff, 2012), but as we have argued, they are sensitive to both linguistic context and to the broader language context; in the case of language immersion, they exploit lexical knowledge to guide syntactic processes, and they regulate their dominant language to enable proficient spoken production. The adaptive control that each of these demands makes on bilingual performance is likely to create adjustments in the networks that enable cognitive control and that determine which neural circuitry is engaged (Abutalebi & Green, 2016; Green & Abutalebi, 2013).

The way that the consequences of bilingualism are manifest has been particularly evident in studies that assess cognition as we age, including the language control processes in which we engage. The results of Blumenfeld et al. (2016) discussed above are informative on this level as well. In the study, Blumenfeld et al. specifically tested the implications of bilingualism on language processing and cognition across the lifespan by including younger and older participants who were either monolinguals or fluent bilinguals. All participants completed tasks assessing linguistic competition resolution as well as nonlinguistic cognitive control. Although they found general age-related effects, with increased susceptibility to linguistic and nonlinguistic competition for older over younger participants, these effects were more consistent for monolinguals: Strikingly, older bilinguals did not typically differ from their younger bilingual counterparts.

These results suggest that inhibitory mechanisms in monolinguals may be more susceptible to age-related decline than in bilinguals (for similar arguments, see Gold et al., 2013) and are congenial with a body of work linking the bilingual experience with cognitive reserve that may protect against age-related cognitive decline (e.g., Alladi et al., 2013; Bialystok, 2011; Bialystok et al., 2016). To illustrate, several studies have reported a delay in the onset of Alzheimer symptoms for bilinguals compared to monolinguals (e.g., Alladi et al., 2013; Bialystok et al., 2007; Woumans et al., 2015). A recent large-scale study on cognitive impairment post-stroke even suggests that bilingualism may improve stroke outcomes (Alladi et al., 2016). In healthy aging, then, the effects of bilingualism may actually manifest as a lack of change when compared to monolingual counterparts and an increased stability for some cognitive functions that are typically susceptible to age-related decline, an effect that has been attributed to cognitive reserve.

In the discussion that has developed on the issue of whether bilingualism confers benefits to executive function, there has been concern about the comparison across groups of bilinguals and monolinguals who cannot be matched perfectly and for whom there may be remaining differences in demographic factors that may have contributed to the observed results (e.g., Morton & Harper, 2007). The studies on bilingual older adults are also notable for another reason. The Alladi et al. (2013) findings on the benefits of bilingualism for delaying the symptoms of dementia and the Alladi et al. (2016) study on the effects of bilingualism on stroke outcomes reflect data on bilingual speakers in India who are not necessarily literate and whose socioeconomic situation is dramatically different than the older bilinguals in the studies conducted in Canada or Belgium. Like the studies on the cognitive consequences of bilingual for young children (e.g., Calvo & Bialystok, 2014; Carlson & Meltzoff, 2008), the pattern suggests that although socioeconomic status certainly does affect cognitive functions, bilingualism makes an additional contribution, one that may compensate for some of the deleterious effects of living in poverty.

6. Conclusions

Historically, language research has focused on monolingual speakers to explain how language is processed in the mind. Bilinguals were seen as a special population who muddied the research waters, and findings could only be interpreted in comparison to the monolingual gold standard. Increasingly, however, popular media and researchers are now coming to recognize that bilingualism and multilingualism are the norm. Rather than being a liability, investigating bilingualism offers the opportunity to consider the full range of cognitive and brain functioning. In response to this changing mindset, recent years have documented a significant upsurge in bilingual research. While the increased research on bilingualism is exciting in its own right, findings have significant broader implications, providing a unique opportunity to investigate the ability of the brain to change in response to experience that would not be possible in those who speak only one language. Our review of the dynamics and plasticity that accompanies bilingualism suggests that as a bilingual speaker gains language experience, the weaker, but surprisingly also the stronger, language changes in response: the two languages adapt to each other and converge with respect to their sound, grammar, and vocabulary. The effects of using multiple languages appears to extend beyond language to cognition more generally. Those consequences are varied because bilingualism itself is a complex experience that engages language processes in ways that differentially impact cognitive processes and the neural processes that support them. A bilingual's lifelong experience in juggling the co-activation of languages may act like brain exercise that has exciting implications for the health and flexibility of the brain's cognitive wellbeing.

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CHAPTER 15

Neurobiology of bilingualism

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A basic issue in the neuroscience of language is whether the neural representation of L2 converges with that of L1. In this chapter we review data from functional and structural neuroimaging studies focusing on phonological, grammatical and lexico-semantic processing in bilinguals. Functional data indicate that L1 and L2 are processed through the same neural structures, both in comprehension and production. Reported L1-L2 differences are typically modulated by L2 proficiency and exposure. Structural data show that bilinguals may exhibit neuroanatomical alterations as a consequence of bilingual experience, and that the quantity and quality of second-language experience affects brain structure. Neuroimaging evidence also supports the notion that language control is a crucial aspect specific to the bilingual language system.

1. Introduction

The regular use of more than one language is an ever-increasing phenomenon in modern globalized societies. It is generally estimated that more than half of the world's population is bilingual or multilingual as a result of migration, educational requirements or other factors (Grosjean, 2012; see also Grosjean & Li, 2013). However, the way in which a second or subsequent language is acquired and used varies significantly within and across linguistic communities, yielding multiple profiles of bilingual/multilingual users. Bilingual individuals may simultaneously acquire two languages from birth with extensive contextual presence of both languages, or may learn the second language (L2) later in life – during adolescence or adulthood – after having consolidated the native language (L1). The age of acquisition (AoA) of L2, the context in which L2 is acquired and used, as well as the level of attained L2 proficiency, not only impose sociolinguistic differences among bilinguals, but also play a critical role in the cerebral organization of multiple languages (Abutalebi et al., 2013a; Liu & Cao, 2016; Mechelli et al., 2004; Perani et al., 1998, 2003; Wartenburger et al., 2003). When selecting a target language for

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communication, bilinguals may encounter conflict due to interference from the language not in use (Abutalebi & Green, 2007). The monitoring for this conflict – a set of neurocognitive processes known as 'language control' – is orchestrated by a network of cortico-subcortical regions tightly related to executive control functions (Abutalebi & Green, 2007, 2008, 2016). For successful acquisition of an L2, an extensive array of phonological, morphosyntactic and lexico-semantic representations largely distinctive from L1 must be stored and instantiated in the human brain. Based on the 'Critical Period Hypothesis' (CPH) (Lenneberg, 1967; Penfield & Roberts, 1959), according to which the ability to acquire a language is biologically constrained by AoA, a few researchers have hypothesized a fundamental difference between the acquisition of L1 and L2 in late bilinguals, due to maturational decay of L2 capability and/or prepotent interference from L1 (Birdsong & Molis, 2001; Birdsong & Vanhove, 2016; Johnson & Newport, 1989; Newport, 1990). Most recently, however, electrophysiological and structural imaging data have suggested much greater plasticity for late bilinguals than previously thought (Abutalebi et al., 2014; Abutalebi et al., 2015; Steinhauer, 2014).

In this chapter, we review functional and structural neuroimaging evidence on the representation, processing and control of two (or more) languages.

For historical purposes, it is worth underlining that prior to the advent of functional brain imaging techniques, clinical observations of language impairment in bilingual aphasics and behavioral response to brain stimulation in bilingual patients during neurosurgery led many researchers to believe that different languages were represented in different brain areas or even different hemispheres (Albert & Obler, 1978; Aglioti & Fabbro, 1993; Giussani et al., 2007; Paradis, 2000). Such hypothesis was based on the observation of unequal recovery patterns of two languages in post-stroke bilingual patients, as well as on neurosurgery monitoring reports indicating that the stimulation of language-sensitive cortical locations in bilinguals interfered unequally with the patients' languages. However, substantial evidence from positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) studies employing well-controlled experimental designs has contradicted the proposition according to which different languages might rely on distinct neuroanatomical substrates. It is now well established that the neural representation of L2 converges with that of L1 (cfr. 'Convergence Theory' by Green, 2003 and Abutalebi & Green, 2007; see also García-Pentón et al., 2016 and Mouthon, Annoni, Khatebc, 2013). On the other hand, factors inherent to the studied populations (e.g. L2 early vs. late acquisition, L2 low vs. high proficiency; L2 low vs. high exposure) are known to affect the neural resources deployed by L1 and L2 processing (see, for reviews, Liu & Cao, 2016; Perani & Abutalebi, 2005). Recent findings indicate proficiency – rather than AoA – as a critical differential factor in the functional organization of bilingual language processing, as differences that are prominent in the initial stages of L2 acquisition seem to reduce greatly once the L2 proficiency becomes comparable to that of L1 (Consonni et al., 2013; Kotz, 2009; Stowe & Sabourin, 2005; Sugiura et al., 2015). The critical role of L2 proficiency has also been underlined by structural neuroimaging investigations. If the use of hemodynamic monitoring techniques has led to a significant understanding of the bilingual brain function, structural imaging has allowed to measure neuroanatomical alterations in bilinguals vs. monolinguals as a result of mastering more than one language (see, for a review, Abutalebi & Green, 2016; Li, Legault, & Litcofsky, 2014). Neuroplastic changes in both younger (Abutalebi et al., 2012; Burgaleta et al., 2016; Pliatsikas, Johnstone, Marinis, 2014a; Stein et al., 2012) and elderly (Abutalebi et al., 2014, 2015; Luk, Bialystok, Craik, Grady, 2011) bilinguals have been documented in areas related to executive control and language processing. Increased grey and white matter density in/between these territories has been significantly correlated with L2 proficiency and usage, showing that neuroplasticity depends most importantly on how well and how often a second language is used.

In the present chapter, we will first examine the neural basis of distinct aspects of language processing in bilinguals such as phonological, grammatical and lexico-semantic processing, and then conclude by illustrating how the brain controls two or more languages.

2. Neural basis of L2 phonology

Phonological competence is the ability to recognize and produce the distinctive sound patterns of a language. Mastering non-native sounds may be difficult, even for individuals who have been exposed for considerable periods of time to a foreign language (e.g. Pallier, Bosch, Sebastián-Gallés, 1997). The learning of new sounds is constrained by the relationship between the established L1 phoneme categories and the new L2 categories. It has been proposed that previous language experience rather than age-related plasticity may interfere with the perception of new sounds at an auditory or early-phonetic level, as L2 learners tend to hinge upon acoustic cues that are perceptually salient in L1 but not reliable for sound categorization in L2 (Iverson et al., 2003). Phonological awareness in L2 learners is typically assessed through identification and discrimination tasks, the former involving the assignment of a category label to a given sound stimulus, the latter providing measures of the learners' capability to discriminate between contrastive L2 phonemes (see Munro & Bohn, 2007). Along with passive listening, word/non-word generation/repetition, phoneme monitoring and rhyming, and identification/discrimination tasks have been used to investigate the neuroanatomical organization of L2 phonology with functional imaging methods.

Phonological processing in monolinguals is supported by specialized networks in the left hemisphere, drawing on the auditory input system in Heschl's gyrus, the auditory association areas in the perisylvian region, and the arcuate fasciculus pathway connecting Wernicke's and Broca's areas (Hickok & Poeppel, 2007; Friederici & Gierhan, 2013; Saur et al., 2008). The early cortical stages of speech analysis occur bilaterally in the posterior superior temporal plane (Binder et al., 2000; Poeppel et al., 2004). With significant exceptions represented by voice dynamics and quality, subsequent computations on speech structure are lateralized to left temporal, parietal and frontal cortices. Dorsal pathways projecting dorso-posteriorly from the posterior superior temporal plane to the premotor cortex have been proposed to mediate the mapping of phonological representations onto motor representations for articulation, thereby constraining the planned motor output with stored templates of sound structure (Indefrey & Levelt, 2004; Kümmerer et al., 2013; Warren, Wise, Warren, 2005). It has also been suggested that phonological working memory – a memory component responsible for the transient online holding and manipulation of phonological information – is embedded in the same auditory-motor integration network (e.g. Hickok, 2009).

Although a limited number of functional imaging studies has investigated the neural underpinnings of phonological processing in bilinguals, converging findings show the activation of overlapping brain regions during the processing of phonological information in L1 and L2 (see, for a review, Golestani, 2015). Greater recruitment of fronto-temporal and parietal regions was found in late and low-proficiency L2 learners, especially during the processing of infrequent or phonologically complex non-native forms (Callan et al., 2003, 2004; Golestani & Zatorre, 2004; Wang et al., 2007). These results converge with fMRI data on bilingual language processing in general, where the activation patterns in the language processing and cognitive control networks are significantly modulated by L2 proficiency and exposure.

Early neuroimaging investigations typically used word generation tasks to explore the neural basis of L2 phonology (e.g. Klein et al., 1995). As a result, imaging data did not allow to disentangle phonological from lexico-semantic processing, limiting possible interpretations on L2 phonology. More recently, tasks employing phonetic feature contrasts and isolated phonemes or syllables have also been adopted, providing a clearer picture of L2 phonological representation *per se*. In a longitudinal study by Golestani and Zatorre (2004), for instance, greater recruitment of the auditory-motor integration network was detected in L1 English speakers that had been trained to hear a Hindi dental-retroflex contrast. After training sessions, brain activation patterns crucially overlapped to those observed during the processing of native contrasts, with greater engagement of the superior temporal plane bilaterally, the left inferior temporal gyrus, the right insular cortex and the left caudate nucleus. Greater activation in these fronto-temporal regions has been claimed to underpin top-down reshaping of lower-level phonetic encoding in the auditory cortex during the acquisition of phonological awareness skills. Parker-Jones et al. (2012) contrasted functional signatures of bilingual vs. monolingual groups during naming, articulatory and semantic decision tasks. Higher activation for bilinguals was found in the left dorsal precentral gyrus, Broca's area, superior temporal gyrus and temporal plane for overt picture naming and reading aloud. These areas are known to be involved in controlling verbal interference during word retrieval, articulatory planning, articulation, auditory processing of speech output, and auditory-motor feedback in monolinguals (Price, 2010). The effects of bilingualism on these regional activations have been interpreted as pointing toward the greater demands that word retrieval, articulation, and post-articulatory monitoring processes impose on bilingual speakers (see also Liu, Hu, Guo, Peng, 2010). Most importantly, the advantage of speaking more than one language comes at the expense of increased activity in the same territories which support phonological processing in monolinguals (Abutalebi & Green, 2007; Parker-Jones et al., 2012).

At the structural level, substantial evidence indicated increased grey matter density in bilinguals as opposed to monolinguals in traditional phonology-related areas, including Heschl's gyrus (Ressel et al., 2012), the superior temporal gyrus (Golestani et al., 2007; Sebastián-Gallés et al., 2012), and inferior frontoparietal areas (Klein et al., 2014; Mechelli et al., 2004). Increased connective white matter volumes between these areas have been reported as well (e.g. Kuhl et al., 2016; Lebel & Beaulieu, 2009; Luk et al., 2011). These structural differences have been hypothesized to correspond to the enhanced phonological competence that comes with bilingual experience.

Notwithstanding recent advances in the field, further fine-grained analyses are needed to explore the specific mechanisms underlying differential phonetic encoding of L1 versus L2 within overlapping regions in the auditory cortex (Golestani, 2015). Another issue demanding further inquiry concerns the controversially discussed individual contribution of AoA and proficiency on the reported L1-L2 activation differences in cortical areas related to higher-level phonological processing (Berken et al., 2015; Sugiura et al., 2015). Moreover, as different perceptual tasks meant to measure phonological processing have produced variable outcomes depending on which phonological process they tapped into (Díaz, Mitterer, Broersma & Sebastián-Gallés, 2012), more accurate information about the different stages of L2 phonological processing may possibly be obtained through more carefully conceived task designs.

Overall, imaging measures consistently provide evidence for a shared neural circuitry housing for L1 and L2 phoneme perception and production, indicating that L1 and L2 phonological representations are processed in a substantially comparable fashion.

3. Neural basis of L2 grammar

Grammatical competence is the ability to recognize and produce the distinctive grammatical structures of a language. Grammatical competence may be partitioned into two subcomponents: morphological competence and syntactic competence. The former allows for the generation and processing of morphologically complex words (inflected, derived and compound) (Scalise, 1984); the latter allows for the generation and processing of an unbounded array of hierarchically and recursively constructed sentences (Moro, 2016). Inflectional processes, which produce grammatical variants of the same word within given syntactic slots, are considered to straddle the morphology-syntax interface. The neuroimaging literature of language processing variously defines inflectional phenomena as 'morphological', 'syntactic', or 'morphosyntactic'.

The left inferior frontal gyrus is generally indicated as the main locus of morphological parsing in monolinguals, 'morphological parsing' being the decomposition of a complex word into its constituent parts. However, whereas a left fronto-temporal network (with greater involvement of the inferior frontal gyrus) is systematically activated when inflected words are processed (e.g. ENG *boy-s*, *call-ed*) (e.g. Bozic & Marslen-Wilson, 2010; Lehtonen et al., 2009; Moro et al., 2001; Tyler, Bright, Fletcher, Stamatakis, 2004), neuroimaging evidence on derived words (e.g. ENG *play-er, in-compar-ably*) is more mixed. A few fMRI studies reported cortical activation patterns for derived words that overlap with those involved in the processing of inflectional items (e.g. Bick, Goelman, Frost, 2011); others documented a more extensive bilateral recruitment of cortical areas not found for inflectional phenomena (e.g. Bozic & Marslen-Wilson, 2010; Marangolo et al., 2006; Meinzer et al., 2009). As these studies employed a wide range of typologically different languages (e.g. English, Chinese, Hebrew), it is unclear whether additional neurocognitive processes are needed for morphological derivation, or whether the reported differences in brain activation depend on cross-linguistic dissimilarity in morphological structure.

In the brain imaging literature, only few studies have addressed morphological processing in L2 speakers. Whether inflectionally (Lehtonen et al., 2009; Pliatsikas, Johnstone, & Marinis, 2014b; Sakai, Miura, Narafu, & Muraishi, 2004; Tatsuno & Sakai, 2005) or derivationally (Bick, Goelman, & Froset, 2011) complex words were used as experimental stimuli, the left inferior frontal gyrus was consistently associated with the processing of morphological structure. Morphological parsing may be challenging for L2 speakers (and even more so for late L2 learners) as it requires in-depth knowledge of the internal structure of existing and admissible words in a language. However, Pliatsikas et al. (2014b) used a masked priming task involving inflected verbs with late but highly proficient L2 English learners vs. English monolinguals. They found activation in the left inferior frontal gyrus for regularly inflected verbs vs. irregularly inflected verbs – which are more likely to be accessed as holistic units – in both groups. On these grounds, a common decompositional strategy has been attributed both to L1 and L2 users, AoA not representing a differential factor in the functional organization of morpheme-based computation in late bilinguals. Along similar lines, Sakai et al. (2004) used fMRI to explore the acquisition of inflectional competence in late bilingual students during L1 (Japanese) vs. L2 (English) verb conjugation and past tense processing (see also Tatsuno & Sakai, 2005). When pre- and post-learning sessions were compared, L2 inflectional competence was shown to be achieved through the same neural structures used for processing L1 inflection. Moreover, the activation level in the left inferior frontal gyrus and the participants' performance were positively correlated. This last finding was interpreted as if the cortical plasticity for L2 acquisition was guided toward the L1 specialization of the left inferior frontal gyrus, in spite of notable differences between L1 and L2 in the students' linguistic knowledge. The scant neuroimaging evidence so far concerning morphological derivation processing in bilinguals seems to confirm a common neural circuitry underpinning the decomposition of derived words in the bilingual brain, comprising the left inferior frontal gyrus and regions in the inferior temporal lobe (e.g. Bick et al., 2011).

At the structural level, a study on inflectional competence by Pliatsikas et al. (2014a) reported increased cerebellar grey matter volumes for late but highly proficient Greek-English bilinguals contrasted with a group of English monolinguals. A significant correlation between greater cerebellar volumes and more efficient behavioral performance on a masked priming task was found only for bilingual participants, thereby emphasizing the importance of this portion of the brain for the establishment and use of an L2 morphosyntax. Of note, the cerebellum is highly connected to prefrontal areas such as the inferior frontal gyrus, and this connection is supposedly involved in bililngual speech planning (Abutalebi & Green, 2016; Green & Abutalebi, 2013). Syntactic processing in monolinguals draws on a cortico-subcortical network comprising Broca's area, the posterior superior temporal gyrus/sulcus, the basal ganglia and possibly the cerebellum (Cappa, 2012; Friederici, 2011).

Neuroimaging investigations of bilingual syntax employing both sentence production and sentence comprehension revealed that L1 and L2 syntactic processing recruit an overlapping fronto-temporal network with activation patterns modulated by L2 AoA, L2 proficiency and syntactic complexity. For instance, Wartenburger et al. (2003) administered a grammaticality judgment task requiring sentence comprehension to Italian-German bilinguals with variable AoA and proficiency levels. Whereas no differences between L1 and L2 in brain activation patterns were reported for early high-proficient participants, late bilinguals with the same proficiency and late bilinguals with a lower proficiency activated a more extended network of areas surrounding Broca's area, indicating that syntactic processing is modulated by AoA and somehow neurally wired-in. Dodel et al. (2005) confirmed this finding and reported additional activation for L2 in the basal ganglia and cerebellum. Likewise, Golestani et al. (2006) found greater left prefrontal activation in L2 vs. L1 in late non-proficient bilinguals engaged in a covert sentence generation task. Jeong et al. (2007) and Suh et al. (2007) were also able to detect a syntactic complexity effect in late but highly proficient L2 learners, showing a comparable fronto-temporal activation in L1 and L2 that was significantly modulated by cross-linguistic dissimilarity in syntactic structure (Japanese/Korean vs. English) (see also Yokoyama et al., 2006).

According to the declarative/procedural model (DP) (Ullman, 2001, 2004), language processing in L1 users relies on a declarative (i.e., explicit) memory system in which lexico-semantic knowledge is represented, and a procedural (i.e., implicit) memory system that allows for the computation of grammatical rules on a finite set of lexical formatives. When an L2 is learned after the purported 'critical period' for language acquisition, it can no longer rely on the procedural resources that are used for the computation of L1 grammar. Rather, grammatical knowledge in L2 would be processed using the declarative memory system. As declarative and procedural knowledge are mediated by distinct neural networks (i.e., left temporal areas vs. Broca's area and the basal ganglia, respectively), late L2 learners would rely more heavily on the cortical territories responsible for lexico-semantic processing when computing L2 grammar.

The neuroimaging literature thus far has failed to support the maturational constraints proposed by Ullman's model: data collected from typologically different languages and different learner groups demonstrate that early and late bilinguals use similar brain regions to process grammatical information. In line with functional data on phonological processing, reported L1-L2 differences involve the degree of activation of portions of this shared network. Supposedly reflecting less automaticity for L2 grammatical processing, such network is driven more extensively in late learners and low proficient speakers.

4. Neural basis of L2 lexico-semantics

Semantic competence is the ability to extract meaning from linguistic structure. Semantic processing in monolinguals is supported by a widely distributed neural system crucially modulated by factors such as input modality and task requirements. According to 'dual stream' models of language processing (e.g. Hickok & Poeppel, 2004; Saur et al., 2008), a ventral pathway that projects ventrolaterally from the posterior superior temporal plane to the middle and inferior fronto-temporal cortices interfaces sensory/phonological networks with distributed semantic networks. In the context of the lexico-semantic domain, neuroimaging studies have implicated a number of brain regions as being involved in semantic tasks, including the ventral occipitotemporal cortex, the anterior temporal lobe, the left inferior frontal gyrus, the middle frontal gyrus, and the posterior middle temporal gyrus (Binder, Desai, Graves, & Conant, 2009; see Cappa, 2012, for a concise review). At the subcortical level, thalamic engagement has been associated to lexical meaning extraction in the context of competing alternatives (Mestres-Missé et al., 2008). The recruitment of nonlinguistic subcortical reward mechanisms during successful word learning has also been reported (Ripollés et al., 2014).

The revised hierarchical (RH) model (Kroll & Stewart, 1994), initially put forward to account for observed asymmetries in translation performance by late bilinguals, claims that separate declarative memory systems exist in the bilingual brain: an abstract memory system common to both L1 and L2 in which semantic concepts are stored, and lexical memory systems containing words for each of the two languages. Whereas the acquisition of L1 vocabulary is concept-mediated, L2 words are generally learned with reference to existing L1 concepts, i.e. through mediation of L1 lexico-semantics. Accordingly, during early stages of L2 acquisition, L2 words may be heavily dependent upon their L1 translation equivalents. On the other hand, increasing L2 proficiency would reduce reliance on the native language system, L2 lexical items becoming more tightly bound to their specific conceptual representations. Following the RH model, lexical processing would mostly rely on language proficiency rather than AoA (see also Green, 2003).

The critical role played by L2 proficiency in the cerebral organization of the bilingual lexico-semantic system(s) has been documented by substantial neuroimaging evidence. A number of experimental studies involving single-word tasks (e.g. verbal fluency, word completion, word repetition, picture naming) reported that when the degree of L2 proficiency is comparable to that of L1 shared neural networks in the left frontal and temporo-parietal regions are recruited (Illes et al., 1999; and see for review: Abutalebi, 2008; Indefrey, Hellwig, Davidson, Gullberg, 2005). Consonni et al. (2013) used fMRI to evaluate single-word production and sentence comprehension in two groups of highly proficient bilinguals only differing in AoA. Whereas one group learned Italian and Friulian from birth, the second group learned Italian between 3 and 6 years. All participants were highly proficient in both languages, but more exposed to Italian than Friulian. The results indicated a complete overlap of neural activations for L1 and L2 both during production and comprehension tasks. However, an extra activation for the less-exposed language was detected in the left thalamus, a region known to be involved in language monitoring processes (Mestres-Missé et al., 2008; Wahl et al., 2008). This last finding was interpreted as confirming that decreased exposure to a given language enhances controlled processing for that language. Bilinguals with low L2 proficiency have been shown to engage additional brain activity in the left inferior frontal gyrus and other prefrontal regions (e.g. Marian et al., 2007; Perani et al., 2003; Rüschemeyer, Fiebach, Kempe, & Friederici, 2005). In line with studies on lexical processing in monolinguals, other differential factors include the nature of the utilized tasks and the different processing demands that such tasks impose on participants. For instance, Vingerhoets et al. (2003) reported that late multilinguals engaged in a covert lexico-semantic processing task showed similar regions of activation irrespective of the language used. However, word generation involved additional L2 recruitment of fronto-temporal areas, and picture naming was associated with additional L2 recruitment of inferior frontal, lateral and medial regions. During more complex comprehension processes, such as the understanding of whole sentences, differences in brain activation between L1 and L2 – typically detected in the left prefrontal cortex – have been shown to be associated with the task's workload (e.g. Hasegawa, Carpenter, & Just, 2002).

At the structural level, MRI studies revealed that bilinguals show increased grey matter volumes with respect to monolinguals in areas that are known to be susceptible of plastic changes due to vocabulary size expansion across the lifespan (Richardson et al., 2010). Morphological alterations in the bilingual brain have been found in the supramarginal gyrus (Mechelli et al., 2004) and in the rostral portion of left Broca's area (Grogan et al., 2012). Increased grey matter volume in these territories were positively correlated with lexical efficiency in second language use.

Overall, lexico-semantic processing in bilinguals is associated with similar areas as in monolinguals, with greater recruitment of the anterior inferior frontal cortex when the level of L2 proficiency and/or exposure is low. An L2 acquired late in life can be semantically processed through the same neural networks that process L1.

5. Neural basis of language control

Common to the aforementioned studies are the findings of additional brain activity during L2 vs. L1 processing when the level of L2 proficiency is not native-like, the amount of exposure to L2 varies, and/or the task load is different. This additional activity was detected within and around portions of the perisylvian language network, but most prominently in territories usually related to executive control and not specifically to language processing, such as the anterior cingulate cortex (ACC), the prefrontal areas, the left inferior parietal lobules, and subcortical structures (see, for a review, Abutalebi & Green, 2007, 2008, 2016). It has been posited that the use of two (or more) languages not only affords novel opportunities for communication, but also imposes additional demands on the executive control system (Abutalebi & Green, 2007). Such demands were shown to be particularly taxing in low-proficient bilinguals, who seem to heavily rely on the active suppression of the native language when speaking an L2 (to prevent interferences from the non-target dominant L1). On the other hand, highly proficient bilinguals would select their language output with minimal interference from the unintended language (Abutalebi & Green, 2016; Costa, Branzi, & Avila, 2016).

The ACC has been indicated as a key structure in the neural circuit mediating domain-general cognitive control processes as conflict monitoring, error detection and response control (Botvinick, Cohen, Carter, 2004; Carter, Botvinick, & Cohen, 1999; Petersen & Posner, 2012). Functional neuroimaging investigations have shown that the ACC is recruited when bilinguals perform both linguistic and non-linguistic conflict tasks (Abutalebi et al., 2007; Abutalebi et al., 2008; Abutalebi et al., 2012; Branzi et al., 2016; Hernandez, 2009), indicating the ACC as a critical component of the brain network subserving conflict monitoring, whether in the verbal or in the non-verbal domains. Further, the ACC has also been shown to be tuned up in terms of increased grey matter in adult bilinguals (Abutalebi et al., 2012) and in elderly bilinguals (Abutalebi et al., 2015) as opposed to matched monolinguals. Bilinguals use also this brain structure in a more efficient way as compared to monolinguals during non-linguistic conflict monitoring (Abutalebi et al., 2012). General executive and language control processes are also known to be supported by a shared cluster of brain structures in the prefrontal cortices, activity in these areas being documented for response selection and suppression during language switching tasks, but also during word generation, picture naming and verbal fluency tasks (see Abutalebi & Green, 2007). In detail, following Abutalebi & Green (2016), the left prefrontal cortex is involved in response selection during language control while its right counterpart is responsible for response inhibition. Additional recruitment of the left prefrontal cortex is a constant observation during the initial stages of L2 acquisition or when L2 is processed with low proficiency, possibly reflecting the additional needs to select properly the correct L2 response while inhibiting the prepotent L1 response. Furthermore, it is well-established that the inferior parietal lobules, involved in a wide range of tasks (e.g. Majerus et al., 2010; Rushworth, Paus, & Sipila, 2001; Shomstein, 2012), are also potentially involved during language switching and its control (Abutalebi & Green, 2016). Based on clinical evidence dating back to the 1920's (Pötzl, 1925) as well as on functional imaging research on language switching (e.g. Price, Green, & Von Studnitz, 1999), Abutalebi and Green (2008) proposed a detailed characterization of the inferior parietal lobules for language control. During language switching, whereas the inferior parietal lobule in the left hemisphere would be involved in diverting language selection away from the language not in use, its right counterpart would be responsible in directing selection towards the intended language. On the other hand, substantial brain imaging evidence has indicated that subcortical structures such as the left caudate nucleus and the left putamen, as well as the cerebellum, are being activated during language selection and language switching tasks, both in production and comprehension (e.g. Abutalebi et al., 2013a, 2013b; Crinion et al., 2006; Garbin et al., 2011). Accordingly, at least in contexts in which both languages are engaged, these structures seem to play a critical role in keeping L1 and L2 apart when processing linguistic information.

At the structural level, recent findings have shown that bilingual experience induces increased grey and white matter density in/between regions of the executive control network, including the frontal lobes (Luk et al., 2011), the left inferior parietal lobule (Della Rosa et al., 2013; Mechelli et al., 2004), the ACC (Abutalebi et al., 2012), the left caudate (Grogan et al., 2009; Zou et al., 2012) and the left putamen (Abutalebi et al., 2013b), along with the cerebellum bilaterally (Pliatsikas et al., 2014a). A relevant consequence of these structural changes in the executive control network has been posited to be the promotion of cognitive reserve in elderly people: elderly bilinguals frequently outperform monolinguals in executive control tasks and appear to have a 4–5 year onset delay of behavioral symptoms associated to Frontotemporal and Alzheimer's Dementia when compared to monolinguals (Alladi et al., 2013; Bialystok, Craik, & Luk, 2012). The source of this cognitive advantage has been discussed in terms of the bilinguals' lifelong experience in mastering more than one language (see Valian, 2015, for a review). However, it is worth emphasizing that the bilingual advantage hypothesis – challenged in recent years (e.g. Hilchey & Klein, 2011) – is currently the basis of a lively debate in the field of bilingual research (Bak, 2016; Bialystok et al., 2015; de Bruin, Treccani, & Della Sala, 2015).

6. Conclusions

In this chapter, we have offered a concise review of the functional and structural neuroimaging evidence concerning the representation and processing of two (or more) languages. The impact of bilingualism on brain structure and function has been addressed with special reference to the major ingredients of spoken language: sound, grammar, and meaning. Functional imaging data contrasting bilingual vs. monolingual language processing revealed that the neural language network is similar for L1 and L2, both in comprehension and production: phonology, grammar, and semantics are processed in a substantially comparable fashion. Differences in activation patterns between native and second or subsequent language are more pronounced when the L2 system is 'weak', i.e. during the initial stages of L2 acquisition and/or when L2 is processed with low proficiency. Major L1-L2 differences in low proficient bilinguals consist in increased L2-related brain activity in and around Broca's area for language production, as well as in the distinctive recruitment of additional structures outside the language network such as those related to executive control. Greater neural activity for L2 production may reflect a compensatory mechanism necessary to perform a difficult task such as speaking an L2. The engagement of control-related regions arguably underlines a low level of automatism for L2 processing as compared to L1. On the other hand, high levels of proficiency produce representations of L2 that converge onto those of the native language. Structural imaging data showed that bilingual/multilingual users generally exhibit neuroanatomical alterations as a consequence of bilingual experience. There is also evidence that the quantity and quality of second-language experience affects brain structure.

However, a few limitations exist to the conclusions that can be drawn from the data presented. For instance, it would be useful to develop standardized protocols that parameterize controversially discussed factors such as AoA, proficiency and exposure, as not all studies revised here controlled for all of these variables. Another limitation, which first and foremost concerns theoretical acquisitions on the human language's workings in general, is the discrepancy between the fine-grained representations of linguistic theory and the broad conceptual distinctions implemented in neuroimaging literature. A two-way interaction between linguistic research and neuroscience of language is advised to open up new opportunities for advancements in both fields.

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CHAPTER 16

Bilingualism and children with developmental language and communication disorders

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Research on bilingualism in children with developmental language and communication disorders has focused primarily on children with specific language impairment (SLI), but some recent research has emerged on children with Autism Spectrum Disorder (ASD). In this chapter we review research on bilingual development in children with SLI and ASD organized around the following topics: (1) The capacity for successful bilingualism in children with developmental disorders; (2) The linguistic profiles of bilinguals with SLI across different languages and linguistic subdomains; (3) Crosslinguistic influence in bilingual development with SLI; (4) Development of a minority/heritage language in children with developmental disorders, and (6) Challenges and strategies in assessment and intervention practices with bilingual children.

1. Introduction

Researchers have been interested in understanding bilingual development in children with specific language impairment (SLI)[1] and with Autism Spectrum Disorder (ASD) for two fundamental reasons. One reason is more theoretical, rooted in how language and communication are impacted by these developmental disorders, and the other reason comes from clinical issues. Children with SLI are delayed in the onset of speaking and show language disorder extending into adolescence, but otherwise, have normal intelligence and no ASD behaviours, no hearing loss or neurological trauma (Leonard, 2014; Schwartz, 2009). Even though children with SLI, by definition, have non-verbal IQs above the range of intellectual disabilities, at the same time, they can exhibit deficits in cognitive systems implicated in language learning, such as processing speed, verbal memory or executive functions

1. Specific language impairment is also referred to as "primary language impairment" or "developmental language disorder" or simply "language impairment".

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(Leonard, 2014; Schwartz, 2009). ASD is primarily a disorder of social-interaction and communication (Gerenser, 2009; Tager-Flusberg, 2016) and on some theories of language acquisition, social interaction is a key mechanism for learning language (Ambridge & Lieven, 2011). Furthermore, a substantial proportion of children with ASD are delayed in the onset of speaking and show language disorder in the domain of morphosyntax (Lindgren, Folstein, Tomblin, & Tager-Flusberg, 2009; Oetting & Hadley, 2009). This is in addition to the discourse-pragmatic deficits in language use exhibited by nearly all children with ASD (Gerenser, 2009).

Since language and communication abilities and mechanisms for language learning are implicated in both developmental disorders, researchers have asked whether dual language learning would pose extraordinary difficulties for children with SLI or ASD, causing their language and communicative abilities to show slower development, disruption or unique characteristics. An additional reason for the interest in bilingual development in children with SLI and ASD has to do with clinical concerns about assessment and intervention. Diagnoses of SLI and ASD are based on behavioural assessments, unlike other developmental disorders like Down Syndrome which can be identified through biological markers. Because bilingual children show some differences in language acquisition patterns and rates compared to their monolingual peers in each language (e.g., Grüter & Paradis, 2014), this complicates the ability to detect the presence and extent of language disorder in bilingual children, especially when using standardized tools and protocols based on a monolingual population (Elin Thordardottir, 2014; Kohnert, 2010; Paradis, Genesee & Crago, 2011). This issue has been of particular concern for children with SLI whose primary deficits are in the domain of language and not in other behaviours. Furthermore, intervention, educational programming and advice to parents are made more complex when two languages instead of one need to be considered (Kay-Raining Bird, Trudeau, & Sutton, 2016).

The theoretical/knowledge-oriented and clinical motivations for studying bilingualism in children with developmental disorders have yielded a body of research that we review in this chapter. We review studies that include simultaneous bilinguals, that is, bilinguals who have been exposed to two languages from birth or shortly after, as well as sequential bilinguals, also referred to as second language (L2) learners, who began to learn their L2 after 2 to 3 years of age. We include research on bilinguals for whom both languages are high status or majority languages, e.g., French and English in Canada or English and Hebrew in Israel, as well as on bilinguals who are learning a minority heritage language alongside the majority societal language, e.g., Spanish in the United States or Turkish in the Netherlands. In order to narrow the scope of this chapter, we focus on studies that included bilingual children with SLI or ASD as participants.

2. Capacity for bilingualism in children with developmental disorders

2.1 Bilinguals with SLI compared to monolinguals with SLI: The Cumulative Effects Hypothesis

As noted in (1), children with SLI have deficits in cognitive mechanisms used in language learning, like working memory, processing speed and executive functions. These deficits in language learning mechanisms could underlie, wholly or in part, the protracted language development of children with SLI because they could cause children to have more difficulty in "uptake" from their linguistic input. Because bilingual children receive less input, on average, in each of their languages than monolingual children, bilingual children with SLI could be expected to experience more difficulties than their monolingual peers with SLI as they have reduced input in addition to the cognitive deficits potentially limiting uptake (Orgassa & Weerman, 2008; Paradis, 2010). This *Cumulative Effects Hypothesis* has been tested in studies including participant groups of bilinguals and monolinguals with TD and SLI. The presence of a cumulative effect of bilingualism and SLI is typically measured by examining the gap in abilities between bilinguals with SLI on one hand, and monolinguals with SLI and bilinguals with TD on the other (cf. Paradis, 2010, for use of effect sizes in this context). In spite of the logic behind the Cumulative Effects Hypothesis, support from research for it has been mixed.

In Paradis, Crago, Genesee, and Rice (2000, 2003), 5 different groups of 7-year-old children were examined: TD French-English simultaneous bilinguals with SLI, French speaking monolinguals with SLI, TD French monolinguals, TD English monolinguals and English monolinguals with SLI. Accuracy with tense morphemes was examined, as this structure constitutes a clinical marker of SLI in both languages (Jakubowicz & Nash, 2001; Rice, 2004). While both groups of children with SLI had lower scores than the TD groups (Paradis et al., 2000), no significant differences were found between the monolingual and the bilingual SLI groups (Paradis et al., 2003). In Paradis, Crago, and Genesee (2005/2006), object clitic pronouns – considered to be clinical markers of SLI in French (Jakubowicz & Nash, 2001; Prévost, 2015) – were examined in 4 groups of children: 7-year-old bilinguals with SLI, 3-year-old bilinguals with TD, 7-year-old French monolinguals with SLI and TD 7-year-old monolinguals. The bilingual group with SLI did not lag behind the monolingual group with SLI, but both used fewer object clitics in permissible contexts than their TD peers. Results from these studies suggest that, in spite of deficits in language learning mechanisms, bilingual children with SLI appeared to be keeping pace with their monolingual peers with SLI for difficult morphosyntactic structures. However, the children in the studies by Paradis and colleagues were school age and learning two high-status majority languages from birth. It is possible that research with younger sequential bilinguals who speak a minority language would show different results.

Two studies with younger, Spanish-English bilinguals in the United States actually found parallel results to those of Paradis and colleagues. Gutiérrez-Clellen, Simon-Cereijido, and Wagner (2008) used a narrative task to examine accuracy in English verb morphology by 4- to 6-year-old simultaneous bilinguals with TD and SLI, monolinguals with SLI and English L2 learners with TD. The monolingual and bilingual SLI groups did not differ significantly from each other, but displayed lower accuracy than the TD monolinguals and bilinguals. Similarly, Morgan, Restrepo and Auza (2013) examined a range of morphosyntactic structures, e.g., articles, clitics, subjunctive verbs and derivational morphemes, in the Spanish of 5- and 6-year-old children from the following groups: Spanish monolinguals with TD and with SLI in Mexico, and Spanish-English bilinguals with TD and with SLI in the United States. The bilingual SLI group did not differ significantly from the monolingual SLI group.

In contrast, some studies have found significant differences between monolinguals and sequential bilinguals with SLI, and thus, provide support for the Cumulative Effects Hypothesis. Orgassa and Weerman (2008) found differences in gender-marking accuracy between Turkish-Dutch bilingual children with SLI and Dutch monolingual children with SLI. A monolingual group with SLI, bilingual groups with TD and with SLI, all 7½ years old, as well as a younger, 4½-year-old monolingual group with TD, participated in this study. The bilingual group with SLI differed significantly from the monolingual group with SLI and had very low scores for adjectival gender inflection in particular. Verhoeven, Steenge, and van Balkom (2011a) also found evidence for a cumulative effect of bilingualism and SLI. In this study, narrative performance in Dutch was examined for four different groups of 7 and 9 year olds: Dutch monolingual children with TD and with SLI and bilingual children with TD and SLI who spoke Turkish, Arabic or Berber as their first language (L1). The bilinguals with SLI differed significantly from the monolinguals with SLI in both utterance length and grammaticality, thereby showing an "additional disadvantage" of both bilingualism and SLI (Verhoeven et al., 2011a: 1192). A companion study, Verhoeven, Steenge, van Weerdenburg, and Van Balkom (2011b), brought additional support for the Cumulative Effects Hypothesis. In this study, the performance of 6-, 7- and 8-year-old bilingual children with SLI on a standardized Dutch test was compared to that of monolinguals with TD and with SLI and bilinguals with TD. The bilingual children with SLI differed significantly from the monolingual children with SLI in both lexical and morphosyntactic skills. Importantly, differences were more pronounced for the 8 year olds, suggesting that the gap between bilinguals and monolinguals with SLI might increase over time.

2.2 Bilinguals with ASD compared to monolinguals with ASD: Does bilingualism exacerbate difficulties in language and communicative development?

Both parents and clinicians express concern about the suitability of bilingual development for children with ASD (Hambly & Fombonne, 2012; Kay-Raining Bird, Lamond, & Holden, 2012, Kremer-Sadlik, 2005). While existing research is limited, evidence so far indicates that there is no negative impact of bilingualism on the language and communicative development of children with ASD, at least at the early stages.

In a landmark study, Hambly and Fombonne (2012) used parent report measures to study bilingualism and ASD in children 3 to 6 years old. A total of 75 families with children on the spectrum were recruited for this study. The children were monolingual or bilingual, with the bilingual group including both simultaneous and sequential bilinguals. Bilingual children with ASD – regardless of group – did not differ significantly from monolingual children with ASD on standardized tests of expressive and receptive vocabulary and language (in bilingual children's dominant language). There were also no bilingual-monolingual differences among the children with ASD in their early language milestones, like age of first words.

Findings from other studies dovetail with those of Hambly and Fombonne (2012). Petersen, Marinova-Todd, and Mirenda (2012) examined English monolinguals and English-Chinese bilinguals with ASD, 3½ to 6 years old. Both groups had equivalent scores on English production vocabulary, receptive vocabulary and conceptual production vocabulary. When non-verbal intelligence was controlled, the bilingual group had larger total production vocabulary than their age-matched monolingual peers. Similarly, in Reetzke, Zou, Sheng, and Katsos (2015), 5-year-old children exposed to two Chinese languages did not differ significantly in their structural language or pragmatic abilities when compared to monolingual children with ASD the same age. Ohashi et al. (2012) examined slightly younger bilingual and monolingual children with ASD, aged 2–4½, matched for non-verbal IQ. With hours of intervention co-varied out, the two groups showed equivalencies across multiple measures of communicative function, expressive and receptive language and age of onset of first words and word combinations. Valicenti-McDermott et al. (2013), also examining younger children, found that Spanish-English bilingual toddlers with ASD did not differ significantly from monolingual toddlers with ASD on English receptive or expressive language skills, and bilinguals showed no disadvantages in cognitive functioning or in non-linguistic autistic characteristics.

3. Linguistic profiles of bilinguals with SLI: Different languages and linguistic subdomains

3.1 Morphosyntax in bilingual SLI

Morphosyntax is the linguistic domain of greatest weakness in monolingual children with SLI and morphosyntactic abilities can distinguish between children with TD and those with SLI (Leonard, 2014; Oetting & Hadley, 2009). However, not all aspects of morphosyntax are equally difficult for children with SLI. Some morphosyntactic structures constitute "clinical markers", i.e., are a locus of particular difficulty in acquisition for children with SLI, while other morphosyntactic structures are relatively less problematic (Leonard, 2014; Oetting & Hadley, 2009; Rice, 2004). Furthermore, which morphosyntactic structures constitute clinical markers varies crosslinguistically (Leonard, 2014). Clahsen, Rothweiler, Sterner, and Chilla (2014) note that, while clinical markers of SLI have been studied across different languages for monolingual children with SLI, much less is known about clinical markers of SLI in bilingual children.

Rothweiler, Chilla, and Clahsen (2012) looked at subject-verb agreement morphology in German and found that Turkish-German bilingual children with SLI showed similar acquisition difficulties as their monolingual peers with SLI. Clahsen et al. (2014) examined past participle inflection in the same bilingual and monolingual children with SLI, and found that both groups produced past participles relatively accurately. Clahsen et al. (2014) concluded that, while subject-verb agreement is a clinical marker in German SLI, other areas of verbal morphology are not necessarily affected, and these patterns hold equally for bilingual and monolingual children.

Studies with other language pairs have also found similar results for monolingual and bilingual children with SLI in that the same clinical markers appear in bilingual and monolingual speakers with SLI and that some aspects of morphosyntax are clinical markers while others are not. Monolingual English-speaking children with SLI have difficulties with bound and unbound tense morphemes, tending to omit them (Leonard, 2014; Rice, 2004). Bilingual children with SLI also exhibit similar patterns in their English (Blom & Paradis, 2013, 2015; Jacobson & Livert, 2010; Jacobson & Schwartz, 2005; Paradis, 2010). Jacobson and Schwartz (2005) looked at tense morpheme production by Spanish-English bilinguals with and without SLI, 7 to 9 years old. The TD children produced verbs more accurately and produced more overgeneralization errors than children with SLI. Similar results were observed by Blom and Paradis (2013, 2015), who studied tense morpheme production in younger English L2 children with TD and SLI from diverse L1 backgrounds. Blom and Paradis (2015) found that L2 children with SLI's acquisition of tense morphology was influenced more by age than by amount of L2 exposure, while the opposite was found for L2 children with TD. Furthermore, English L2 children with SLI are similar to their TD L2 peers in accuracy with non-tense morphology, which is not a clinical marker in English SLI (Paradis, 2010; Rice, 2004). However, unlike monolingual English-speaking children with SLI, bilingual children with SLI show few inaccuracies in the use of unbound BE morphemes, making inflectional morphology a stronger clinical marker in bilingual English SLI. Finally, the Turkish-Dutch children with SLI studied by Orgassa and Weerman (2008) exhibited clear deficits with Dutch gender morphology, but were comparable to their TD bilingual peers for subject-verb agreement morphology (Orgassa, 2009).

Turning to cross-linguistic comparisons, the language-specific nature of clinical markers is emphasized by the research on bilingual children with SLI. For example, Armon-Lotem, Galit, Siege-Haddad, and Walters (2008) noted that English-Hebrew bilingual children with SLI produced tense morpheme omission errors in English but not in Hebrew, while subject-verb agreement substitution errors were more common in Hebrew. In addition, French-English bilingual children with SLI show deficits with tense and object clitic pronouns in French, but they only show deficits with tense morphemes in English and have no difficulties with English object pronouns, paralleling their monolingual peers with SLI in each language (Paradis et al., 2003; Paradis et al., 2005/2006). Object clitic pronouns are considered to be a clinical marker in Spanish SLI as well, and both younger and older Spanish-English bilingual children with SLI display omission and substitution errors with object clitics in Spanish (Jacobson, 2012; Morgan et al., 2013) at the same time as they display tense morpheme omission errors in English (Jacobson & Livert, 2010).

3.2 The lexicon in bilingual SLI

Studies on monolingual children with SLI indicate that these children have a general delay in vocabulary acquisition and also have specific lexical difficulties such as, needing additional exposure to learn new words, displaying limitations with semantic processing and having fewer semantic associations between words (Leonard, 2014; Sheng & McGregor, 2010). Regarding bilinguals with SLI, there is less research on their lexical than their morphosyntactic acquisition.

Existing studies on bilingual children with SLI have found that they display some difficulties in lexical learning. In Sheng, Peña, Bedore, and Fiestas (2012), a repeated word association task was given to Spanish-English bilinguals with TD and with SLI, 7 to 9 years old. Children with SLI had lower semantic depth scores than TD children. Similarly, in Sheng, Bedore, Peña, and Taliancich-Klinger (2013), the Spanish-English children with SLI had a lower rate of semantic convergence than their TD peers, and therefore, produced fewer highly frequent responses in a repeated word association task. In contrast, Verhoeven et al. (2011b) did not always find significant differences in Dutch between bilingual children with SLI and TD for lexical measures, particularly at younger ages. For example, no significant difference was found in receptive vocabulary scores between the bilingual children with TD and SLI among the 6 and 7 year olds; significant differences were found only for the 8 year olds. For word definitions, significant differences emerged only among the 7 and 8 year olds. Paradis, Schneider, & Sorenson Duncan (2013) found no differences between English L2 children with TD and SLI from diverse L1 backgrounds on a receptive vocabulary test.

3.3 Narrative skills in bilingual SLI

Studies on narratives focus on both narrative macrostructure, which refers to the structure of the story (e.g. story grammar components), as well as on narrative microstructure, a more local analysis of linguistic features (Boudreau, 2007). Monolingual children with SLI exhibit weaknesses in narrative microstructure. For example, children with SLI produce stories with more grammatical errors, less lexical diversity and fewer complex sentences (Fey, Proctor-Williams, Tomblin, & Zhang 2004; Norbury & Bishop 2003), and they also have difficulties using referring expressions, e.g., may introduce referents with definite articles or pronouns even in the absence of a shared context (Schneider, Hayward, & Dubé, 2010). However, not all studies comparing TD monolinguals and those with SLI have found significant differences in narrative macrostructure (e.g., Reilly, Bellugi, & Wulfeck, 2004 vs. Norbury & Bishop, 2003).

Akin to the monolingual research, studies looking at bilinguals have found significant differences between the microstructure features of TD bilingual children's narratives and those of bilingual children with SLI (Altman, Armon-Lotem, Fichman & Walters, 2016; Iluz-Cohen & Walters, 2012; Rezzonico et al., 2015; Tsimpli, Peristeri, & Andreou, 2016). For example, Rezzonico et al. (2015) looked at Canadian bilingual preschoolers (aged 5 or younger) with TD and SLI from diverse L1 backgrounds, as well as monolingual preschoolers with TD and with SLI. In a story retell task in English, the TD preschoolers outperformed preschoolers with SLI on all four microstructure measures in this study- sentence length, lexical diversity, referring expressions and verb accuracy – and no bilingual-monolingual differences emerged. Iluz-Cohen and Walters (2012) also found that English L1-Hebrew L2 children with SLI, aged 5 to 7, showed weaker performance for lexical diversity and grammar in Hebrew story-telling than their TD peers. Tsimpli et al. (2016) compared the performance of Greek L2 children with TD and with SLI (9 years old) from diverse L1 backgrounds on a narrative retell task and found L2 children with SLI scored lower for lexical diversity. Thus, difficulties with narrative microstructure, that can be traced to limited morphosyntactic and lexical abilities, hold across different L2s for bilinguals with SLI.

Also similar to research with monolinguals, studies with bilingual children show mixed results for narrative macrostructure. Iluz-Cohen and Walters (2012) and Tsimpli et al. (2016) did not find that narrative story grammar differentiated bilinguals with SLI from their TD peers. In contrast, Paradis et al. (2013) and Rezzonico et al. (2015) found significant differences in narrative macrostructure abilities between Canadian English L2 children with TD and SLI aged 3 to 7 years old, on both story generation and story retell tasks. Rezzonico et al. (2015) found that story grammar scores were a good measure for discriminating children with SLI from those with TD, for both monolinguals and bilinguals. Similarly, Boerma, Leseman, Timmermeister, Wijnen, & Blom (2016) compared macrostructure abilities in narratives from 132 Dutch-speaking monolingual and bilingual children with SLI and TD. Their analyses revealed that macrostructure elements, in particular internal state elements, differentiated children with TD from those with SLI amongst both monolingual and bilingual groups. Like Rezzonico et al. (2015), they also found that narrative macrostructure had good diagnostic value.

3.4 Linguistic subdomains in bilinguals with ASD

Children with ASD exhibit a wide range of language and communication skills: some children are low- or non-verbal, others are verbal but with language delay and disorder, and still others have verbal skills within the normal range for linguistic skills apart from pragmatics (Gerenser, 2009). Children with ASD and language disorder have morphosyntactic difficulties paralleling children with SLI, for example, difficulties producing tense morphemes (Lindgren et al., 2009; Oetting & Hadley, 2009). Children with ASD also produce narratives with more ambiguous pronouns for referents when compared to TD children (Novogrodsky & Edelson, 2016) or children with SLI (Norbury & Bishop, 2003), reflecting their pragmatic deficits.

As discussed in 2.2, studies looking at bilingual children with ASD have not found significant differences between these children and their monolingual peers with ASD for general measures of language and communication development. Hambly and Fombonne (2014) examined the role of relative exposure to each language in predicting expressive vocabulary development in French-English bilingual 5 year olds with ASD. Parallel to findings for bilinguals with TD (e.g., Elin Thordardottir, 2014), vocabulary size in bilinguals with ASD was sensitive to relative exposure to each language. Overall, research on bilingual ASD has focused on standardized test performance, mainly early vocabulary and basic communicative skills, and the morphosyntactic and narrative abilities of verbal bilingual children with ASD at any age are still largely unknown. Investigating the linguistic profiles of bilingual children with ASD should be a priority for future research.

4. Crosslinguistic influence in bilinguals with SLI

An aspect of linguistic representation and use that is unique to bilinguals is crosslinguistic influence. Cross-linguistic influence may be at the surface/structural level, commonly viewed as transfer from one language to the other, or at the cognitive-linguistic interface, meaning a sharing of conceptual and processing mechanisms (e.g., Cummins, 2000; Kohnert, 2010). Cross-linguistic transfer may be positive, when one language has a facilitative effect on the other, or negative, when the influence of one language causes errors to appear in the other. A wealth of research has documented crosslinguistic influence in TD bilinguals' language and literacy development (e.g., Riches & Genesee, 2006; Serratrice, 2013). Research documenting crosslinguistic influence in bilinguals with SLI is just emerging, and there are conflicting findings regarding children with SLI's ability to share resources across their languages (see also Section 6.2).

Windsor, Kohnert, Lobitz, and Pham (2010) looked at non-word repetition (NWR) performance in both Spanish and English by bilingual children with TD and SLI aged 6–11. Cross-linguistic associations were found after controlling for age and non-verbal intelligence for the TD bilinguals but not for the bilinguals with SLI. Verhoeven, Steenge, and Van Balkom (2012) looked at cross-linguistic associations in 6- to 11-year-old Turkish-Dutch bilinguals with SLI on standardized tests in Turkish (L1) and Dutch (L2) measuring language knowledge and processing skills. Significant cross-linguistic associations were found for different tasks such as, sentence repetition and story comprehension. However, in the lexical domain, while significant cross-linguistic correlations were found for NWR, this was not the case for receptive vocabulary, word definitions and expressive vocabulary. Ebert, Pham, and Kohnert (2014) looked at RAN (Rapid Automatic Naming) performance and NWR performance in Spanish-English bilinguals with SLI, also 6 to 11 years old. Standardized tests measuring expressive and receptive vocabulary were also administered. Like Verhoeven et al. (2012), positive crosslinguistic associations were found more for processing based tasks (NWR and RAN) than for lexical knowledge tasks. Turning to morphosyntax, Blom and Paradis (2015) looked at tense morpheme production in English L2 bilinguals with and without SLI from a variety of L1 backgrounds. The TD children showed evidence of positive transfer from their L1 to English L2 morphology, but not the children with SLI. Meir, Walters and Armon-Lotem (2016) examined a range of morphosyntactic properties through a sentence repetition task given to Russian L1-Hebrew L2 bilinguals, with and without SLI. They found evidence for crosslinguistic transfer in error patterns for the TD group only, in line with Blom & Paradis (2015).

5. Minority/heritage language acquisition in children with developmental disorders

For bilingual children who are acquiring a minority/heritage language alongside a majority societal language, the successful development and maintenance of the heritage language can be beneficial (see 5.2), but is not always certain due to fewer opportunities for hearing and using the heritage language compared with the societal language and limited educational opportunities in the heritage language (Montrul, 2008). Furthermore, a younger age of L2 acquisition onset is associated with an early shift in dominance from L1 to L2 and a greater risk for attrition or incomplete acquisition of the L1 (Montrul, 2008). For bilingual children with developmental disorders, successful heritage language development could be in even more jeopardy. Children with language delay/disorder would have lower levels of L1 abilities when the L2 is introduced than their TD peers, thus, exacerbating the potential impact of early dominance shift on the L1 (Jacobson, 2012). Moreover, children with developmental disorders could experience even more early L2 exposure than their TD peers through intervention programs outside of preschool/school time as well, also putting the heritage language at more risk. Finally, children with developmental disorders might face less support for dual language learning, especially in a subtractive context where the societal L2 would be prioritized (see Section 5.2).

5.1 Acquisition of the minority/heritage language in bilingual SLI

Paradis, Emmerzael, and Sorenson Duncan (2010) examined parent report data on the L1 development of bilingual children from migrant backgrounds learning English as an L2, with and without SLI. While parents of children with SLI consistently reported lower current L1 abilities than parents of the TD children, there was no difference between these groups in parents' answer to a direct question asking whether they believed their child was losing the L1 in favour of English. These findings suggest that children with SLI might not be at a greater risk for L1 attrition than their TD peers; however, it is difficult to know whether L1 attrition was playing a role in the lower current L1 ability scores for the children with SLI without direct examination of children's heritage language abilities. To date, only a few studies have looked specifically at the heritage language acquisition of bilingual children with SLI, with some studies focussed on young children at the beginning of elementary school (Gutiérrez-Clellen, Simon-Cereijido, & Sweet, 2012; Morgan et al., 2013; Simon-Cereijido, Gutiérrez-Clellen, & Sweet, 2013) and others on older children in the upper grades of elementary school (Ebert et al., 2014; Jacobson, 2012; Verhoeven et al., 2012).

Morgan et al.'s (2013) study included 4 groups of 5- and 6-year-old children: Spanish monolinguals with TD and with SLI (in Mexico) and Spanish-English bilinguals with TD and with SLI (in the United States). They examined children's production of morphosyntactic clinical markers in Spanish. Both monolinguals and bilinguals with SLI performed worse than their TD peers, as expected. Bilinguals with SLI did not perform worse than monolinguals with SLI on tasks for each morphosyntactic construction; however, bilinguals with SLI did perform worse than monolinguals with SLI on a composite score across all tasks. Therefore, this study has mixed findings with respect to whether bilinguals with SLI can keep pace with their monolingual peers with SLI in the heritage language.

Studies by Gutiérrez-Clellen and colleagues examined Spanish-English bilingual 4 year olds with SLI who took part in an academic enrichment program (Gutiérrez-Clellen et al., 2012; Simon-Cereijido et al., 2013). Results seemed to signal that the heritage language is more fragile and in need of support. For example, children using more English in the classroom was negatively associated with growth in Spanish. Also, the language of the intervention program did not matter for Spanish outcomes, but children's English improved more in the English-only than the bilingual program. Therefore, even at 4 years of age, there could be signs of dominance shift and heritage language attrition in children with SLI.

Ebert et al. (2014) studied lexical acquisition in older Spanish-English children with SLI (6 to 11). They found a plateau in Spanish expressive and receptive lexical tasks because scores did not increase with age. By contrast, in English, there was a positive correlation between children's ages and task performance. Moreover, Ebert and colleagues' analyses revealed a clear dominance shift from L1 to L2 in this group of children, which was at a younger age than what has been reported for Spanish-English bilinguals with TD. In contrast, Verhoeven et al. (2012) found that Turkish-Dutch children with SLI of a similar age range showed consistently higher scores on lexical and syntactic tasks in Turkish than Dutch and increased growth in Turkish over this time period. Ebert et al. (2014) suggest that the difference in dominant languages could be due to different social integration patterns in these countries.

Jacobson (2012) examined Spanish-English bilingual children with SLI's accuracy with known morphosyntactic clinical markers in Spanish. Children were 7 to 11 years old. Children with SLI in higher grades showed greater accuracy than children with SLI in lower grades, indicating that Spanish is still developing for these children, and that they were not showing complete L1 attrition for these grammatical features, even though they are notoriously difficult for children with SLI. Also, Jacobson noted that the children with SLI were not making unique errors in Spanish compared to their TD peers. On the other hand, the persistence of errors in the Spanish of bilingual children with SLI at 11 years of age could be a sign of incomplete L1 acquisition.

5.2 Advice to parents about language use at home

There is a disconnect between our knowledge of the benefits of bilingual development on one hand, and the advice given to parents about language use at home and educational choices for their children with developmental disorders on the other hand. Early bilingualism can be advantageous for children's cognitive, academic and social-emotional development, and there is no reason to assume that children with developmental disorders are exceptions. First, bilingualism can enhance metalinguistic awareness, a skill underlying early literacy development (Bialystok, 2001). Second, crosslinguistic influence means that some language and literacy skills and their cognitive underpinnings can be shared between two languages, thus, heritage language children do not have to learn everything from the ground up in the societal L2 (Section 4). Finally, there are benefits to children's socio-emotional development of learning both the heritage language and the L2. Maintenance of the heritage language can have a positive impact on children's sense of identity and belonging in their heritage community, on their relationships with their parents, extended family and community members, especially as children grow older (Jegatheesen, 2011; Kremer-Sadlik, 2005; Tseng & Fuligni, 2000; Yu, 2013, 2016). Maintaining continued development of the heritage language in the case of children with developmental disorders is critically important because their parents and extended families are likely to be long-term caregivers.

In spite of these benefits, and of the evidence that children with developmental disorders can and do become bilingual (Section 2), heritage language maintenance can be a challenge for families of children with developmental disorders. First, dual language learning is frequently discouraged by educational and clinical professionals, and only a minority of parents receive support for their child's bilingualism (Kay-Raining Bird et al., 2012; Jegatheesan, 2011; Kremer-Sadlik, 2005; Yu, 2013). Scherba de Valenzuela et al. (2016) and Marinova-Todd et al. (2016) conducted qualitative and quantitative studies, respectively, probing the attitudes of educators and clinicians regarding the appropriateness of bilingualism for children with developmental disorders in Canada, the United States and the United Kingdom. Both studies found that professionals were unlikely to support "elective bilingualism" for children with language delay or disorder – that is, foreign language classes or immersion programs. They also were more hesitant to support bilingual exposure for severely affected children. More negative and ambivalent attitudes emerged in the qualitative interviews than in the questionnaire rating scale data.

What is the impact of advising parents to discontinue using the heritage language with their child, post diagnosis? First, if parents follow the advice, it often means that the linguistic input they are giving their children at home would not be as rich as if they were speaking their native language. When the L2 is used at home by parents who are non-proficient speakers of the L2, this has no demonstrable positive impact on children's L2 acquisition and can have a negative impact on their development of the heritage language (Hammer et al., 2012; Place & Hoff, 2011). If one considers that children with language delay and disorder are in even more need of rich linguistic input at home, then it is clear that asking non-proficient speakers to switch to only using the L2 is not in the best interests of these children. Furthermore, parents of children with ASD who have followed the advice of professionals to switch to the L2 at home have reported that there were barriers in their communication with their child with ASD, that the child with ASD was left out of family conversations, and that parents could not fully express themselves in the L2 (Kremer-Sadlik, 2005; Yu, 2013). By contrast, parents who ignored the advice from professionals reported more positive experiences about their child's communicative development (Jegatheesan, 2011; Kay-Raining Bird et al., 2012).

6. Clinically-oriented research on assessment and intervention

Whether children with developmental disorders speak a minority heritage language or two majority languages, whether they are simultaneous or sequential bilinguals, because assessment and intervention practices are largely based on a monolingual population, established practices might not be appropriate for them. Because of bilingual-monolingual differences in rates and patterns of language development and because standardized language measures are usually normed with monolinguals in the societal language, bilingual children, sequential bilinguals in particular, are at risk for over- and under-identification of language disorders (Elin Thordardottir, 2014; Paradis, 2016; Paradis, Genesee & Crago, 2011). Due to the lack of qualified bilingual clinicians and the prioritization of the societal L2, children with language disorder are most often given intervention programming in their L2, raising issues about the efficacy of this practice (Ebert, Kohnert, Pham, Rentmeester Disher, & Payesteh, 2014; Restrepo, Morgan, & Thompson, 2013). To date, studies on assessment and intervention have focussed on bilingual children with SLI, rather than with ASD, but similar issues arise for children with ASD. First, while diagnosis of ASD would involve behavioural assessment apart from language, understanding if a verbal bilingual child with ASD has co-morbid language disorder would require a language assessment. Second, issues raised in Section 5.2 about language choices in the home for bilingual families of children with ASD can and should apply to consideration of intervention programming.

6.1 Bilingual children with SLI: Assessment

Developing strategies for more effective language assessment practices with bilingual children in North America and Europe has received a great deal of recent attention (e.g., Armon-Lotem, Meir, & de Jong, 2015; Gathercole, 2014). Strategies fall under two main themes: Consideration of both L1 and L2 in assessment and developing alternative procedures for assessing children in a single language, typically the L2. Importantly, strategies are not mutually exclusive and combining them would improve accuracy in assessment with bilingual children.

The research reviewed in this chapter shows that bilingual children show signs of language disorder in both their languages; therefore, dual language assessment would provide the most comprehensive information. Accordingly, researchers in the United States have shown the effectiveness of Spanish-English assessment tools normed with bilinguals (e.g., Peña, Bedore, & Kester, 2015). Likewise, European researchers have been developing common tests across languages for the purposes of dual language assessment (Armon-Lotem et al., 2015). However, in spite of the obvious benefits of dual language assessment, linguistic diversity often makes it impossible to achieve. For example, testing resources might not be available in all minority languages and there could be insufficient numbers of bilingual clinicians and trained interpreters to cover all minority languages. Because of these barriers, some researchers have examined the use of parent report to obtain information on a bilingual child's minority/heritage L1 (O'Toole, 2014; Paradis, Emmerzael, & Sorenson Duncan, 2010; Tuller, 2015). For example, Paradis et al. (2010) developed and tested a parent report instrument on L1 developmental history and current L1 abilities, designed for use in diverse contexts, the ALDeQ. Paradis et al. (2010)'s study included 158 English L2 children with TD and SLI 4–7 years old, and found that ALDeQ scores discriminated between the children with TD and with SLI with good specificity but fair sensitivity, meaning it would be useful for assessment but needs to be combined with other measures.

Some studies have shown that using monolingual-based tests could be an acceptable practice for simultaneous bilinguals who are dominant in the language of testing (Elin Thordardottir, 2014; Gutiérrez-Clellen & Simon-Cereijido, 2007;

Rezzonico et al., 2015). For example, in Rezzonico et al.'s (2015) study, the bilingual children with SLI were dominant in their English L2 and displayed no significant differences from their monolingual peers with SLI across the majority of narrative macro- and microstructure abilities analysed. However, for sequential bilinguals, who are often dominant in the heritage L1 until school entry where dominance gradually shifts to the L2, researchers have developed several alternative assessment procedures.

One procedure is the use of bilingual – instead of monolingual – norm-referencing for L2 tests. The logic behind this procedure is that what tests are measuring in the L2 might be highly relevant information, i.e., clinical markers, but children need to be compared to an appropriate group in order to know if their performance is aligned with age-based expectations. Paradis et al. (2013) found that English L2 children with SLI could be adequately discriminated from their TD L2 peers (i.e., good specificity and sensitivity) using a parent report instrument (ALDeQ) combined with English tests of tense morphology, non-word repetition and narrative story grammar. In contrast, monolingual-norm referencing for these tests would have resulted in over-identification of SLI. Similarly, Morgan et al. (2013) found that 60% of the Spanish-English bilinguals in their study would have been misclassified as having SLI if monolingual cut off scores were used for the measures of Spanish morphosyntax.

Another alternative strategy involves emphasizing measures of language processing over measures of language knowledge in assessment (Armon-Lotem & Meir, 2016; Elin Thordardottir, 2014; Kohnert, 2010; Marinis & Armon-Lotem, 2015). The reasoning behind this approach is that processing measures would be less biased against bilingual speakers because they are targeting language-learning mechanisms more than accumulated language knowledge. Elin Thordardotir (2014) reports results of a set of studies examining the association between language exposure and French-English simultaneous bilingual children's performance on non-word repetition (NWR) tasks and tests of receptive vocabulary. NWR performance was less sensitive to variations in language exposure and functioned better to discriminate children with SLI among these bilinguals. Armon-Lotem and Meir (2016) found that sentence repetition tasks could accurately discriminate Russian-Hebrew children with SLI from their peers with TD when bilingual cut off points were used and children were tested in both languages. However, some mixed findings have emerged regarding the discriminant accuracy of NWR with bilinguals (e.g., Windsor et al., 2010). Since performance on NWR in the L2 is influenced by language exposure and L1 phonological factors, this could interfere with discriminant accuracy of NWR in the L2 (Sorenson Duncan & Paradis, 2016). Therefore, use of L2 language processing tasks in conjunction with other measures, including parent report on the L1, would be recommended (Marinis & Armon-Lotem, 2015).

Finally, another alternative procedure is the use of dynamic assessment techniques when using L2 tests (Kohnert, 2010: Peña, Gillam, & Bedore, 2014). The advantage of the dynamic assessment approach is that testing, teaching and then measuring a child's modifiability or response to teaching can give insights into language learning capacity that one-time, static testing of specific L2 knowledge cannot. Peña et al. (2014) examined the use of dynamic assessment techniques for a narrative task in English with Spanish L1-English L2 children, 5 ½ years old, with a wide range of exposure to English. Children with both TD and SLI were given a narrative pretest and posttest in addition to training sessions in between, aimed at increasing the length and complexity of children's narratives, and children's modifiabilty as a result of these sessions was measured. Peña and colleagues found that the discriminant accuracy of the narrative task greatly increased when both scores for macro- and microstructure narrative elements and measures of modifiability were considered.

6.2 Bilingual children with SLI: Intervention

Recent research on intervention with bilingual children with SLI has been centred on determining the impact of single vs. dual language intervention on the majority L2 and the heritage/minority L1. At issue are the following: whether L2-only intervention is efficacious for either language in bilinguals, whether dual language intervention is sufficient to support L2 development – the language of schooling – as well as L1 development, and whether positive cross-language interdependence would be apparent from the treatment language to the non-treatment language.

Regarding early intervention with 4-year olds, Gutiérrez-Clellen et al. (2012) and Simon-Cereijido et al. (2013)'s studies (discussed in 5.1) found no differences between single language/English-only or dual language/Spanish-English intervention on children's growth in Spanish abilities, but children's English abilities showed more growth in the English-only intervention, and children's English abilities grew more than their Spanish abilities in both intervention groups. Gutiérrez-Clellen et al. (2012) found that higher Spanish skills at the beginning predicted greater growth in English across grammatical measures, providing some evidence for cross-language interdependence. Restrepo et al. (2013) also carried out an intervention study with 4-year-old Spanish-English bilinguals. They found that growth in lexical skills increased equally in the English-only and bilingual intervention for English, but not for Spanish; Spanish skills showed less improvement than English overall, but more improvement in the bilingual intervention.

Ebert et al. (2014) and Pham, Ebert, and Kohnert (2015) also report on an intervention with Spanish-English bilinguals with SLI, but children were 8½ years old, on average. The intervention included single-language/English-only and dual language/primarily Spanish intervention, as well as an intervention targeting non-linguistic cognitive processing mechanisms that children with SLI show deficits with. Parallel to the research with younger children, gains in English abilities were more pronounced than gains in Spanish abilities, even though the dual language intervention was essentially in Spanish. Furthermore, three months after intervention, there was only positive change in English and not in Spanish. Also parallel with Restrepo et al. (2013), the English-only intervention did not boost children's Spanish abilities, and there were no differences in the English abilities of children from the single vs. dual language intervention three months afterwards. Analyses revealed modest evidence for transfer from Spanish to English, but not the other way around. Finally, the non-linguistic cognitive mechanisms intervention had only a limited impact.

Elin Thordardottir, Cloutier, Ménard, Pellan-Blais, and Rvachew (2015) conducted an intervention study in Canada, where the diversity of heritage languages among newcomer families makes it impractical to consider developing a program in just one of these languages. This study took place in the French-speaking province of Québec, and the 5- year-old participants and their families had French as the societal L2. Dual language intervention consisted of involving parents in the therapy sessions to carry out the activities in the heritage language alongside French. Their results echo the other studies in that both single and dual language intervention produced gains in the L2. There was no discernable impact on the L1, but the authors note that inconsistent parent engagement and lack of robust measures of L1 abilities might explain the null results.

Taken together, these studies show clear efficacy of L2 intervention on L2 development in bilingual children with SLI, but effects of dual language intervention on heritage L1 development are less straightforward. Moreover, evidence for cross-language interdependence is limited and is mainly uni-directional, from L1 to L2.

7. Conclusions and future directions

Children with language and communication disorders like SLI and ASD clearly have the capacity to become bilingual and, for children who speak a heritage L1 at home, continued bilingual development post diagnosis is the best recommendation for the child's social-emotional well-being within his/her family. Bilingual children with SLI have similar linguistic profiles as their monolingual peers with SLI in each language; therefore, clinical markers in a particular language can be expected to be the same whether a child with SLI is learning that language alone or alongside another. Compared to bilingual children with TD, bilingual children with SLI appear to have reduced crosslinguistic influence, which could, in turn, contribute to their language learning difficulties because they might not be able to take full advantage of positive transfer and shared cognitive proficiencies. Bilingual children with SLI also might be more at risk for attrition or incomplete acquisition of a heritage L1 than their bilingual peers with TD. Overall, less is known about bilingual development in children with ASD than with SLI and studies on bilingual children with ASD need to move beyond assessing their capacity for bilingualism. Turning to clinical issues, even though assessment of language disorder in bilingual children is challenging, recent research investigating strategies to circumvent these challenges has shown promising results. In contrast, research on single and dual language intervention indicates that providing effective support for a heritage L1 in children with SLI still poses a significant challenge for clinicians.

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CHAPTER 17

Understanding the nature of bilingual aphasia

Diagnosis, assessment and rehabilitation

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In this chapter, we review the current state of the science with regards to bilingual aphasia. Four important themes emerge from this research. First, bilingual aphasia is an exponentially complex manifestation of a dynamic interaction between age of acquisition, exposure, proficiency, and impairment after brain damage. Second, findings of language coactivation have implications for bilingual aphasia rehabilitation in terms of whether cross language generalization can be expected or not. Third, few studies on bilingual aphasia have begun to examine this notion of domain general versus domain specific language and cognitive control. Finally, there are structural and functional changes in the bilingual brain, and in the case of brain damage, these changes can impact the extent of language impairment and recovery.

1. Introduction

Bilingual aphasia, defined as an impairment of one or both languages in bilingual individuals after a stroke, is of increasing interest worldwide because more than half the world's population is bi/multilingual. The combination of an increasing bi/multilingual population as well as stroke being the leading cause of long-term disability (approximately 800,000 strokes each year in the US alone) increases the importance of studying bilingual aphasia, its nature, assessment and rehabilitation. Yet, some of the basic questions about bilingual aphasia remain unanswered (Fabbro, 1998; Roberts, 1998a, 1998b). First, the nature of impairment in the two (or multiple) languages in a person who speaks more than one language and has aphasia is still a complex question for which there are no clear answers (Kiran & Roberts, 2012). Second, it is not yet known whether it is sufficient to rehabilitate one language in bilingual aphasic patients and if rehabilitation in one language has beneficial effects in the untreated language (Ansaldo, Marcotte, Scherer, & Raboyeau, 2008; Ansaldo & Saidi, 2014; Fabbro, 2001).

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Research in bilingualism has resulted in several important insights into the way a bilingual brain processes languages. The details of these important results are the focus of other chapters in this book and will not be discussed in detail here, but each of these findings has important implications for the field of bilingual aphasia. This chapter is broadly organized into these themes to provide a context for the current state of research in bilingual aphasia. Through these themes, we seek to highlight recent advances in our understanding of diagnosis and assessment of bilingual aphasia as well as in our current understanding of rehabilitation approaches for this population.

Advances in research in bilingualism have provided many important observations including that (1) language processing in a bilingual individual is a dynamic process, (2) both language systems are active during language processing tasks, (3) there are cognitive consequences of being bilingual, and (4) there are structural and functional changes in the bilingual brain. Each of these findings are based on decades of robust scientific evidence and have important implications for our understanding of bilingual aphasia. In the context of these four main themes, we will highlight our understanding of bilingual aphasia and open challenges in this field.

2. Language processing in a bilingual individual is a dynamic process

It is a well-known fact that learning a second language is influenced by a number of factors including the age of acquisition (AoA) of the second language and the extent of language proficiency (Abutalebi, 2008; De Keyser & Larson-Hall, 2005; Hernandez & Li, 2007). It is also well understood that learning L2 not only changes representations and access for L2 but also for L1 itself (Bice & Kroll, 2015; Kroll & Stewart, 1990; Kroll & Stewart, 1994). Indeed, the link between L1 and L2 can be asymmetrical, in that the connection from L2 to L1 can be stronger than from L1 to L2 (Kroll & Stewart, 1994; Scholl, Sankaranarayanan, & Kroll, 1995). Importantly, mixing between the two languages poses a greater cost to L1 (more dominant) than to L2 (less dominant) (Christoffels, Firk, & Schiller, 2007). Similarly, immersion experiences in L2 result in attenuation/attrition of L1 (Baus, Costa, & Carreiras, 2013; Linck, Kroll, & Sunderman, 2009; Tokowicz, Michael, & Kroll, 2004) and long term immersion can change the dominance between the two languages with L2 now becoming the L1. Thus, there can also be a shift from the chronological order in which languages are learned to relative language dominance such that L1 (native language) and L2 (second language) can be replaced by "Most Dominant Language" (MDL) and L2 by "Least Dominant Language" (LDL) (Heredia, 1996). Further, the extent of influence of L2 on L1 depends on proficiency of L2 as well as task demands (Titone, Libben, Mercier, Whitford, & Pivneva, 2011). All these results suggest that language processing is a dynamic process in a bilingual individual where both languages are highly interactive but also influenced by the age of second language acquisition (AoA), relative proficiency and use within each language.

2.1 Implications for aphasia

The study of bilingual aphasia affords the possibility of examining the effect of a brain damage event on two languages in the brain, allowing the systematic testing of several aspects of this dynamic process. There are, however, several complexities to studying these individuals. Because no two individuals are similar in their language learning experience, the amount of language exposure in the two languages determines how each individual's language impairment is manifested. Unlike in monolingual aphasia, where it is assumed that an individual was proficient in the language they spoke prior to stroke, in bilingual aphasia, information regarding the level of proficiency in each language the individual knows (and the relative proficiency) cannot be assumed to be at 100% and, thus, needs to be ascertained in the form of a language use questionnaire. Further, this information is obtained after the stroke and is at best, an estimate of proficiency pre-stroke. Because of the dynamic nature that is an inherent component of bilingualism and aphasia, the results of patient studies that focus on bilingual aphasia can offer a wide variety of findings. Specifically, because there are several factors noted above (e.g., AoA, language proficiency) that influence our interpretation of a bilingual individuals' language status even prior to their stroke, making interpretations regarding the degree of language impairment *after* stroke can be complicated. Thus, different patients with identical pre-stroke language learning profiles can present with very different language impairment profiles, and conversely, different patients with very different pre-stroke language learning profiles can present with identical language impairment profiles (Gray & Kiran, 2013; Kiran & Roberts, 2012; Roberts, 1998a, 1998b). As noted above, AoA and the extent of language proficiency are critical factors that influence bilingual language representation in healthy bilinguals and when combined with other factors such as site and size of lesion that are specific to aphasia and brain damage (Fabbro, 2001; Lorenzen & Murray, 2008), understanding the nature of bilingual aphasia is a daunting endeavor.

Consequently, our current understanding of bilingual aphasia is limited to prevalence of dissociable language deficits (Fabbro, Skrap, & Aglioti, 2000; Nilipour & Ashayeri, 1989; Sasanuma & Suk Park, 1995), and an introduction to the host of factors that may influence the nature of impairment. That said, trends can be observed and meaningful interpretations can be made by examining different levels of language impairment in this population.

For instance, a few studies have investigated lexical access and retrieval in bilingual aphasia (Gray & Kiran, 2013; Kiran, Balachandran, & Lucas, 2014; Kiran & Tuchtenhagen, 2005; Kong, Abutalebi, Lam, & Weekes, 2014; Roberts & Deslauriers, 1999). Of these, some studies have demonstrated the degree of influence of premorbid proficiency on the nature of impairment in terms of lexical access (Edmonds & Kiran, 2006; Kiran & Lebel, 2007; Kiran & Tuchtenhagen, 2005; Lalor & Kirsner, 2001). Others, such as Roberts and Deslauriers (1999) evaluated the performance of bilingual adults with aphasia on the linguistic properties of the words (cognates versus noncognates) and concluded that patients show an advantage for naming cognate words. As another example, Kiran et al. (2014), examined the performance of 12 healthy Spanish-English bilingual adults and 10 Spanish-English bilingual adults with aphasia on two picture naming tasks and a verbal fluency task (i.e., a category generation task consisting of three semantic categories). Results showed that although healthy bilingual adults outperformed bilingual adults with aphasia (i.e., higher naming accuracies and generating more words in the word fluency task), both groups were observed to make similar types of errors on naming tasks (e.g., circumlocutions) in the target and non-target languages, and clustering strategies on verbal fluency tasks were similar across groups. These results indicate that although bilingual patients with aphasia exhibit lexical retrieval deficits, the underlying mechanism supporting lexical retrieval on naming tasks for bilingual patients with aphasia still mirrors bilingual language processing utilized by healthy bilinguals.

Gray and Kiran (2013) evaluated the patterns of lexical and semantic deficits in 19 Spanish-English bilingual adults with aphasia. This study was the first of its kind to include a large sample of patients and use their data to identify patterns of lexical and semantic processing deficits between two languages. The authors also conceptualized a framework of bilingual language processing that integrated specific levels of language processing (e.g., comprehension, expression, non-linguistic semantics, and translation), and this framework was validated by using the patient data from standardized measures of diagnostic testing in Spanish and English. The results showed strong relationships between measures of input and output for both languages. Notably, pre-stroke language ability rating was a strong predictor of post-stroke outcomes. Also, two distinct groups were identified in the patients, those who lost the same amount of language in Spanish and English and those who lost different amounts of Spanish and English. Overall, results from this study indicate that differential patterns in language deficits do arise and can offer meaningful interpretations of how bilingual language processing in patients can be explained.

Similar to lexical-semantic processing, several studies examining bilingual aphasia have explored grammatical category and morphological performance of nouns and verbs across a variety of language combinations (Hernandez et al., 2008; Kambanaros, Messinis, & Anyfantis, 2012; Tschirren et al., 2011). Generally, these studies show an association between grammatical categories across languages (e.g., poorer performance in naming verbs relative to naming nouns across languages), suggesting that languages share grammatical class information (Almagro, Sanchez-Casas, & Garcia-Albea, 2003; Faroqi-Shah & Waked, 2010; Kambanaros, 2008; Kambanaros et al., 2012; Kambanaros & van Steenbrugge, 2006). For a partial review of grammatical category and morphological studies see Miozzo, Costa, Hernandez, and Rapp (2010).

A third set of studies have examined the nature of orthographic processing in bilingual aphasia, specifically, in acquired dyslexia and dysgraphia (Weekes, 2012). This body of research consists of language combinations that differ on many components of language (e.g., orthographical-to-phonological transparency vs. opaqueness or morphological complexity) as well as language scripts that are alphabetic and non-alphabetic (Dai, Kong, & Weekes, 2012; Druks, Aydelott, Genethliou, Jacobs, & Weekes, 2012; Eng & Obler, 2002; García-Caballero et al., 2007; Kambanaros & Weekes, 2013; Law, Wong, Yeung, & Weekes, 2008; Weekes, 2012; Weekes & Raman, 2008). Many factors can affect how acquired dyslexia and dysgraphia manifest themselves. For example, acquired dyslexia can exhibit differential impairments in two languages that share an alphabetic script but differ on transparency (Yin, He, & Weekes, 2005). However, selective dyslexia in only one of two alphabetic languages that overlap significantly has also been documented (e.g., Garcia-Caballero et al., 2007). Additionally, differential dyslexia and dysgraphia has been reported in biscriptal bilinguals (Raman & Weekes, 2005a, 2005b). For instance, Raman and Weekes (2005a; 2005b) reported on a Turkish-English bilingual who presented with surface dyslexia in English and deep dysgraphia in Turkish and English secondary to a cerebrovascular accident. The authors suggest that the patient's dyslexia may be attributed to under activation of phonological representations in both Turkish and English. Clearly, research into the nature of orthographic processing and its intersection with different language scripts is worthy of further study as there remain several unanswered questions.

To better understand the nature of language impairment in bilingual aphasia, there have been several attempts to develop appropriate assessments for bilingual aphasia. These have included the Aachen Aphasia Test (Huber, Poeck, Weniger, & Willmes, 1983); Western Aphasia Battery (Kertesz, 1982; Kertesz, 2007; Kertesz, Pascual-Leone, & Pascual-Leone, 1990), Boston Diagnostic Aphasia Examination (Garcia-Albea, Sanchez-Bernardos, & Del Viso-Pabon, 1986; Goodglass, Kaplan, & Barresi, 2000), Bilingual Aphasia Test (BAT) (Amberber, 2011; Gomez-Ruiz & Aguilar-Alonso, 2011; Ivanova & Hallowell, 2009; Kambanaros & Grohmann, 2011; Kong & Weekes, 2011; Koumanidi Knoph, 2011; Munoz & Marquardt, 2008; Paradis, 1989) to name a few. Clearly, the main advantage of these tests is that they allow cross-linguistic comparisons of language impairment. However, these standardized assessments are based on colleting norms for healthy individuals and a variety of patients, and it is very difficult to assume a normative framework in the assessment of bilingual aphasia (Kiran & Roberts, 2012). Importantly, there is no way to reasonably assume pre-stroke levels of knowledge for bilingual individuals given the tremendous variability in levels of language proficiency even in healthy bilingual adults. Further, many of these tests are translated into many different languages from the starting item sets and these translated tests may introduce biases of items and levels of difficulty. Consequently, the same tests may have unequal levels of difficulty between the two languages, as reported with the Boston Naming Test (Kohnert, Hernandez, & Bates, 1998; Roberts, Garcia, Desrochers, & Hernandez, 2002).

A more viable and appropriate alternative to assessing language function and impairment after bilingual aphasia is to conduct relatively open ended tasks such as category generation and narrative production tasks. These types of tasks do not rely on pre-determined norms ensuring that items are valid in a particular language, however, they allow for the quantification of language production abilities in the two languages. For instance, a category generation provides a numerical score of the number of items produced in each language of the bilingual patient and the difference in the number of words produced in each language for the category provides an estimate of the differential performance between the two languages. As discussed before, studies have shown similar performance across the two languages, providing a means of detecting differential language impairment in patients (Kiran et al., 2014; Roberts & Le Dorze, 1998). Similarly, a discourse production task provides a quantitative measure of production that make comparing performance between the languages possible. For instance, Muñoz and Marquardt (Muñoz & Marquardt, 2004) examined semantic accuracy of the utterance, the number of verbal disruptions (such as repetitions, omissions, fillers), and word retrieval errors (such as semantic errors, phonemic errors, descriptions) in bilingual patients with aphasia. Similar work has been done by Kong and colleagues on narrative discourse production in Chinese-Cantonese-English bilingual aphasia that have provided insights on performance relating to differences in language structure versus performance that signifies impairment (Kong & Law, 2009; Kong, Whiteside, & Bargmann, 2015). More work needs to be done to examine category generation and narrative production in bilingual aphasia but they provide an important venue to pursue in the future.

To summarize, the dynamic nature of language dominance is influenced by factors such as attrition and immersion, in addition to the usual factors that influence language proficiency (such as AoA, use and exposure) and the differential nature of impairment after brain damage. These factors need to be taken into account when evaluating impairment in the multiple languages of multilinguals. Just as bilingualism is viewed as a continuum of relative proficiency, bilingual aphasia should also be viewed as continuum with the event of brain damage separating language proficiency before and after the event (see Figure 1). Thus, it is important to understand bilingual aphasia in the context of relative impairment and relative recovery in determining whether both/all of the client's languages were similarly affected and consider pre-morbid proficiency when determining parallel patterns of impairment post-stroke.

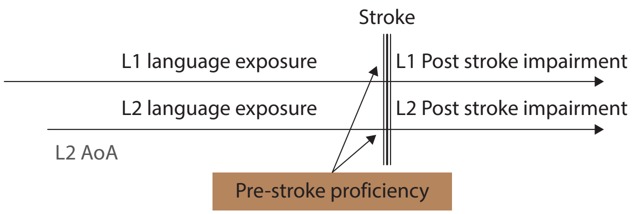

Figure 1. Schematic representation of the continuum of bilingual aphasia separated into pre-stroke language exposure and post-stroke impairment

3. Both language systems are active during language processing tasks

A compelling finding of research in bilingualism is that the non-target language is active during production and comprehension during language processing. Specifically, an overwhelming body of research has shown that across different language processing paradigms and languages, language co-activation is a consistent phenomenon (Costa & Caramazza, 1999; Costa, La Heij, & Navarrete, 2006a; Costa, Miozzo, & Caramazza, 1999; Guo & Peng, 2006; Hoshino & Thierry, 2010, 2011; Marian, Spivey, & Hirsch, 2003; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008; Wu & Thierry, 2010). Importantly, even though language coactivation is a well observed phenomenon, how bilinguals resolve activation in the non-target language is still a topic of debate (Costa, 2005; Costa et al., 2006a; Costa & Santesteban, 2004b; Green, 1998a; Kroll, Bobb, & Wodniecka, 2006; Kroll, Bobb, Misra, & Guo, 2008). Studies examining this issue have reported activation in the non-target language but this activation is controlled by an attentional mechanism that effectively ignores competitors that are not from the target language (Costa, 2005; Costa & Santesteban, 2004a; Costa, Santesteban, & Ivanova, 2006b; Finkbeiner, Gollan, & Caramazza, 2006). Through selective attention, the target language is heightened, and a mental firewall is established in the non-target language. In contrast, the Control Activation and Resource Model (CARM) (Green, 1986; Green, 1998b) assumes that all activated alternatives potentially compete for selection. A specified inhibitory mechanism influences both the target and non-target language, thus enabling bilinguals to access the target language while simultaneously suppressing the non-target language (i.e. irrelevant information) (Green, 1998a).

3.1 Implications for aphasia

Based on the evidence above, one could assume that both impairment and rehabilitation for bilingual adults with aphasia would be influenced by the potential for language co-activation. A more detailed description of studies that have examined the nature of language co-activation in the context of inhibitory control are explained later in the chapter. A few studies have examined if language co-activation can enable performance on language tasks for bilingual patients particularly using cognate words (Lalor & Kirsner, 2001; Siyambalapitiya, Chenery, & Copland, 2013; Tiwari & Krishnan, 2015).

With regards to rehabilitation, it would seem likely that language co-activation could be capitalized over the course of treatment and that cross-language generalization should be a consistent observation in rehabilitation research. In other words, if target words and structures are active in all the languages of the individual, then training in one language should result in changes in all languages. Unfortunately, only a few studies have even examined rehabilitation outcomes in bilingual aphasia (Abutalebi, Della Rosa, Tettamanti, Green, & Cappa, 2009; Ansaldo & Saidi, 2013; Ansaldo, Saidi, & Ruiz, 2010; Croft, Marshall, Pring, & Hardwick, 2011; Edmonds & Kiran, 2006; Goral, Naghibolhosseini, & Conner, 2013; Kiran & Iakupova, 2011; Kiran & Roberts, 2010; Kurland & Falcon, 2011; Meinzer, Obleser, Flaisch, Eulitz, & Rockstroh, 2007; Miertsch, Meisel, & Isel, 2009; Miller Amberber, 2012; Radman, Spierer, Laganaro, Annoni, & Colombo, 2015) and have found varied results. A few of these studies have observed cross-language generalization (Edmonds & Kiran, 2006; Goral, Levy, & Kastl, 2007; Kiran & Iakupova, 2011; Kiran & Roberts, 2010; Kurland & Falcon, 2011; Miertsch et al., 2009; Miller Amberber, 2012). For instance, Miertsch and colleagues (Miertsch et al., 2009), trained a German, English and French speaking trilingual in his L3 (French) and found that both L3 (French) and L2 (English) improved as a function of treatment.

Edmonds and Kiran (2006) examined a semantic-based treatment to improve naming and facilitate generalization to untrained semantically related items in the trained language and translations of the trained and untrained items in the untrained language in three English-Spanish bilingual individuals with aphasia. The three patients demonstrated a within- and across-languages effect on generalization related to pre-stroke language proficiencies. In a follow-up study, Kiran and Roberts

(2010) also administered the same semantic treatment to improve picture naming in two English-Spanish patients and two English-French patients and measured generalization to translations of the treated words and to words semantically related to the target words in each language. Results revealed that the performance in all four patients was highly variable but reflected both within- and across-languages effects on generalization.

Other studies have not observed cross-language generalization with improvements limited to the trained language only (Galvez & Hinckley, 2003; Miller Amberber, 2012). Miller Amberber (2012) examined a French-English individual who was French dominant and demonstrated greater impairment in English relative to French. This patient was trained in English and improved in the trained language but not in French, indicating a language specific improvement as a function of treatment. In another similar study, Goral et al. found selective generalization from trained L2 (English) to L3 (French) but not L1 (Hebrew) in a trilingual patient with agrammatic deficits (Goral, Levy, & Kastl, 2010). Still others have observed cross-language interference (Goral et al., 2013; Keane & Kiran, 2015). For instance, Keane and Kiran (2015) examined rehabilitation in a trilingual woman through two periods of semantic treatment (French, followed by English) to alleviate naming deficits. While the participant improved on trained items, she did not show within- or cross-language generalization. In addition, error patterns revealed a substantial increase of interference of the currently trained language into the non-trained language during each of the two treatment phases. These findings indicate a failure of generalization within and across languages and an increase in cross-language intrusions that suggest a larger cognitive control impairment in this individual.

In studies that have reported generalization, mechanisms have been explained in terms of increasing spreading activation of both target words and their semantically related neighbors in both the trained language and the untrained language (Kiran, Sandberg, Gray, Ascenso, & Kester, 2013b). These findings are consistent with what is known about generalization in monolingual aphasia (Kiran & Bassetto, 2008; Maher & Raymer, 2004) and cross-language priming (Altarriba & Basnight-Brown, 2007; Basnight-Brown & Altarriba, 2007). In contrast, explanations for cross-language interference or the lack of a cross-language generalization hypothesize that cross-language inhibition mechanisms may interfere with facilitation following treatment (Keane & Kiran, 2015; Kiran et al., 2013b) and are based on models of inhibitory control (Dijkstra, 1998; Green, 1998b; Schreuder & Hermans, 1998). In addition, inhibition between languages may be asymmetric depending on the relative proficiency of the two languages (Goral et al., 2013), underscoring the extensive evidence from typical bilinguals regarding asymmetric language transfer/switch effects seen across behavioral and neuroimaging paradigms (Abutalebi et al., 2012a; Costa & Santesteban, 2004b; Costa et al., 2006b; Misra, Guo, Bobb, & Kroll, 2012).

To compound our interpretation of bilingual aphasia rehabilitation, two recent meta-analyses (Ansaldo & Saidi, 2013; Faroqi-Shah, Frymark, Mullen, & Wang, 2010) found that while treatment provided in the target language resulted in improved treatment outcomes in that language, there were several factors that precluded clear interpretation of the results. These included variability in (a) the type of treatment including naming treatment (Croft et al., 2011; Kiran & Roberts, 2010; Miertsch et al., 2009), morphological treatment (Goral et al., 2013) or non-specific treatment (Galvez & Hinckley, 2003; Junque, Vendrell, Vendrell-Brucet, & Tobena, 1989); (b) the language combinations studied that have included French-English (Miller Amberber, 2012), Spanish-Italian (Abutalebi et al., 2012a), German-French-English (Miertsch et al., 2009), Hebrew-French-English (Goral et al., 2007); (c) time-post-stroke; and (d) pre- and post-stroke language impairment profiles.

In recent work, Kiran et al., (Kiran, Grasemann, Sandberg, & Miikkulainen, 2013a) have taken a different approach to understanding rehabilitation by developing a computational model to simulate language recovery following rehabilitation in bilingual aphasia (Miikkulainen & Kiran, 2009). In that work, they trained, lesioned, and retrained a bilingual computational model in order to systematically characterize the effect of AoA, pre-stroke language proficiency, and post-stroke naming output on rehabilitation outcomes. The model first generated a large number of different 'computational' patients by systematically varying (a) AoA of L1/L2, (b) pre-stroke language proficiency, and (c) post-stroke language impairment in each language and compared them to actual human patients (Grasemann, Sandberg, Kiran, & Miikkulainen, 2011). The authors then validated the model by comparing output of the model's retrained performance to actual treatment outcomes in 17 Spanish-English individuals who received behavioral rehabilitation (Kiran et al., 2013a). Results demonstrated that a computational model including these variables was able to capture the many complex profiles that surface in aphasia both before and after rehabilitation and provides a promising new avenue to understand the effects of rehabilitation in patients with bilingual aphasia.

4. There are cognitive consequences of being bilingual

One of the most important advances in our understanding in bilingualism research is the impact of being bilingual on the way the brain processes and manages competing information. There is varied evidence that repeated practice at language selection and control can also influence other aspects of control, specifically, cognitive control. Extensive work by Bialystok and colleagues (Bialystok, 2010, 2011;

Bialystok, Craik, & Luk, 2008; Bialystok, Craik, Green, & Gollan, 2009; Bialystok, Craik, Klein, & Viswanathan, 2004) suggests that being bilingual offers cognitive advantages such as higher performance on non-linguistic interference control tasks such as the flanker task and the Simon task. Additional studies that examine attentional networks and conflict monitoring tasks also suggest that bilinguals enjoy the added cognitive benefit of higher, more efficient performance on nonverbal tasks compared to monolinguals (Costa, Hernandez, Costa-Faidella, & Sebastian-Galles, 2009; Costa, Hernandez, & Sebastian-Galles, 2008). The inference from these studies is that constant management of language activation and language control results in a corresponding advantage in non-linguistic cognitive control (Festman, Rodriguez-Fornells, & Munte, 2010; Rodriguez-Pujadas et al., 2013) and offers bilinguals lifelong advantages including staving off neurological decline (Craik, Bialystok, & Freedman, 2010; Marian & Shook, 2012). In contrast to the findings outlined above, other studies have not been able to replicate the bilingual advantage (Gathercole et al., 2014; Kousaie & Phillips, 2012a, b; Paap & Greenberg, 2013) and suggest that bilinguals do not enjoy more efficient cognitive processing. For a review of the on-going debate, see Hilchey and Klein (2011).

Recently, focus has shifted to understanding the specific mechanisms of the bilingual cognitive advantage. These studies examine the evidence for two distinct types of processing, domain general cognitive control and domain specific cognitive control. Domain general cognitive control suggests that language control mechanisms and cognitive control mechanisms are associated and exhibit some overlap in processing. Several studies that have examined differences within bilingual groups provide evidence in support for the concept that the constant monitoring of two languages, as well as how the two languages are managed, can impact control in non-linguistic contexts (Festman & Münte, 2012; Festman et al., 2010; Prior & Gollan, 2011). In contrast, domain specific cognitive control suggests that language control mechanisms and cognitive control mechanisms are independent from each other and do not overlap in processing. Several studies within bilingual groups have found that the control mechanisms of the two systems may not interact as strongly and that bilinguals are better able to maintain linguistic control when tasks increase with difficulty or as age increases, whereas non-linguistic control does not show the same preservation (Calabria, Hernández, Branzi, & Costa, 2012; Weissberger, Wierenga, Bondi, & Gollan, 2012).

4.1 Implications for aphasia

Studies on healthy adults raise the possibility that an impairment in language control can have profound effects on our interpretation of language deficits in bilingual aphasia. Therefore, it can be challenging to differentiate between deficits in lexical access versus deficits in language control if there is a potential interaction between language and cognitive control. For example, Munoz and Marquardt (2003) discuss patients that lost more lexical access in one language relative to the other, this differential impairment may instead be interpreted as a loss of lexical representation *and/or* language control impairment. Similarly, Adrover-Roig et al. (2011) report on a bilingual patient who presented with differential language impairment and deficits in executive functioning subsequent to a subcortical lesion. On language tasks that required overt levels of control, the patient demonstrated poor performance in *both* languages, which illustrates the challenge in isolating loss of lexical representations and the ability to control them. Also Kong and colleagues (Kong et al., 2014) describe a trilingual patient who presented with aphasia, deficits in language control, and impaired executive control. This patient showed pathological code-switching during discourse production that was related to the task switching abilities on the modified Stroop color-word task and the Wisconsin Card Sorting Test. Taken together with lesions in the frontal and temporo-parietal lobes, these data highlight the association between linguistic and non-linguistic control mechanisms after brain damage.

Because of the intersection between language and cognitive control in bilingual aphasia, and the clear manifestations of impairment in language, bilingual individuals with aphasia can provide a unique insight into the relationship between language and cognitive control and whether these mechanisms are domain specific or domain general. Nonetheless, only a few studies have investigated cognitive control in bilingual aphasia (Dash & Kar, 2014; Gray & Kiran, 2015; Green et al., 2010; Verreyt, De Letter, Hemelsoet, Santens, & Duyck, 2013). Each of these studies will be explained in detail below because they show mixed results and highlight the complexity of research in this topic.

Green et al. (2010) asked 12 non-native bilingual and 14 monolingual neurologically healthy adults and two non-native English (French-English and Spanish-English) bilingual adults with aphasia who exhibited parallel impairment and recovery patterns to perform three tasks that required control in linguistic (e.g., lexical decision, Stroop) and non-linguistic (e.g., flanker) contexts. Results revealed that compared to healthy monolingual participants, healthy bilingual participants exhibited greater effects of interference on the lexical decision task and smaller effects of interference on the Stroop task, whereas no difference between the two control groups was observed on the flanker task. Specific to the two patients, results diverged from each other and from the results exhibited by the neurologically healthy bilingual participants. Relative to the healthy bilinguals, Patient 1 exhibited abnormal effects of interference (for RT and accuracy) on the lexical decision task and English Stroop task, whereas effects of interference (for RT and accuracy) on the flanker task were in line with healthy bilinguals. In contrast, relative to healthy bilinguals, Patient 2 exhibited abnormal effects of interference (for accuracy only) on the lexical decision task, English Stroop task, and flanker task illustrating problems with both the verbal and the non-verbal domains. These results show the complexity in interpreting cognitive control deficits in patients with aphasia. While Patient 1's results were suggestive of domain specific cognitive control, Patient 2's results were indicative of domain general cognitive control.

In a different study, Verreyt et al. (2013) examined the relationship between executive control and lexical access impairment in one French-Dutch bilingual adult with aphasia who presented with differential language impairment. The patient completed the non-linguistic flanker task and a linguistic task that accounted for cognate and non-cognate status of words in L1 and L2. Results revealed impaired control in both the linguistic and non-linguistic contexts, which was suggestive of domain general cognitive control.

In the next study, Dash and Kar (2014) report data from four bilingual patients with aphasia who were asked to complete a linguistic flanker task consisting of letters, a non-linguistic flanker task, and a non-linguistic negative priming task. Results revealed that all four patients demonstrated a preference for reactive control mechanisms. However, patient performance varied on each task. For instance, on the non-linguistic flanker, two patients employed reactive and proactive control mechanisms, one patient relied on reactive control and another relied on proactive control. Another variation in performance was based on L1 vs L2. For example, one patient engaged proactive control when using L1 and reactive control when using L2. To summarize, the findings point towards a dissociation between language control and cognitive control as evidenced by the variation of engaged control processes across tasks.

Finally, Gray and Kiran (2015) examined the performance of ten Spanish-English bilingual adults with aphasia and 30 age matched Spanish-English neurologically healthy bilingual adults on two tasks that tap resistance to distractor interference: the non-linguistic flanker task and a linguistic task developed specifically for their study. Healthy bilingual controls showed the congruency effect both in accuracy and reaction time on the non-linguistic flanker task, however, they did not show a congruency effect on the linguistic task. Specifically, while they showed a within-language semantic facilitation effect they did not show a cross-language congruency effect (slower reaction times on the incongruent condition requiring translation). The bilingual individuals with aphasia exhibited unimpaired non-linguistic control as evidenced by showing the congruency effect on the non-linguistic flanker task, but exhibited impaired control on the linguistic task as evidenced by individual patient analysis, and the combination of these task results is indicative of domain specific cognitive control.

In a follow up study, Gray and Kiran (under review) examined linguistic and non-linguistic control mechanisms in 13 Spanish-English bilingual patients and 20 Spanish-English bilingual, healthy controls. Participants completed two linguistic and two non-linguistic tasks that accounted for low and high levels of complexity. Results revealed that on low complexity tasks, both groups exhibited positive effects of control on the non-linguistic task only, and the linguistic task was shown to be affected by automaticity of reading, thus generating a null effect of control when accounting for proficiency. On high complexity tasks, only the healthy controls exhibited positive effects of control in both domains, indicative of domain general cognitive control, whereas the patients exhibited positive effects of control only on the non-linguistic task, indicative of domain specific cognitive control. The magnitude of control for each task was also examined. Results revealed that healthy bilinguals exhibited significant amounts of conflict on all tasks, whereas patients exhibited this pattern only on non-linguistic tasks, suggesting that patients present with a dissociation in how they process linguistic and non-linguistic information.

The outcomes of the studies discussed above are conflicting. While some provide evidence of domain general cognitive control, others provide evidence of domain specific cognitive control. The disjointed findings highlight a few important points that must be appreciated because they are integral aspects of exploring these relationships: (1) the complex interplay between cognitive control and bilingual language processing, (2) the complicated nature of bilingual aphasia, and (3) the challenge in designing studies that are comparable, e.g., employ measures that tap similar types of inhibitory control and interference. Clearly, more research that investigates control mechanisms in bilingual aphasia needs to be conducted because it has the potential to offer important insights into how linguistic and non-linguistic control mechanisms function in the brain. In order to systematically explore linguistic and non-linguistic control mechanisms in bilingual aphasia, future work should be meticulous when choosing linguistic and non-linguistic tasks so that they appropriately correspond to each other. Further, larger samples of bilingual individuals with aphasia should be examined so that individual differences between patients and language profiles can be explained and accounted for while allowing the opportunity to draw some group level interpretations.

Better understanding the relationship between cognitive and language control also has implications for aphasia rehabilitation. Ultimately, it may be possible that working with bilingual individuals on cognitive exercises (targeting inhibition and suppression) may have beneficial effects on their ability to maintain cognitive control. For instance, it is possible that training cognitive control (or efficient inhibition/suppression of irrelevant information) can be done in tandem with language therapy. Early indicators from healthy bilinguals suggest that this may be useful (Liu, Liang, Dunlap, Fan, & Chen, 2016).

5. There are structural and functional changes in the bilingual brain and these also relate to recovery in the brain

Another important advancement in our understanding of bilingualism is the effect being bilingual has on the brain. Recent studies have shed light on the fact that brain undergoes short-term and long-term structural and functional changes in the course of learning and using multiple languages. For instance, several studies have shown that activation patterns during bilingual language processing tasks is driven by language proficiency (Abutalebi, Cappa, & Perani, 2005; Abutalebi et al., 2012a; Hernandez & Li, 2007; Isel, Baumgaertner, Thran, Meisel, & Buchel, 2010; Perani et al., 2003; Stein et al., 2009; Tatsuno & Sakai, 2005; Videsott et al., 2010; Xue, Dong, Jin, Zhang, & Wang, 2004). In general, these studies have found that when the degree of proficiency in bilinguals is very high, a common language system comprising the left hemisphere language network appears to be responsible for the processing of both languages (Chee, Hon, Lee, & Soon, 2001; Illes et al., 1999; Perani et al., 2003; Perani et al., 1998; Pillai et al., 2004; Stein et al., 2009; Suh et al., 2007; Vingerhoets et al., 2003; Xue et al., 2004). In low-proficiency subjects, however, a more extended network of activations is observed that includes brain regions related to speech motor and cognitive functions (Abutalebi et al., 2009; Chee et al., 2001; Perani et al., 1998; Stein et al., 2009; Tatsuno & Sakai, 2005), thus indicating that higher proficiency in a language tends to induce efficiency in processing (Feng, Chen, Zhu, He, & Wang, 2015; Stein et al., 2009; White, Genesee, & Steinhauer, 2012; Zou et al., 2012).

As bilinguals are acquiring a new language, there is a dynamic interplay between language and control regions that is described eloquently in the model of neuro-cognitive control (Abutalebi, 2008; Abutalebi & Green, 2007) which suggests that language control and lexical selection are part of broader cognitive control processes that comprise a network of regions including the prefrontal cortex, anterior cingulate, basal ganglia and inferior parietal lobe (hereafter called the cognitive control network (CCN)) (Abutalebi, 2013; Abutalebi et al., 2012b; Abutalebi et al., 2012c; Wang, Kuhl, Chen, & Dong, 2009; Zou et al., 2012). Incidentally, this model provides a neural basis for the domain general cognitive control discussed in the previous section. The importance of the non-language regions such as ACC within this cognitive control networks in adapting to the plasticity of language learning has been highlighted in several recent papers (Li et al., 2015; Tu et al., 2015).

There are studies that have examined the nature of structural and functional connectivity in bilinguals and have found differences in anatomical (i.e. white matter) connectivity, connectivity changes in vocabulary acquisition, or connectivity changes related to practice in the default mode network (DMN) or language networks in bilingual adults (Dodel et al., 2005; Majerus et al., 2008; Prat, Keller, &

Just, 2007; Veroude, Norris, Shumskaya, Gullberg, & Indefrey, 2010). One recent study has examined the integration of language and control networks in bilingual individuals (Ghazi Saidi et al., 2013) and has shown higher integration between these two networks with effortful processing of L2, and a decreased integration between the networks with consolidation of learning.

5.1 Implications for aphasia

All of these findings in healthy bilinguals have implications for bilingual aphasia. In addition to the neuroimaging studies that examine the neural correlates of bilingual aphasia, there have been several case studies that have highlighted the prominence of subcortical regions (e.g., basal ganglia) in patients who present with language control deficits or pathological switching deficits (Abutalebi, Miozzo, & Cappa, 2000; Ansaldo & Marcotte, 2008; Ansaldo et al., 2010; García-Caballero et al., 2007; Keane & Kiran, 2015).

With regards to imaging studies, one study has examined the neural mechanisms underlying language recovery in bilingual aphasia using a functional connectivity approach (Abutalebi et al., 2009). Results from a bilingual (L1: Spanish, L2: Italian) man with aphasia who underwent naming treatment in his L2 showed not only a lack of cross-language treatment generalization, but also negative effects on the patient's L1, resulting in lower post-treatment test scores. This observed effect was coupled with an fMRI and effective connectivity analysis that showed a shift in activation patterns as treatment progressed. During pre-treatment tasks, both the prefrontal cortex and anterior cingulate cortex were activated during L1 tasks. However, after the treatment period, this activation decreased. Instead, greater levels of activation in these regions was observed during L2 tasks. In addition, results showed that treatment in L2 strengthened connections within the L2 language network, but weakened connections within the L1 language network. The authors explained these outcomes in the context of a shift in cognitive control, where improvement in L2 naming appeared to strengthen activation in the regions associated with control in this language but greater interference was then observed from L2 to L1.

Meinzer et al. report the evolution of language recovery in a German-French bilingual adult using fMRI (Meinzer et al., 2007). This individual presented with a large left hemisphere infarct which included portions of the frontal, temporal, parietal and subcortical (basal ganglia) regions. This individual received treatment in German which improved over the course of treatment but no improvements were observed in French. Moreover, improvement in word access in German was associated with greater activation in right hemisphere frontal and temporal regions and left hemisphere prefrontal regions, suggesting a bilateral response to improved German while no discernable changes were observed in French.

In another study that did not include rehabilitation, Sebastian and colleagues examined (Sebastian, Kiran, & Sandberg, 2012) semantic processing in three English-Spanish patients with aphasia and healthy bilingual controls. The three normal control participants showed robust left-sided activation in the left frontal and/or temporal cortex during the English semantic judgment task. Similar regions were also activated in the left frontal and temporal cortex during the Spanish semantic judgment task. Although there was an overlap in the left frontal and temporal regions during Spanish and English semantic processing, the activated volumes were larger in the frontal and temporal regions for the Spanish semantic judgment task compared to the English semantic judgment task. Notably, all participants with aphasia, irrespective of the site or size of lesion, showed increased activation in the right hemisphere and cingulate regions during Spanish semantic processing relative to English processing. Thus, increased bilateral activation was observed during the weaker native language processing relative to the more proficient language, indicating that decreased language usage/proficiency results in a distributed network of activation including regions of control. To rephrase, increased activity was observed in the right hemisphere and cingulate region during the processing of a less proficient (pre-stroke) and more difficult language post-stroke. Therefore, the redundancy of the neural regions may support language recovery in ways that are facilitative.

For bilingual patients with similar language impairment, the less used language resulted in greater activations, not only in regions traditionally involved in language processing but also in regions known to sustain the 'cognitive control system', such as the prefrontal cortex and the anterior cingulate cortex. Thus, the left prefrontal and anterior cingulate activity may constitute an important neural signature of language dominance in the bilingual brain. These results, when situated with other reports that highlight the importance of basal ganglia, prefrontal and anterior cingulate cortex in regulating language selection and control in patients with bilingual aphasia (Abutalebi et al., 2009; Adrover-roig et al., 2011) provide further support to the neuro-cognitive model put forth by Abutalebi and colleagues.

To summarize, studies examining the neural representation of bilingual aphasia are still in in their infancy and much more work needs to be done. Importantly, although the studies reviewed above are varied in their results, they provide an important starting point for understanding the brain basis of bilingual representation after stroke.

6. Conclusion

In this chapter, we reviewed the current state of the science with regards to bilingual aphasia. The chapter focused on four themes that are of current interest in the field of bilingualism. First, behavioral studies on language processing in a bilingual individual is a dynamic process. Bilingual aphasia is an exponentially more complex manifestation of this dynamic interaction between AoA, exposure, proficiency, and impairment after brain damage. Second, studies in bilingualism have shown that both language systems are active during language processing tasks and these findings have implications for bilingual aphasia rehabilitation in terms of whether cross language generalization can be expected. Third, there are cognitive consequences to being bilingual and recently, a few studies on bilingual aphasia have begun to examine this notion of domain general versus domain specific language and cognitive control. Finally, there are structural and functional changes in the bilingual brain, and in the case of brain damage, these changes can impact the extent of language impairment and recovery for the individual.

As this chapter highlights, many aspects of study in bilingual aphasia are in the early stages and filled with opportunities. For instance, studies examining rehabilitation of aphasia can examine to what extent (a) language co-activation benefits or hampers treatment outcomes, (b) the nature of cross-language interference during task switching, and (c) if the presumed benefits of being bilingual extend to rehabilitation outcomes as well. Likewise, studies examining the neural underpinnings of language processing in bilingual aphasia could investigate (a) whether brain damage disrupts the representation of less and more proficient languages differentially, (b) if the neural substrates involved in language and cognitive control overlap after brain damage, and (c) if reorganization of language after brain damage resembles normal bilingual language networks. This chapter highlights many of the methodological challenges to consider when studying patients with bilingual aphasia. With careful attention to these issues, research focused on understanding bilingual language processing after brain damage can produce valuable results.

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Index

This collection brings together leading names in the field of bilingualism research to celebrate the 25th anniversary of the *Studies in Bilingualism* series. Over the last 25 years the study of bilingualism has received a tremendous amount of attention from linguists, psychologists, cognitive scientists, and neuroscientists. The breadth of coverage in this volume is a testament to the many different aspects of bilingualism that continue to generate phenomenal interest in the scholarly community. The bilingual experience is captured through a multifaceted prism that includes aspects of language and literacy development in child bilinguals with and without developmental language disorders, language processing and mental representations in adult bilinguals across the lifespan, and the cognitive and neurological basis of bilingualism. Different theoretical approaches – from generative UG-based models to constructivist usage-based models – are brought to bear on the nature of bilingual linguistic knowledge. The end result is a compendium of the state-of-the-art of a field that is in constant evolution and that is on an upward trajectory of discovery.

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