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Nina-Kristin Pendzich

LEXICAL NONMANUALS IN GERMAN SIGN LANGUAGE

AN EMPIRICAL AND THEORETICAL INVESTIGATION

SIGN LANGUAGES AND DEAF COMMUNITIES

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Empirical Studies and Theoretical Implications

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Notational conventions

Manual signs

SIGN	Signs are glossed with English words in small capitals
IX_1, IX_2, IX_3	IX is the abbreviation for *index*. The subscript numbers stand for locations in the signing space where a referent is located. IX_1 = first person, IX_2 = second person, IX_3 = third person.
$POSS_1$, $POSS_2$, $POSS_3$	Possessive pronouns, the subscript numbers stand for locations in the signing space where a referent is located. $POSS_1$ = first person, $POSS_2$ = second person, $POSS_3$ = third person
:	Prosodic break
SIGN++	Crosses mark a reduplication of a sign or parts of a sign. Reduplication is used for different grammatical purposes such as the marking of plural. Inherent lexical reduplications are not marked in the glosses.

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Nonmanual markings

Nonmanuals are indicated by a line above the glosses for the manual signs. The length of the line represents the duration of the respective nonmanual marking. Lexical nonmanuals are not indicated in the glosses. Nonmanual markings relevant for the glosses in this book are listed below.

$\overline{\text{SIGN SIGN}}^{\text{br-r}}$	Brow raiser
$\overline{\text{SIGN SIGN}}^{\text{br-l}}$	Brow lowerer
$\overline{\text{SIGN SIGN}}^{\text{h-n}}$	Head nod
$\overline{\text{SIGN SIGN}}^{\text{h-s}}$	Head shake
$\overline{\text{SIGN SIGN}}^{\text{h-f}}$	Head forward
$\overline{\text{SIGN SIGN}}^{\text{h-d}}$	Head down
$\overline{\text{SIGN SIGN}}^{\text{h-u}}$	Head up

Sign language acronyms

In the following, I give an overview of the acronyms for sign languages that are used throughout the book. The acronym ISL is usually used for Irish Sign Language and Israeli Sign Language. In order to distinguish both, I refer with Irish SL to Irish Sign Language.

ASL	American Sign Language
BSL	British Sign Language
DGS	German Sign Language
FinSL	Finnish Sign Language
GSL	Greek Sign Language
IPSL	Indo-Pakistani Sign Language
Irish SL	Irish Sign Language
ISL	Israeli Sign Language
KK	Kata Kolok
LIS	Italian Sign Language
LSC	Catalan Sign Language
NGT	Sign Language of the Netherlands
NSL	Norwegian Sign Language
PJM	Polish Sign Language
RSL	Russian Sign Language
SSL	Swedish Sign Language
TİD	Turkish Sign Language

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1 Introduction

The early research on sign languages starts with Stokoe's study on American Sign Language (ASL) in 1960. The lexicons of sign languages consist of various different sign categories. Stokoe (1960) sets up the first model for the phonology of signs. He clarifies that signs are not holistic units, but rather are comprised of individual phonological components. In his pioneer work on the structure of sign languages, Stokoe named these components as *cheremes*, a derivation of the Greek word *cher* (= Hand). However, the term is suboptimal as nonmanual componentscomponent are precluded (see also Becker 1997). In analogy to spoken languages, the term *phonemes* has become widespread in sign language research as a designation for the smallest units that distinguish one sign from another. The term *manual* refers to articulations with the hands and arms, and the term *nonmanual* is used for articulations with the torso, the head, and/or the face. Grammatical and lexical markings in sign languages are restricted to parts of the upper body. Usually, movements of the lower body by the legs, feet, and hips do not have grammatical or lexical functions. The increased awareness of the importance of nonmanual markings in sign languages has lead to an essential research field.

1.1 Research questions

When analyzing nonmanuals in sign languages, we have to deal with a variety of i) linguistic functions and ii) gestural and emotional functions. Linguistic nonmanuals can be subdivided into grammatical and lexical markings. As signers use their upper body to express language, they both sign and gesture in the same visual modality.[1] Interestingly, many co-speech gestures have found their way into the sign language system as linguistic markers with a grammatical or lexical function.

1 In research different terms are used for the modality of sign languages such as *manual-visual modality* (cf. e. g. Wilbur 2000, 217; Wilbur 2003, 342), *visual-gestural modality* (cf. e. g. Meier 2012, 574), and *visual/spatial* or *visuo-spatial modality* (cf. e. g. Wilbur 2000, 216; Meir 2012, 82). All these terms are used to differentiate sign languages from spoken languages in the auditory-oral modality. The term *visual-gestural modality* may blur the fundamental distinction between gesture and sign which is, however, a fluid boundary. The term *manual/visual modality* underlines the manual components of sign languages, but the nonmanual markers are not named. The third term, *visuo-spatial modality*, highlights the fact that sign languages are languages produced in space. Within this book the broader terms *visual modality* for sign languages and *auditory modality* for spoken languages are used.

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When differentiating between linguistic, gestural and emotional nonmanuals, it is an important question how crucial muscular contractions in the upper and lower face and actions of the head and torso are at the lexical level. While there is a considerable number of studies focusing on mouth patterns as an obligatory component in the citation form of certain signs and on the status of mouthings in different sign languages (cf. Ebbinghaus & Heßmann 1994; Ebbinghaus & Heßmann 1995; Boyes Braem & Sutton-Spence 2001; Woll 2001; Crasborn et al. 2008; Woll 2014 etc.), there is still a need for further empirically and theoretically research concerning the collective analysis of all relevant lexical nonmanual markers. To date, there is no consensus about the status of lexical nonmanuals. More studies are necessary to ascertain whether lexical nonmanuals must be treated as phonological components comparable with the manual components of signs or which alternative models are appropriate. It has to be investigated whether lexical nonmanuals can be split up into single features as it is the case for manual components. For the four manual components, inter alia, the minimal pair method serves as evidence. Manual minimal pairs are signs that have different meanings being based on only one difference within one of the four manual parameters. Thus, handshapes, hand orientations, movements, and places of articulation in sign languages have a similar status as phonemes in spoken languages (cf. Steinbach 2007, Papaspyrou et al. 2008, 18-64). In contrast, it has hardly been investigated comprehensively whether minimal pairs based on nonmanual components exist in German Sign Language (DGS) and several other sign languages. Nonmanual minimal pairs are mentioned, for instance, by Zeshan (2000) for Indo-Pakistani Sign Language (IPSL) and Köhler & Herrmann (2009) for DGS. But, so far there are no studies with a main focus on nonmanual minimal pairs which are based on a comprehensive empirical foundation. However, in order to define the theoretical status of lexical nonmanuals it is essential to investigate on an adequate empirical basis whether nonmanual minimal pairs, and thus distinctive nonmanual components, exist in different sign languages. Furthermore, it is crucial to precisely investigate whether the different types of nonmanuals, such as expressions in the lower face, expressions in the upper face, head actions, and upper body actions, have the same relevance at the lexical level.

Based on three different empirical studies on DGS (see Section 1.2), the aim of this book is to uncover the nature of lexical nonmanuals in DGS and to implement an adequate theoretical approach. The following eight research questions are decisive:

1. Are expressions in the lower face, expressions in the upper face, head actions, and torso actions inherent parts of certain lexical signs in DGS?
2. Is the lexical relevance of lower face, upper face, head, and torso more balanced than has been suggested so far?
3. Which forms of articulation, semantic categories, and basic properties of lexical nonmanuals are crucial for the definition of lexical nonmanuals?
4. Do minimal pairs based on nonmanual components exist in DGS?
5. Are nonmanual components comparable with manual components of signs?
6. How are lexical nonmanuals represented in the mental lexicon? Are nonmanuals lexically specified as individual components or rather as holistic units?
7. Are lexical nonmanuals subject to diachronic change? Do these markers play a different role for the younger and older signer generation?
8. How clear is the boundary between nonmanual phonemes and morphemes?

Although the focus of this book lies on lexical nonmanuals, mouthings are considered in relation to these markers.

1.2 Methodology

To reach an extensive understanding of lexical nonmanuals in DGS, I designed and carried out three empirical studies based on different elicitation methods. Study I: *Lexical Judgment and the Meaning of Signs* is based on a video questionnaire with a lexical judgment task and a subsequent three-part interview with a translation task, a repetition of the lexical judgment task including explanatory statements by the participants, and a mouthing classification task. This study investigates the significance of lexical nonmanuals by showing stimulus videos with nonmanual features (NMF) and manipulated stimulus videos without these nonmanual features (m-NMF). All stimuli are signed by one male deaf signer. If the participants agreed, the subsequent three-part interview was recorded.[2] One video camcorder recorded the communication situation between the participant and me as the instructor and one video camcorder captured the signer's face. Afterwards, videos were annotated with the professional tool ELAN.[3]

2 One participant did not want to be filmed. Another participant was not recorded as the study was carried out in public in a library of the Humboldt-University Berlin.

3 ELAN is the abbreviation for European Distributed Corpora Linguistic Annotator, an annotation tool developed at the Max Planck Institute for Psycholinguistics in Nijmegen (https://tla.mpi.nl/tools/tla-tools/elan/).

Study II: *Lexical Decision with Reaction Times* is based on a video questionnaire as well, but it includes a forced-choice lexical decision task instead of the lexical judgment task. In this study each stimulus video of Study I is combined with two answer words for measuring the reaction time. The hypothesis is that, within a lexical decision task, nonmanual manipulations, in terms of an omission of these markers, have to be reflected in a slowing down of reaction times when these markers are part of lexical entries of certain signs in the mental lexicon. Seeing a sign that normally contains a nonmanual marking in citation form without this marking must lead to an inhibition effect whereby the access to the mental entry of the lexical sign takes more time.

Study III: *Meaning Attribution to Isolated Facial Expressions* is an empirical perception and meaning attribution study on lexical and grammatical facial expressions in DGS. The study aims to get deeper insights into nonmanual actions at the interface between gesture, emotion, and sign. The meaning of muscular actions in the lower and upper face is investigated by presenting stimulus videos with different facial expressions articulated by one male deaf signer. This study is based on an online questionnaire via Internet.

All studies were carried out with deaf and hard of hearing native signers and near-native signers. Study III was additionally conducted with hearing native speakers of German. Most signers are at least second-generation signers, which means, they have deaf parents. First-generation signers are deaf signers whose parents do not communicate with a sign language and hear normally (cf. Mayberry et al. 1983, 207). Native signers are second- or third-generation signers. Near-native signers are defined as deaf people who do not have deaf parents and acquired sign language before the age of seven. Regarding the metadata of the participants, it has to be noted that the information collected, with respect to the hearing status of the participants and their parents, is based on self-assessments. Sometimes it seems to be difficult to draw a clear distinction between what is deaf and what is hard of hearing. In general, it often seems to be the case that signers are, from the medical perspective, hard of hearing but, from the deaf cultural point of view, see themselves as deaf. More important is that all hard of hearing signers who participated in one or more of my studies have at least one deaf parent and grew up with DGS as native language.

As just described, the empirical basis of my book are predominantly language perception studies with different tasks. Data in the form of language production is elicited through the interviews with the participants as part of Study I as well as discussions with deaf informants. The investigation of lexical nonmanuals by means of comprehensive production studies is, of course, very important as well (see the study on lexical facial expressions in DGS by Pendzich (2012)). After gaining more insights into the nature of lexical nonmanuals in DGS, these markings have to be elicited in full sentences and natural language situations. In sentence contexts, lexical nonmanuals may overlap with i) emotional and gestural nonmanuals and ii) grammatical nonmanuals. These influencing factors make the complex analysis of lexical components more difficult. Therefore, analyses of lexical nonmanuals in full sentences and natural language situations may be more expedient after achieving more clarification about the nature of lexical nonmanuals.

Throughout the book, sign language examples are glossed by using written words in English as the language of publication. As DGS is by no means a signed version of spoken German, it is not convenient to use German glosses (cf. Frishberg et al. 2012). The notational conventions I used are summarized in the front matter (for further information on different systems for the transcription and notation of sign languages, see Frishberg et al. 2012; Garcia & Sallandre 2013; Crasborn 2015). For the detailed description and analysis of nonmanuals, I use the Facial Action Coding System (FACS, cf. Ekman et al. 2002b).[4] The terminology of FACS is explained in Section 2.3.

1.3 Outline of the book

The book is divided into three main parts. Part I provides theoretical and methodological background information. I start with detailed information on the nonmanual complexity in sign languages focusing on the inventory of nonmanual components, the different functions realized with nonmanuals, and the Facial Action Coding System (FACS, cf. Ekman et al. 2002b) which is an elementary tool for my studies (see Chapter 2). Subsequently, I summarize the state of research on lexical nonmanuals and mouthings (see Chapter 3). Part II of this book presents three of my empirical studies in detail: Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4), Study II: *Lexical Decision with Reaction Times* (see Chapter 5), and Study III: *Meaning Attribution to Isolated Facial Expressions* (see Chapter 6). Part III deals with the theoretical implications of the results of my empirical and theoretical analyses going towards a new classification of lexical nonmanuals (see Chapter 7). The book ends with a conclusion. In the last chapter, I summarize the results by answering the question *What are lexical nonmanuals?* and give an outlook for further research (see Chapter 8).

4 Nina-Kristin Pendzich is a certified FACS-Coder by the authors of FACS Paul Ekman, Wallace V. Friesen, and Joseph C. Hager.

The title *Nonmanual complexity in sign languages* is used for Chapter 2 in order to underline that the phenomenon of nonmanuals is highly complex in sign languages. This complexity refers, on the one hand, to the form of nonmanuals and, on the other hand, to the various functions realized with nonmanuals. The chapter starts with a close view on the nonmanual channel which comprises the following four components: torso action, head action, upper face action, and lower face action (see Section 2.1). The two latter components can be split up into further individual sub-components. All four components are further characterized by different muscle actions. Subsequently, I differentiate various functions realized with nonmanuals (see Section 2.2). A distinction between two main types of nonmanuals is essential: i) affective and gestural nonmanualsand ii) grammatical and lexical nonmanuals. Whereas type i) is relevant for deaf signers as well as hearing speakers, type ii) is unique for sign languages. Nonmanuals are of fundamental importance on all levels of sign language grammar. As both types of nonmanuals are expressed with the same articulators in the visual modality, the differentiation is quite challenging. In light of this, I explain the differences between both types of nonmanuals. In addition to the complex functional system of nonmanuals, the articulation system of nonmanuals is highly refined. Thus, it is of critical importance to work with a scientifically objective and accurate tool for the description of these markers. This is also crucial for transparency and comparability of the results of studies by different researchers. In order to meet this demand, I utilize FACS, which is a very useful tool for the analysis of sign languages. It provides upper face action units, lower face action units, miscellaneous action codes, head position codes, eye position codes, eye and head movement codes, visible codes, and gross behavior codes (cf. Ekman et al. 2002b). I describe the basic concept of FACS and explain its use for the present book (see Section 2.3).

Chapter 3 provides an overview of the state of research on lexical nonmanuals and mouthings in DGS and further sign languages. Firstly, I consider lexical nonmanuals based on the following four topics (see Section 3.1): theoretical and empirical treatments of lexical nonmanuals in different sign languages, the question of whether sign languages comprise nonmanual minimal pairs, the question of whether sign languages contain nonmanual signs, and criteria for the classification of nonmanuals as phonological markings. Secondly, I discuss the role of mouthings in sign languages (see Section 3.2).

In order to get deeper empirically based insights into lexical nonmanuals, I carried out various studies. These studies are strongly connected with each other by my main research questions expounded in Section 1.1. All three studies presented in this book are based on video questionnaires which include completely different elicitation methods. I present Study I: *Lexical Judgment and the Meaning of Signs* in Chapter 4, Study II: *Lexical Decision with Reaction Times* in Chapter

5, and Study III: *Meaning Attribution to Isolated Facial Expressions* in Chapter 6. These three main chapters on the empirical studies are structured in the same way: explanation of the research issue, exposition of the methodology by describing the study design and the group of participants, overview on the elicited data, presentation of the analyses and results, and a final summary and discussion.

In Chapter 7, I collectively discuss results of my empirical studies and theoretical analyses. This leads to theoretical implications towards a new classification of lexical nonmanuals. As the distinction between meaningless and meaningful units in sign languages is not as clear cut as in spoken languages, I start with a discussion of the overlap of phonemes and morphemes in the visual modality which is important with respect to manual as well as nonmanual parts of signs. In the lexicons of sign languages, iconicity has a much higher significance than in the lexicons of spoken languages (see Section 7.1). In the next step, I focus on various formational aspects of lexical nonmanuals (see Section 7.2). I investigate whether lexical nonmanuals can be analyzed in the form of nonmanual sign types, components, sub-components, and features. Concerning the articulation of lexical nonmanuals, there are two opposing research positions. On the one hand, it is assumed that single nonmanual elements can hardly be differentiated from one another (cf. e. g. Becker 1998; Fontana 2008) and, on the other hand, nonmanuals, in particular mouth patterns, are regarded as decomposable into components or features (cf. e. g. Ajello et al. 2001). I introduce two articulation patterns which seem to be crucial for the nature of lexical nonmanuals: i) *muscle contraction based articulation pattern* (MuCon-AP) and ii) *component based articulation pattern* (Com-AP). Moreover, I make a distinction between constant nonmanuals and dynamic nonmanuals. Furthermore, I discuss lexical nonmanuals with respect to the syllable in sign languages. Subsequently, I introduce in analogy to the term *dominant hand* the terms *dominant face half* and *dominant half of the upper body*. In the next step, I present a semantic categorization of lexical nonmanuals: i) *lexical nonmanual imitation of action*, ii) *lexical nonmanual highlighting of a characteristic aspect of the sign meaning*, iii) *lexicalized affective nonmanuals*, iv) *lexicalized gestural nonmanuals*, and v) *lexical non-iconic nonmanuals* (see Section 7.3). In addition, I discuss the diachronic change of lexical nonmanuals, the interaction with mouthings, the distinctive function of lexical nonmanuals, and semantic accentuation with lexical nonmanuals (see Section 7.4). Based on the new findings, I provide a model for the representation of nonmanual parts of signs in mental lexical entries (see Section 7.5). In the end, I argue for an extension of Brentari's Prosodic Model (cf. Brentari 1998) with regard to lexical nonmanuals (see Section 7.6).

Finally, in Chapter 8, I aim to answer the question *What are lexical nonmanuals?* (see Section 8.1) and give an outlook for further research (see Section 8.2).

Part I: **Theoretical and methodological background**

2 Nonmanual complexity in sign languages

In the visual modality, gestures, affects, and language are expressed via the same articulatory channels. Nonmanual actions fulfill various functions, either as gestural and affective[1] elements or as linguistic markers operating on all grammatical levels of sign languages. The term *nonmanual* is used for articulations with the body apart from the arms and hands. However, grammatical markings are restricted to certain parts of the body. Usually, actions of the lower body with the legs and feet do not have grammatical functions. All actions of the upper body articulated with the torso, the head, and the face are relevant for the grammar of sign languages. Nonmanual markers such as a backward body lean or raised eyebrows can belong to a lexical entry of a sign or may serve grammatical functions such as the syntactic marking of yes/no-interrogatives and conditionals with raised eyebrows. However, the same nonmanual actions may also be nonmanually expressed gestures or affects indicating dissociation or surprise, for instance. Nonmanuals that play an essential role in the grammars of sign languages, in many cases, have emerged from the gesture systems of the surrounding spoken language cultures. It is appropriate to assume a multilayered language approach that broadly reflects the continuum of gestures/affects and grammatical/lexical features on a signer's body (cf. Herrmann & Pendzich 2014). In particular, four characteristics of nonmanuals are decisive: i) nonmanuals are multifunctional, ii) they are simultaneously combined with manual components, iii) they may independently fulfill specific functions, and iv) they may be layered with further nonmanuals to nonmanually express different functions at the same time (cf. Wilbur 2000; Wilbur 2003; Pfau & Quer 2010; Herrmann & Steinbach 2013a).

The following sections focus on the nonmanual complexity: firstly, with respect to formal aspects (see Section 2.1) and, secondly, with respect to functional aspects (see Section 2.2). Subsequently, I describe criteria for the differentiation between affective/gestural nonmanuals and grammatical/lexical nonmanuals (see Section 2.2.3). In Section 2.3, I give an introduction to the Facial Action Coding System (FACS, cf. Ekman et al. 2002b) and explain the use of FACS for my descriptions of lexical nonmanuals throughout the book.

1 Whereas the term *emotional* refers exclusively to emotions, the term *affective* includes emotions and also comprises a wider range of phenomena, e. g. moods (cf. Ekman 2004).

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2.1 Components of the torso, head, and face

Research on sign languages has clearly revealed that nonmanuals may fulfill diverse functions either as gestural and affective expressions or as grammatical and lexical markers. The nonmanual channel comprises the following four components: torso action, head action, upper face action, and lower face action. The latter two can be split into further individual sub-components. All four components are further characterized by different muscle actions.[2] Table 2.1 gives an overview of the essential nonmanual components and sub-components in sign languages. In Section 2.3.2, I will extend this overview of the components and sub-components with the relevant Action Units (AUs) according to FACS (cf. Ekman et al. 2002b). Some of the components listed in Table 2.1 exhibit a strong physical relation and may jointly fulfill the same grammatical function. One example is the combination of a head action in the form of a forward head tilt as a marker for yes/no-interrogatives in DGS, which is often combined with a torso action in the form of a forward upper body lean (cf. Herrmann & Pendzich 2014).

Tab. 2.1: Nonmanual components and sub-components for grammatical and lexical functions

Component	**Sub-component**
Torso action	–
Head action	–
Upper face action	Eyebrow action Eye aperture Eye gaze
Lower face action	Nose action Cheek action Mouth aperture Lip or corner of the mouth action Tongue action Chin action Air action Neck action Mouthing

2 With respect to the terms *channel* and *component*, different definitions are given in the literature. In contrast, to the use of both terms throughout this book, for example Baker & Padden (1978, 29), use the terms as follows: “For example, a component of the face channel might be a raised brow or a depressed lower lip. A component of the eyes channel might be a blink or a change in the direction of a signer’s gaze”.

The last-named sub-component in Table 2.1, mouthing, is a special category. Mouthings are voicelessly expressed words or parts of words from the surrounding spoken language (e. g. German in the case of DGS) and are articulated simultaneously with certain signs. There is some controversy about the status of mouthings in different sign languages (cf. Ebbinghaus & Heßmann 1995; Boyes Braem & Sutton-Spence 2001; Konrad 2011, 124-162). Given that the linguistic status of mouthings in relation to the genuine parts of sign languages is still not completely clear, I consider mouthings as a special category of nonmanual components (for further information on mouthings, see Section 3.2).

The different components and sub-components listed in Table 2.1 are not only relevant for grammatical and lexical functions but also for the gestural and affective use of nonmanuals. In spoken or signed communication, body actions, head actions, and facial expressions are used to produce nonmanual gestures and to reflect affects such as emotions or reactions to external physical triggers. With respect to such uses of nonmanuals, the overview in Table 2.1 can be extended with a further component, namely the lower part of the body. One example is a backward step to express dissociation (cf. Herrmann & Pendzich 2014).

When investigating facial signals, it stands out that a plurality of different muscles is involved in the articulation. As a rough division, it is common to differentiate between markings with the upper and the lower face (cf. e.g. Coerts 1992; Wilbur 2000; Ekman et al. 2002b; Wilbur 2003; Pendzich 2012). Facial expressions on the upper face comprise three sub-components: eyebrow action, eye aperture, and eye gaze. For the lower face nine sub-components are essential: nose action, cheek action, mouth aperture, lip or corner of the mouth action, tongue action, chin action, air action, neck action, and mouthing (see Table 2.1). In sign language research, sub-components on the lower face apart from mouthings are mostly summarized with the term *mouth gesture* (cf. Ebbinghaus & Heßmann 2001; Crasborn et al. 2008; Bank et al. 2011 etc.).[3] Instead, I prefer the term *mouth pattern* for this phenomenon (see also Herrmann & Pendzich 2014).[4] As we have to deal with an interesting and challenging interface between gesture and sign in the visual modality, it is advantageous to utilize an exact terminological differentiation between gesture and sign. This is important to avoid uncertainties and misunderstandings. Particularly, in view of the following two facts it is necessary to use clear terminology: i) The investigation of gestures used by signers

3 Further terms used in the literature are, for example, *oral component* (Vogt-Svendsen 1983) and *mouth arrangements* (Boyes Braem & Sutton-Spence 2001).

4 In the research literature, the same terms are used for different types of mouth actions. For instance, Zeshan (2000, 42) uses the term *mouth pattern* as a label for mouthings, Rainò (2001, 48) and Pfau & Quer (2010, 383) as an umbrella term for mouth gestures and mouthings.

and the gestural origin of manual and nonmanual features in sign languages are taken more and more into account (cf. Wilcox 2004; Özyürek 2012). ii) It can be assumed that in the future the research field of gestures and the research field of sign languages will cooperate even closer.[5] Therefore, I do not use the term *mouth gestures* for mouth actions that fulfill grammatical or lexical functions in sign languages.

The detailed analysis of the nonmanual components and sub-components listed in Table 2.1 becomes even more complex when investigating the underlying muscle contractions. For a precise and detailed analysis, FACS is an effective tool (cf. Ekman et al. 2002b). FACS provides nine Action Units (AUs) for facial expressions on the upper face, six AUs for eye positions, 32 AUs and Action Descriptors (ADs) for facial expressions on the lower face, and eight AUs for head positions (see Section 2.3 for further explanations on FACS). This different amount of AUs for upper face actions, lower face actions, and head actions illustrates that the lower face displays the most complex nonmanual behavior. In addition, FACS includes criteria for the determination of five intensities of AUs.[6]

With respect to facial expressions, one further terminological aspect has to be clarified: On the one hand, facial expressions can be split up into the eleven facial sub-components (excluding mouthing; see Table 2.1) as well as into several AUs (see Section 2.3.2). On the other hand, facial expression can be described as holistic units (cf. Pendzich 2012). For example, a facial expression is labeled as a holistic unit when defining that the sign SAD is articulated with a sad facial expression without the indication of specific components and muscle contractions.

2.2 Different functions of nonmanuals

"Together speech and gesture present a more complete version of the meaning than either accomplishes on its own" (McNeill 2000, 7). Irrespective of the fact that signers use their body to encode the grammar of language itself, they obviously also produce gestures. Like speakers of any other language, signers express

5 Goldin-Meadow & Brentari (2017, 17) "suggest that the study of language is undergoing a paradigm shift – the full communicative act includes, at the least, both categorical (speech or sign) and imagistic (gesture) components, and our comparisons should be between speech-plus-gesture and sign-plus-gesture."

6 Besides the use of FACS for linguistic analyses, many researchers have developed their own notation system for nonmanual markings. See, for instance, the notation systems for positions of the mouth by Vogt-Svendsen (2001, 11-16), Sutton-Spence & Day (2001, 72-75), and Ajello et al. (2001, 237). The latter is an adapted variant of the notation system by Vogt-Svendsen.

these "utterance uses of visible bodily actions" (Kendon 2004; Kendon 2008) with their hands, their body, their head, and their face. Thus, there is a common articulatory basis between gesture and sign, which makes it quite difficult to disentangle the two when analyzing sign languages (cf. Özyürek 2012; Herrmann & Pendzich 2014).[7]

This chapter presents the diversity of nonmanual elements and their manifold functions in sign languages. Concerning the functions of nonmanuals, it is particularly fascinating that we have to deal in sign languages with a continuum from pure gestural and affective nonmanuals, as in spoken languages (see Section 2.2.1), to grammatical and lexical nonmanuals (see Section 2.2.2). Due to the use of the same nonmanual components and sub-components for these two main functions, the signals of these different categories can resemble each other. However, on closer inspection, it is possible to determine clear criteria for the differentiation (see Section 2.2.3). Nevertheless, in the analysis of empirical data, occasionally, some unclear cases come across which are, in particular, due to the ongoing processes of grammaticalization and lexicalization. A special feature of sign languages is that manual and nonmanual gestures can diachronically develop to linguistic markers (cf. Pfau & Steinbach 2006a). The case of acoustic gestures in the form of intonation in spoken languages shows interesting parallels to the grammaticalization of nonmanuals in sign languages (cf. Pfau & Steinbach 2006a; van Loon et al. 2014). "Given that visual gestures provide more input than acoustic gestures, it is not surprising that the grammaticalization of gestures appears much more common in sign languages" (van Loon et al., 2014, 2146).

2.2.1 Affective and gestural nonmanuals

Affects and gestures of the communicating interlocutors may be expressed by nonmanuals in the auditory as well as in the visual modality. "Our faces reveal to any human observer whether we are interested, amorous, bored, thoughtful, worried, curious, excited, jealous, or anxious. Interpretation of these human intentions may sometimes need to be contextualized but not always" (Campbell 1997, 149). A key characteristic of affective and gestural nonmanuals is that they can autonomously and independently from the language system accompany every utterance. Furthermore, they can occur without an accompanying sign or word. This is, for example, the case when communicating just by a smile. In contrast, gram-

7 Parts of this section have already been presented in Herrmann & Pendzich (2014).

matical nonmanuals usually need to have a manual element that they align with (cf. Reilly & Anderson 2002; Pendzich 2012).

Considering the nonmanual articulators which are involved in affects and gestures, a striking contrast between signers and speakers is that the former mainly use the face to nonmanually gesture and to express affects and the latter also apply acoustic gestures, voice quality, and intonation to express affective information in the broadest sense (cf. Liddell 1980; Emmorey 1999; Ekman 2004, 46; Herrmann & Pendzich 2014). In addition, the head and the body seem to play not only a role within nonmanual gestures but also within signals of some emotions (cf. Ekman 2004, 46). For the articulation of gestures, Müller (2009) lists the following body parts: hands, arms, head, face, eyes, lips, shoulders, trunk, legs, and feet. Gestures may be expressed with one or more of these articulators.

With respect to affective facial expressions, it has to be distinguished between "those expressions which convey a speaker's true-felt emotion and those expressions used in the service of communication to convey the emotional tenor of a past event" (Corina et al. 1999, 309). The latter type can be categorized as gestures which refer to emotions or affects. Ekman (2004, 47) uses the term *referential expression*:

> A referential expression is a facial movement that refers to an emotion that is not felt by the person showing it. The person is referring to the emotion, much as the person could with a word, showing the emotion but in a way that makes it clear that the person is not feeling it now. [...] Typically the referential expression is either much briefer or much longer than the actual emotional expression, and it involves only one set of facial movements, not the complete array of facial movements associated with an emotional expression.

The use and intensity of affective and gestural nonmanuals, in particular facial expressions, depend on individual properties of the interlocutor (cf. Corina et al. 1999; Reilly & Anderson 2002; Leuninger et al. 2005, 334; Happ & Vorköper 2006, 595). Moreover, affective and gestural nonmanuals may be influenced by the respective cultural background (cf. Papaspyrou et al. 2008, 69). Nonetheless, some emotional facial expressions are universal. However, it is still a matter of debate how many of these exist. Ekman (1993, 387) names, in particular, five universal facial expressions:

> Distinctive universal expressions have been identified for anger, fear, disgust, sadness, and enjoyment. Even adding contempt, surprise, and interest, about which the evidence is far less certain, the list of emotions that have a universal facial expression is far shorter than the number of emotions most theorists have proposed, far smaller indeed than the various words for emotion.

Furthermore, signers use nonmanual strategies of back-channeling and turn-taking in discourse (cf. Baker 1977; Wilbur 2000; Herreweghe 2002). Likewise, hearing speakers use smiles, eyebrow movements, and head nods, among others, as signals during conversation, which Ekman (1979) calls "conversational signals". For instance, in spoken languages, inner and outer brow raise (AU 1+2) may be a signal for interest or surprise or these signals are used within conversational signals for questioning, greeting, emphasizing or doubting (cf. Ekman 1979, 182). Such conversational signals can be split up into i) facial expressions used while speaking (e. g. signals used as baton, underliner, punctuation, question mark, and word search), ii) facial expressions used while listening as feedback strategies, reactions, and comments (e. g. markers for attention, agreement, disagreement, calls for information, disbelief, and emphasis of the speaker's words), and iii) facial expressions used while communicating without words which are emblems (e. g. a wink to signal reciprocal agreement and complicity; cf. Ekman 1979, 183-191; Ricci Bitti 2014, 1345, 1347). Conversational signals of group i) and ii) "are usually ambiguous outside of the context of talk in which they occur" (Ekman 1979, 187). In contrast, conversational signals of group iii) have "specific semantic meaning" for all people of a culture or subculture (Ekman 1979, 187; cf. Ekman 2004, 39). These signals are used by listeners and speakers during spoken communication as well, but are distinguished from group i) and ii) as these signals show little ambiguity when used without the word context (cf. Ekman 1979, 187). Whereas, some emblems are articulated with the head, the shoulders, or the face, most emblems are performed with the hands (cf. Ekman 2004, 40).

Although affective signals and conversational signals or gestures show some distinct properties, the distinction between both types is not always straightforward. The following differences are particularly decisive (cf. Ekman 1979, 191-194): i) "The emotional expressions are coherent, organized and systematic in their occurrence earlier in life than most of the conversational signals" (Ekman 1979, 191). ii) In contrast to emotional signals, conversational signals occur rarely in situations in which a person is alone. iii) There are probably no universal conversational signals.

In her study on mouth gestures in Israeli Sign Language (ISL), Sandler (2009) argues for a distinction between iconic gestures, "iconics" in McNeill's terms (McNeill 1992), and mimetic gestures. The observed iconic mouth actions are distinguished from mimetic gestures because they express information in addition to the signed utterances by "using the mouth to convey properties of other objects or events" symbolically (Sandler 2009, 255). While retelling a cartoon, a deaf signer of ISL, for instance, uses "a repeated opening and closing mouth gesture" to illustrate the repetitive echoing of a ball rolling down a pipe. Such iconic mouth gestures – equivalent to co-speech gestures – occur simultaneously with the utterance and function as embellishing or complementary elements (cf. Sandler 2009).

When comparing the use of gestures in sign and spoken languages, it seems to be that gestures are more integrated into the language system of sign languages. This can be seen with certain phenomena at the interface between sign language grammar and the gesture system, such as *action role shift* or *constructed action* (cf. Herrmann & Pendzich 2018). This discourse structuring mechanism is a specific type of perspective shift that signers use to take over the role of another referent or fictional character. On the one hand, such a role shift is used for the reproduction of utterances and thoughts (called *quotation role shift*, *constructed dialogue, constructed discourse*, etc.) and on the other hand, which is crucial with regard to the issue of gestures in sign languages, it may be used for the reproduction of actions, emotional states, and mannerisms (called *action role shift, constructed action, role playing*, etc.; for an overview, see Lillo-Martin 2012). As Pfau & Quer (2010, 397) point out, "there is some overlap between both uses of role shift since in quotational role shift, signers frequently take on affective facial expressions of the character whose utterance they report". The prototypical grammatical markers of role shift are body movement, change of head position, and eye gaze change. In addition, similar to intonation in spoken languages, facial expressions are associated with the quoted referent (cf. Herrmann & Steinbach 2012). "Referential shift is a linguistic device that can disambiguate the point of view associated with a facial expression, but the facial expression itself is non-linguistic" (Emmorey 1999, 152). As opposed to quotation role shift, where the reproduction of utterances is based on lexical signs, manual and nonmanual gestures are of the utmost importance for action role shift. In sign languages, gestural acting can be implemented into narration without the need of lexical signs. Nevertheless, action role shift is subject to certain constraints. The gestural imitation of characters within action role shift is restricted to the upper part of the body. Hence, the lower parts of the body such as the legs and feet are not used for action role shift, which is an important difference to the various possibilities in pantomime. Figure 2.1 exemplifies action role shift in DGS by a short passage from the fable *The shepherd's boy and the wolf* taken from our SignLab Göttingen DGS data set of five fables of Aesop (for information concerning the fables and the ECHO project, see Crasborn et al. 2007).

This sequence illustrates the systematic integration of action role shift into sign language. In the left picture in Figure 2.1, the gestural imitation of the shepherd's boy's action is carried out through facial expressions, posture, head position, and the hands but without the use of lexical signs. This pure action role shift can be paraphrased as 'the boy is standing around, holding his chin while thinking'. The second picture illustrates an action role shift that is accompanied by the

Fig. 2.1: Gestural-grammatical interplay within action role shift: pure action role shift (left), action role shift with description in the form of the sign SCREAM (in the middle), the sign WOLF within quotation role shift (right). © De Gruyter Mouton, reprinted with permission: Herrmann, Annika and Nina-Kristin Pendzich. 2014. Nonmanual gestures in sign languages. In Cornelia Müller et al., *Body – Language – Communication. An international handbook on multimodality in human interaction*, 2149-2162. Berlin, Boston: De Gruyter Mouton, p. 2153, Fig. 170.1

sign SCREAM. Presented by the narrator, the added sign SCREAM is "an indirect description" (Metzger 1995, 264) of the simultaneously visible action of screaming. Hence, the shepherd's boy is only "partially mapped onto the signer" (Liddell & Metzger 1998, 668). Here, the action of the boy is represented by facial expressions, the head, and the torso, whereas the hands are used for the descriptive remarks of the narrator. In this construction, the combination of the character role and the narrator perspective becomes evident and exemplifies the gestural-grammatical interplay. By using the strategy of description in signed discourse, the narrator clarifies a simultaneously expressed gestural action role shift of a quoted character that might not be visible enough on its own. In general, such instances of action role shift may function as a matrix clause to introduce the following embedded quotation role shift that reports lexical signs (cf. Herrmann & Pendzich 2018). Part of a regular quotation role shift can be seen with the sign WOLF in the right picture in Figure 2.1. Although gestural embodiments may appear in spoken language storytelling, this device does not usually occur in such a systematic fashion as it does in sign languages. The case of action role shift illustrates the ongoing interplay between gestures and signing in languages in the visual modality.

2.2.2 Grammatical and lexical nonmanuals

The same nonmanual features which are essential for affective and gestural expressions (see Section 2.2.1) may have specific lexical and grammatical functions when they align with manual signs, constituents or sentences in sign languages. Nonmanuals are essential for each level of grammar, which typologically applies to all sign languages investigated so far. The meanings and functions that are associated with the different articulators are not universal but are specifically determined for each sign language. “Furthermore, nonmanual signals that appear to have the same function may in fact display very different behaviors when examined more closely” (Wilbur 2003, 338). By investigating nonmanual features, it becomes immediately evident that these linguistic markers very often have gestural equivalents in the surrounding spoken language and originate from cultural gestures in the respective country (cf. Janzen & Schaffer 2002; Goldin-Meadow 2003; Wilcox 2004; Özyürek 2012). Janzen (2012, 836) emphasizes that “gestures are not ‘hearing people’s’ gestures, they belong to deaf people, too, and evidence is mounting that they are integral to both lexicalization and grammaticalization patterns in sign languages”. Languages in the visual modality make efficient use of grammaticalizing and lexicalizing gestural and affective nonmanual signals into the language system. “Given the nature of conventionalization processes, facial expressions selected as linguistic markers must be inherently salient and easy to categorize” (McCullough & Emmorey 2009, 218).

Regarding facial expressions, the upper and lower face can be considered in relation to different linguistic functions. In her study on nonmanual markers in Sign Language of the Netherlands (NGT), Coerts (1992, 31) describes this as follows:

> Although most facial behaviours contain features from both the upper and the lower face, the distinction is useful, because it seems that the emphasis on either the one or the other correlates with a specific linguistic function. At the phonological, lexical and morphological level the lower face features seem to be the most important. At the syntactic level the upper face features are the most important part of the nonmanual linguistic signal.

Research on different sign languages has revealed that the upper face markers are particularly essential for grammatical structures at the syntactic and prosodic levels. For the lexical and morphological levels, mouth patterns play an important role, but it seems that the relationship between the upper and lower face is more balanced than so far suggested for different sign languages. As mentioned in the introduction (see Section 1.1), one aim of this book is to review, based on empirical data of DGS, the widespread assumption regarding the functional distinction between upper and lower face for the lexical level. In the following, I provide examples of certain nonmanuals that operate on different levels of grammar in sign languages.

With regard to the lexicon, nonmanual signals can be an obligatory, inherent part of specific signs (cf. Coerts 1992; Woll 2001; Liddell 2003; Becker & von

Meyenn 2012). The sign RECENTLY in DGS is always articulated with a slight tongue show. Variations between a lateral or a central tongue show have no effect on the meaning of the sign and may simply be a matter of phonetic variation, perhaps due to differences in dialects (cf. Pendzich 2012). In ASL, apart from the manual articulation, RECENTLY requires a small sideward head turn and a tension of the muscles in the cheeks, either on the same or on both sides (cf. Liddell 2003, 14). Interestingly, sign languages seem to exhibit modality-specific patterns of lexicalization. Some lexical signs for affective concepts are produced with specific facial expressions, head actions, and/or torso actions. While signing SAD, for instance, signers of DGS use downcast corners of the mouth, a tiny eye aperture, and lowered eyebrows (see Figure 2.2; for further information on the state of research on lexical nonmanuals, see Chapter 3.1; for further information on the articulation patterns of lexical nonmanuals and the semantic category lexicalized affective nonmanuals, see Chapter 7).

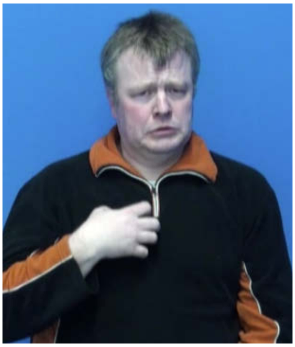

Fig. 2.2: The sign SAD with lexicalized affective facial expression (data elicitation Pendzich 2012)

Considering morphological constructions, facial expressions can be used simultaneously to manual signs. Morphological facial expressions may function as adverbial and adjectival modifications. A basic sign such as WRITE can be adverbially modified by specific facial expressions as in to *write concentrated, write a lot*, and *write carelessly*. Obviously, we find manual adverbs in DGS, such as MAYBE and UNFORTUNATELY, but certain adverbs are solely expressed through nonmanual features and convey their meaning independently from the manual sign. “Adverbial markings are modifiers that can co-occur with signs. Like lexically associated markings, they are coextensive with the sign they modify; however, they are not intrinsically a part of the sign” (Neidle et al. 2000, 47). The on- and offsets of adverbial nonmanuals are temporally coordinated with the manual sign or – in case of sentential adverbs – spread across the clausal domain. Similar to adverbial modifications, nonmanual adjectives may modify nominal elements (cf. Liddell 1980; Boyes Braem 1995; Wilbur 2000, 225; Reilly & Anderson 2002; Aronoff et al. 2005; Happ & Vorköper 2006; Steinbach 2007, 148; Sandler & Meir 2008, 173-176; Baker & Pfau 2016, 103f.). In the case of expressing *a big house* in DGS, the cheeks are puffed simultaneously to the manual sign HOUSE.

For the syntactic and prosodic marking of signed utterances, particularly facial expressions of the upper face are responsible (cf. Liddell 1980; Sandler 2009; Herrmann 2012; Sandler 2012).[8] Raised eyebrows, as an affective and gestural indicator of surprise, astonishment, and attentiveness, in many sign languages function as a syntactic marker of various constructions, such as topics, yes/no-interrogatives, conditionals, and relative clauses. In general, sentence types are often indicated by specifically determined actions of the eyebrows. In DGS, declarative sentences exhibit a neutral facial expression and head position except when they are negated, confirmed or emphasized. Interrogatives and imperatives, however, are marked with specific grammatical nonmanuals. Yes/no-interrogatives are typically accompanied by raised eyebrows and forward head tilt (= head forward, head down) in DGS. It is important to note that sign langauges may have different nonmanuals for various types of interrogatives. Furthermore, the use of nonmanual interrogative markers may be influenced by pragmatic factors (cf. Quer et al. 2017, 292f.). The DGS sentences in example (1) and (2) are manually identical and differ from each other solely in the nonmanuals whereby they are marked for different sentence types. The sentence in example (1) is signed without a prosodic or syntactic nonmanual interrogative marking. This utterance is a declarative sentence. Due to the raised eyebrows and the forward head tilt (= head forward, head down), the utterance in example (2) is a yes/no-interrogative (see Figure 2.3). As Figure 2.3 illustrates, the intensities of the nonmanuals for the interrogative marking may vary within utterances. In this example, especially the intensity of the head action increases within the utterance and shows the individual maximum with the last sign.

8 Bross & Hole (2017, 13) "submit that all NMMs which are not affective facial or body gestures and which do not involve the mouth proper do serve syntactic purposes".

(1) IX$_3$ PICTURE COLORFUL PAINT [DGS]
'She paints a colorful picture.'

(2) $\overline{\text{IX}_3 \text{ PICTURE COLORFUL PAINT}}^{\text{br-r, h-f, h-d}}$ [DGS]
'Does she paint a colorful picture?'

Fig. 2.3: Yes/no-interrogative 'Does she paint a colorful picture?' in DGS

In this case as well as with certain imperatives, grammatical nonmanuals constitute the only morphosyntactic markers. A combination of manual and nonmanual markers is essential for wh-interrogatives. Sign languages differ in the amount of various wh-elements. DGS comprises manual interrogative wh-elements such as, for instance, WHO, WHERE and WHY that are mainly combined with lowered eyebrows. Syntactic nonmanuals usually spread over syntactic constituents, such as the entire clause in the case of yes/no-interrogatives (cf. Boyes Braem 1995; Petronio & Lillo-Martin 1997; Neidle et al. 2000; Happ & Vorköper 2006; Sandler & Lillo-Martin 2006; Papaspyrou et al. 2008; Pfau & Quer 2010; Cecchetto 2012; Herrmann & Steinbach 2013b; Benitez-Quiroz et al. 2014; for an overview of interrogative constructions in various sign languages, see Zeshan 2004b; for further information on relative clauses in different sign languages, see Pfau & Steinbach 2005, Kubus 2016, and Wilbur 2017; for imperatives in different sign languages, see Brentari et al. 2018 and Donati et al. 2017; for additional information on sentence types, see Quer et al. 2017).

Conditional clauses in DGS are predominantly marked with an eyebrow raise as well as head forward and down on the antecedent and a head nod on the consequence. Thus, the conditional relation can be indicated only nonmanually (cf. Pendzich et al. in prep.; see also Reilly et al. 1990; Coerts 1992; Happ & Vorköper 2006). Furthermore, lexical signs such as IF, PF, and THEN can be used in addition to the nonmanual markings of conditionals. Example (3) shows a conditional clause from DGS with the nonmanual markings brow raise, head forward and down, and the manual marker PF (antecedent) as well as the nonmanual marking head nod and the manual marker THEN (condition). This example is signed with a single head nod on the consequence. Moreover, spreading head nods are used in conditionals of DGS (cf. Pendzich et al. in prep.).

(3)
```
    ____________br-r, h-f, h-d       _h-n_
    PF  MANY PERSON++ SHOW UP++   :  THEN GO RESTAURANT        [DGS]
```
‘If many persons show up then we will go into a restaurant.’

Counterfactual conditionals are indicated by additional nonmanuals such as a squint, and are argued to have an inherent meaning that is compositionally combined to derive the complex counterfactual meaning (cf. Dachkovsky 2008). Whether the above described nonmanuals are analyzed as pure instantiations of syntactic features or as prosodic markers with pragmatic meaning contributions is still a matter of debate (cf. Neidle et al. 2000; Sandler & Lillo-Martin 2006; Sandler 2010; Herrmann 2012; Sandler 2012; Herrmann 2013). However, the systematic alignment patterns and the clear structural linguistic functions differentiate the grammatical use of specific nonmanuals from the affective and gestural use (see Section 2.2.3).

With regard to the head as a nonmanual articulator, the negative head shake is a crucial example. Head shake as a gestural negative marker in many spoken languages (cf. Harrison 2014), has become an essential grammatical marker of negation in basically all sign languages examined so far (cf. Zeshan 2004a; van Loon et al. 2014; Pfau 2015; for a detailed analysis of head shake in Austrian Sign Language (ÖGS), see Lackner 2017). However, cultural differences may lead to different negation markers as, for instance, the backward head tilt in Turkish Sign Language (TİD) and Greek Sign Language (GSL). Nevertheless, sign languages which have different negative head movements use a head shake as well. In addition to the head movements, facial expressions are related to negation (cf. Zeshan 2004a; Zeshan 2006b). Zeshan (2004a, 12) states that facial expressions “tend to be less obligatory and more variable than head movements”. Benitez-Quiroz et al. (2016) carried out a study on facial expressions for negation with native speakers of English, Spanish, and Mandarin Chinese as well as native signers of ASL. Interestingly, “[t]he same facial expression of negation was identified in participants of all languages and cultural backgrounds” (Benitez-Quiroz et al. 2016, 78). This facial expression involves AU 4, AU 17, and AU 14 or 24 and sometimes AU 7. For ASL, this facial expression functions as a grammatical marker: i) together with the manual sign NOT, ii) together with the nonmanual marker head shake, iii) without another marker for negation. Benitez-Quiroz et al. (2016) argue that the facial expression for negation is a compound of AUs used within the negative moral judgments anger, disgust, and contempt. Thus, it is an example for “the evolution of grammatical markers through the expression of emotion” (Benitez-Quiroz et al. 2016, 78).

Whereas, the form of negative head movements appears very similar in different sign languages, the scope and status of these nonmanuals present very specific restrictions for each respective sign language (cf. Zeshan 2004a). The typological comparison of sentential negation in various sign languages illustrates how different the language systems incorporate the negation gesture into grammar. There are systematic restrictions concerning the elements that the head shake aligns with and whether or not spreading of the head shake onto constituents is permitted (e. g. the verb and/or object arguments). Moreover, some sign languages are nonmanually dominant, meaning the nonmanual head shake is sufficient to negate a sentence as in DGS and LSC, whereas other sign languages require a manual negative element as their main strategy of negation, e. g. LIS. The head shake in such manually dominant sign languages remains an optional marker (cf. Zeshan 2004a; Geraci 2005; Zeshan 2006a; Pfau & Quer 2007; Pfau 2008; Quer 2012). In TİD, negation is primarily manually realized as well. The negative head movements are strongly bound to the manual negative signs. This negation system is different from many other investigated negation systems as in many sign languages negative head movements have a more prominent status and operate more independently of manual negative signs (cf. Zeshan 2006b; for further information on negation, see Zeshan 2006a, Benitez-Quiroz et al. 2014, and Pfau 2015).[9]

Furthermore, the body as the largest nonmanual articulator is used for various grammatical purposes. Forward and backward body leans in DGS may differentiate between personal and impersonal politeness forms and may also function as markers of exclusion and inclusion such as with the sign REJECT, for instance, and with dual and paucal number forms (*the three of us* vs. *the three of you*; for NGT, see also van der Kooij et al. 2006, 1603). In addition, body leans are part of the grammatical marking of quotation role shift and are used to indicate information structural contrast in signed discourse (cf. Wilbur & Patschke 1998; Happ & Vorköper 2006).

9 For further functions of head movements in the form of nods, nodding, head pulls, and head thrusts see Puupponen et al. (2015). For example, one interesting finding is the use of nods for referential pointing.

The cursory survey has illustrated that nonmanuals constitute a highly complex phenomenon. From small to large units of grammar, nonmanuals are essential and often obligatory elements of signed utterances. Linguistic nonmanuals may accompany single signs and can be layered with syntactic or prosodic phrases. Grammatical facial expressions on the upper face generally have a larger scope than facial expressions on the lower face (cf. Wilbur 2003). Nonmanuals may either occur as a single signal or may systematically combine with other nonmanual markers resulting in complex simultaneous constructions. The described systematic integration of nonmanual gestures into grammar is specific to the visual modality. Even though nonmanual grammatical and lexical as well as gestural and affective markings are performed via the same articulatory channels, they can still be differentiated by specific criteria, which will be discussed in the following section.

2.2.3 Distinguishing affective and gestural nonmanuals from grammatical and lexical nonmanuals

The overview on gestural and affective functions of nonmanuals in Section 2.2.1 and the overview on grammatical and lexical functions in Section 2.2.2 make clear that it is exceedingly important for linguistic analyses of nonmanuals to precisely distinguish between the various functions in sign languages. In their study on the interaction of affective and linguistic eyebrow movements in signed interrogatives in NGT, de Vos et al. (2009) clearly show the importance of the analysis of nonmanual paralinguistic functions that need to be taken into account when investigating linguistic markers. Based on data of ASL, Weast (2011, 221) points out "that one nonmanual, the eyebrow channel, can simultaneously function as syntax, grammatical intonation, and emotional prosody in one change of eyebrow height". Due to the same articulatory transmission mode of sign and gesture, the distinction between the different function is challenging. Nevertheless, there are clear criteria to distinguish between the two main types i) affective and gestural nonmanuals and ii) grammatical and lexical nonmanuals. Most impressively, linguistic nonmanuals have a defined scope and are timed to align with linguistic units. Affective and gestural nonmanuals, on the other hand may often vary and exhibit gradual and inconsistent spreading behavior. The clear on- and offset of grammatical nonmanuals, which mainly correspond to a constituent structure, stand in opposition to the more global patterns of gestural and affective nonmanuals. Signers have clear intuitions when it comes to grammaticality judgments, but show more signer-specific variation with affective nonmanuals (cf. Baker-Shenk 1983; Corina et al. 1999; Emmorey 1999; Wilbur 2003).

Research on sign language acquisition uncovers the fact that children acquire the systematic use of grammatical nonmanuals at a later stage than the respective inconsistent affective nonmanuals. Nonmanual interrogative marking, for instance, follows the acquisition of the respective manual markers, even though the affective uses of brow raise and lowered brows are already present. The same is the case for the marking of conditionals in certain sign languages (cf. Reilly et al. 1990; Emmorey et al. 1995; Reilly & Anderson 2002). Furthermore, with regard to nonmanual morphology, Anderson & Reilly (1998, 139-140) found that "in the case of facial adverbs where there is no explicit affective interference, these nonmanual signals are acquired earlier and without significant difficulty".

Neuropsychological studies provide further evidence for a differentiation between affective and grammatical nonmanuals because grammatical facial expressions are found to be processed left hemispherically, whereas emotional facial expressions are processed bilaterally (cf. Corina et al. 1999; McCullough et al. 2005). Studies on categorical perception of facial features have also shown specific differences in the perception of affective and linguistic facial expressions for deaf signers. Linguistic competence in a sign language may have an effect on categorical perception of affective facial expressions (cf. McCullough & Emmorey 2009; see also Campbell et al. 1999).

In summary, for the status of nonmanual features we can rely on various distinctive criteria, such as scope and alignment. We find functional differences and signers have clear intuitions on the grammaticality of utterances. Further evidence for the distinction between gestural/affective and grammatical/lexical nonmanuals comes from language acquisition studies and psycho- and neurolinguistic studies. Despite the criteria mentioned above, blurred cases appear due to the facts that i) the same nonmanual feature is typically used in both main functions and ii) we deal with a grammaticalization and lexicalization continuum between nonmanual gestures/affects and nonmanual grammatical/lexical markers.

2.3 The Facial Action Coding System (FACS)

2.3.1 Introduction to FACS

> FACS was designed for scoring moving facial behavior from videotape, and the coder notes changes in facial muscular action. The normal procedure for using FACS on still photographs or slides is to compare the slide of the poser making a facial expression to a slide of the poser's neutral face, and then to infer muscular movement on the basis of deviations from neutral. This type of scoring does not include static features of the poser's facial structure that may contribute to its appearance; it only scores deviations from a neutral pose. (Rosenberg & Ekman 1995, 118)

The Facial Action Coding System is used for research in different fields, such as emotions, infant development, sign languages, and psychotherapy (cf. Ekman 2004, 46). "FACS coders are like detectives searching for evidence in the changing facial appearance that shows which AU (or AUs) acted" (Ekman et al. 2002b, 10). All Action Units (AUs) of FACS are defined by a name and a number. The attributions of the numbers to the AUs is arbitrary. For example number two refers to the AU *outer brow raise* (cf. Ekman et al. 2002b, 6). FACS comprises nine upper face AUs and eighteen main lower face AUs. In addition to these AUs, FACS includes fourteen miscellaneous action codes, eight head position codes, six eye position codes, eleven eye and head movement codes, five visible codes, and nine gross behavior codes (cf. Ekman et al. 2002b). All miscellaneous actions are articulated with the lower face. Some are indicated as *Action Descriptor* (AD). In contrast to the AUs, the muscular bases of the ADs are not determined and specific forms are not differentiated as exactly as for the AUs. One example is the AD *tongue show*, which is scored for various actions with the tongue (cf. Ekman et al. 2002b, 295). Visible codes are used to indicate which parts of the face cannot be scored, e. g., code 70 means *brows not visible*. Furthermore, some codes refer to gross behaviors: sniff, speech, swallow, chewing, shoulder shrug, head shake back and forth, head nod up and down, flash, and partial flash (cf. Ekman et al. 2002b, 322, 324). In total, FACS provides 80 codes.[10] In the research literature, the given information on the number of FACS codes varies due to the reference to all codes, to all AUs, to all AUs and ADs etc. For example, Dachkovsky et al. (2013, 222) name 44 AUs and Roesch et al. (2010) name 58 AUs.

The analysis of facial actions with FACS follows a precisely structured scoring procedure. The scoring is carried out in the following order: i) lower face, ii) head and eye position, and iii) upper face. The analysis of each area is structured by a number of detailed scoring steps (cf. Ekman et al. 2002b, 349-355). For the scoring procedure, the FACS manual provides a score sheet for recording the intermediate stages of scoring and the final score (cf. Ekman et al. 2002b, 513f.).[11]

AUs can occur bilaterally or unilaterally. Moreover, a bilaterally articulated AU can be combined with another unilaterally articulated AU. Figure 2.4 illustrates unilateral AUs. In order to score an AU as unilateral, the facial action must appear solely on one side of the face. As the AUs in Figure 2.4 only occur on the left side of the person's face, the letter L has to be placed in front of each number for the single AUs. The letter R would be used when an AU occurs exclusively on

10 Moreover, AU 4 *brow lowerer* can be further split up into three AUs. The according explanation can be found in the investigator's guide of FACS (cf. Ekman et al. 2002a, 163-171).

11 In addition, it is possible to use computer vision algorithms for the detection of AUs. See, for instance, the study by Benitez-Quiroz et al. (2016).

the right side of the face. Alternatively, the letter U can be used in order to specify an AU as unilateral without the indication of the side (cf. Ekman et al. 2002b, 5, 370).

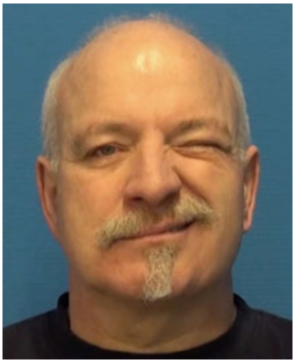

Fig. 2.4: Unilateral AUs

Additionally, FACS provides rules for the scoring of different intensities of facial actions. The use or non-use of intensity scores depends on the individual research issue. Intensities are scored with a five-point scale by using the letters A, B, C, D, and E. A selected letter specifies "how much of the total appearance change that can potentially be caused by the AU is actually present" (Ekman et al. 2002b, 8). Whereas, the intensity score A refers to the lowest intensity of an AU, the intensity score E indicates the maximum of an AU. It has to be noted that the intensity scale is not a uniform interval scale. This means that the levels C and D cover a wider spectrum of appearance changes than the levels A, B, and E. Most of the span of AUs belong to these two levels (cf. Ekman et al. 2002b, 8). The intensity score is placed after the number of the AU, e. g. 4A for a trace of brow lowerer.

In addition to the above mentioned features of FACS, there are further possibilities for the use of FACS (e. g. scoring for asymmetry), but these possibilities largely depend on the needs of each particular research question.

2.3.2 The use of FACS for the present analyses

The FACS analyses presented in this book are based on videos of DGS signers. Each analyzed nonmanual expression is viewed several times for the investigation of facial actions in the different regions of the face as well as head positions, eye positions, and upper body positions. In addition to the use of the videos, a picture with the neutral face of the respective signer was positioned on the top right of the computer monitor during the scoring of nonmanual actions. The scoring was carried out according to the detailed instructions given in the FACS manual, including the use of the FACS score sheet. The scoring of each nonmanual expression consists of several steps of analysis (see Section 2.3.1). The scoring of facial expressions, head positions, and eye positions is part of FACS. Additionally, I added scoring of the upper body actions.[12]

In addition to the various AUs provided by FACS, I use the terms *nonmanual component* and *nonmanual sub-component* as explained in Section 2.1 and associate several AUs with these nonmanual components and sub-components. Similar to the four manual components of signs (handshape, orientation, movement, and place of articulation), which can take on different features, nonmanual components and sub-components can be specified by several muscle contractions. Table 2.2 gives an overview of the AUs which are relevant for lexical and grammatical functions in DGS. This compilation is based on my previous investigations. It may well be that further studies reveal that additional AUs are relevant with respect to specific lexical and grammatical functions in DGS. Whereas the AUs for the face, eyes, and head are based on FACS, the AUs for the upper body actions are add-ons for my part, indicated with the asterisk in Table 2.2. The names and the last digits of tahe AU numbers (e. g. the one in AU 101) for upper body actions are set in analogy to the names and numbers of the AUs for head positions. For example, AU 58 stands for *head back* and AU 108 refers to *body back*.

12 Nina-Kristin Pendzich is a certified FACS-Coder by the authors of FACS Paul Ekman, Wallace V. Friesen, and Joseph C. Hager.

Tab. 2.2: Nonmanual components, sub-components, and AUs for grammatical and lexical functions

Component	**Sub-component**	**AU number**	**AU name**
Torso action	–	101*	Body turn left
		102*	Body turn right
		107*	Body forward
		108*	Body back
Head action	–	51	Head turn left
		52	Head turn right
		55	Head tilt left
		56	Head tilt right
		84	Head shake back and forth
		53	Head up
		54	Head down
		85	Head nod up and down
		57	Head forward
		58	Head back
Upper face action	Eyebrow action	1	Inner brow raiser
		2	Outer brow raiser
		4	Brow lowerer
	Eye aperture	5	Upper lid raiser
		6	Cheek raiser and lid compressor
		7	Lids tightener
		43	Eye closure
		45	Blink
		46	Wink
	Eye gaze	61	Eyes left
		62	Eyes right
		63	Eyes up
		64	Eyes down
Lower face action	Nose action	9	Nose wrinkler
	Cheek action	35	Cheek suck
	Mouth aperture	25	Lips part

Component	Sub-component	AU number	AU name
		26	Jaw drop
		27	Mouth stretch
	Lip and corner of the mouth action	10	Upper lip raiser
		12	Lip corner puller
		15	Lip corner depressor
		16	Lower lip depressor
		18	Lip pucker
		20	Lip stretcher
		22	Lip funneler
		23	Lip tightener
		24	Lip presser
	Tongue action	19	Tongue show
		36	Tongue bulge
		37	Lip wipe
	Chin action	17	Chin raiser
	Air action	33	Blow
		34	Puff
	Neck action	21	Neck tightener
	Mouthing	50	Speech

* Newly implemented AUs

The overview in Table 2.2 shows that the single nonmanual components and sub-components, which are essential for DGS and other sign languages, are defined by a different amount of AUs. The sub-component with the most related AUs is *lip and corner of the mouth action* with nine AUs. The sub-components *nose action*, *cheek action*, *chin action*, *neck action*, and *mouthing* are determined by only one AU.

Regarding AD 33, I revised the scoring criteria given by FACS (for the difference between AUs and ADs, see Section 2.3.1). According to FACS, blow is defined as "[a]ir is blown out through the lips and the cheeks expand" (Ekman et al. 2002b, 310). However, my analyses of sign language data revealed that a distinction between blow with expanded cheeks versus blow without expanded cheeks is required. For example, within the sign WITHOUT in DGS, air is blown through the lips without an expanding of the cheeks. Therefore, I defined the appearance changes due to AD 33 as follows: *Air is blown through the lips. The cheeks may expand.* Due to this modification of the appearance changes named in the FACS manual, I also implemented slightly different criteria for the intensity scoring. In my analyses, the intensity score at level A applies for blow without expanded cheeks. The following guidelines for the intensity scores of AD 33 are based on FACS (Ekman et al. 2002b, 310), but are changed due to the impact of the different intensity criteria for level A:

- 33A: The appearance changes for AD 33 are sufficiently present to indicate AD 33, but insufficient to score AU 33B. The cheeks are not expanded out. The lips are parted. AU 25 must be scored with AD 33.
- 33B: The cheeks are slightly expanded out and the lips are parted. AU 25 must be scored with AD 33.
- 33C: The cheeks are pronouncedly expanded out and the lips are parted. AU 25 must be scored with AD 33.
- 33D: The cheeks are severely expanded out and the lips are parted. AU 25 must be scored with AD 33.
- 33E: The cheeks are maximally expanded out and the lips are parted. AU 25 must be scored with AD 33.

In sign languages, a significant increase of the intensity of specific nonmanuals may, on the one hand, be used for a meaningful enhancement. On the other hand, the intensity of AUs seems often to be signer and situation dependent (see Chapter 7). For the analysis of lexical nonmanuals, I waive the intensity scoring of AUs except for two intensity scores: AD 33A and AU 43E. For AD 33, the intensity scoring is relevant due to the difference between blows with and without expanded cheeks. In my analyses, I score the intensity of AD 33 only at the level A to indicate that the cheeks are not expanded. Whenever AD 33 and not AD 33A is used, it means that the cheeks are expanded. Regarding AU 43, the scoring for the intensity level E is crucial in order to differentiate between small opened eyes and closed eyes. Hence, I use the score 43E to indicate that the eyes are completely closed. For deviations from the neutral eye aperture without a closing of the eyes, I use AU 43 without intensity score.

Moreover, with respect to AU 43, especially the relationship to AU 7 has to be taken into account:

> AU 43 can be scored without scoring 7. On the other hand, with all but the weakest 7, it is rare that 7 can be scored without evidence of at least a *trace* of upper lid lowering or 43A, unless AU 5 has acted with 7 to lift the upper eyelid. If 7 is scored, it is not necessary to score 43 and its intensity unless the study is examining the degree of eye closures, regardless of the action that causes them. (Scoring 43E is always recommended, however.) (Ekman et al. 2002b, 441)

In my analyses, AU 43 is always scored when the upper lid is clearly lowered.

As mentioned in Section 2.3.1, FACS differentiates between AUs, ADs, and other codes. As this differentiation is not overridingly relevant for the present studies and in order to make the descriptions with FACS not too complex, in Table 2.2 and in the following, I use the abbreviation AU for all scoring codes.

With respect to the AUs listed in Table 2.2, some further remarks are necessary. I listed AU 6 under the sub-component *eye aperture* and not under the sub-component *cheek action*. This is due to the fact "that the muscle underlying AU 6 (like that responsible for AU 7) circles the eye orbit. [...] Action Unit 6 pulls skin towards the eye" (Ekman et al. 2002b, 31). This may result, inter alia, in the following appearance changes which have an influence on the eye aperture: "Pushes the skin surrounding the eye towards the eye socket, which can narrow the eye aperture, bag or wrinkle the skin below the eye, and push the eye cover fold down and/or change its shape" (Ekman et al. 2002b, 31).

Based on the muscular anatomy, it is possible to differentiate between two muscle contractions that are responsible for a smile: AU 12 *lip corner puller* and AU 13 *sharp lip puller*. However, as this distinction seems to be irrelevant for linguistic functions in DGS, I listed only the more common form of lip corner puller, that is AU 12.

For the description of lexical facial expressions which involve a tongue action, it is crucial to differentiate between centered tongue protrusion or lateral tongue protrusion. For this purpose, I use the abbreviations R, L, and C as specifications of AU 19. The letters R and L in front of the AU number indicate that the tongue is protruded at the right (R) or left (L) corner of the mouth. I implemented the letter C for centrally protruded tongue. Figure 2.5 illustrates AU R19 as part of the sign RECENTLY.

Fig. 2.5: The sign RECENTLY with lateral tongue show

Furthermore, AU 19 can be refined with respect to a differentiation between i) tongue actions which push the bottom lip forward and ii) tongue actions which do not push the bottom lip forward. However, on the lexical level, this difference seems to be only a phonetic variability. Regarding the lower face in general, Ekman et al. (2002b) note that further differentiation may be necessary:

> FACS probably does not include all of the visible, reliably distinguishable actions on the lower part of the face. The hinged jaw and rubbery lips allow a nearly infinite number of actions. [...] As we and others use FACS, we expect that some other AUs may need to be added; hopefully, not many. (Ekman et al. 2002a, 13)

For the combination of AU 54 *head down* with AU 57 *head forward*, I slightly changed the scoring criteria provided in the FACS manual for AU 54 (cf. Ekman et al. 2002b, 334). The double-chinning caused by AU 54, which is a scoring criteria within FACS, reduces or disappears when combined with AU 57. One example for the combination of the head actions 54 and 57 is the nonmanual marking within the sign CONCENTRATE (see Figure 2.6). In such cases AU 54 is scored without the appearance change of double-chinning. A good clue for the scoring of AU 54 is the orientation of the tip of the nose. Whereas, in the left picture of Figure 2.6, the tip of the nose is directed straight to the front (neutral position), in the right picture, the nose is orientated downward (sign CONCENTRATE).[13]

According to FACS, AU 50 refers to speech production. Throughout this book, AU 50 is used for the indication of mouthings. Like speech production, mouthings used during signing include actions of the jaw, tongue, and lips. Many of the appearance changes on the face during speech and mouthings result from muscles which are involved in other AUs as well (cf. Ekman et al. 2002b, 357). “A goal in FACS scoring is to disregard movements that function only to produce speech and score the other movements that co-occur with speech” (Ekman et al. 2002b, 357).[14]

13 A further beneficial method for measuring nonmanuals, in particular head movements, is the use of the motion capture technology. Puupponen et al. (2015) utilize this technology for the analysis of head movements in FinSL. An optimal way would be a combination of motion capture data and FACS analyses. However, with respect to some facial AUs, such as tongue movements, the motion capture technology is not useful. Furthermore, when using this technology for a simultaneous capturing of all facial muscle activities it can be assumed that the fixing of several markers in the face may have an impact on the signing of the participants. It has to be tested in detail whether this unnatural signing situation has an influence on the nonmanual articulations. For further information on motion capture, see Pfeiffer 2013; Tyrone 2015.

14 In their study on facial expressions occurring with DGS signs for *disgust*, Elliott & Jacobs (2014, 148) use the score AU 50 also for the mouth pattern which is commonly transcribed as *pf*. For the analysis of lexical facial expressions, in my view, it is essential to clearly differentiate between

Fig. 2.6: Neutral head and face (left), head action and facial expression within the sign CONCENTRATE (right)

With respect to sign languages, it is often relevant to indicate how often an AU is articulated consecutively. Therefore, whenever an AU is articulated more than once, I add in brackets the number of repetitions, e. g. 46(2x) for the articulation of a sequence of two winks. If no indication is given in brackets, the AU is carried out once. For a non-reduplicated head shake (AU 84), it is given no indication in brackets as a head shake involves at least two movements. Otherwise, it would be a head turn left (AU 51) or a head turn right (AU 52). The same holds for head nod up and down (AU 85) in contrast to head up (AU 53) and head down (AU 54).

It has to be noted that the duration of AUs within markings that are part of sign language grammar plays a crucial role. Based on different durations, the same AU combination may appear at first glance as different AU combinations. Clear examples are the DGS signs ALWAYS (two handed, indexfinger and thumb in contact, movement in the neutral signing space) and BROKEN (two handed, indexfinger, movement with the dominant hand). Both signs are articulated with the same AU combination: 17+U25+U33. The difference between both mouth patterns is that the articulation tends to be longer within the sign ALWAYS. The duration of lexical nonmanuals in sign languages depends on the duration of the manual sign. In contrast, the duration of facial expressions caused by emotions is usually related to the intensity of the felt emotion (cf. Ekman 2010, 200).

mouth movements referring to a spoken word and other mouth patterns. The mouth pattern labeled as *pf* is a mouth pattern which is a lexical part of different signs in DGS (e. g. STRANGE). A similar mouth pattern is also used by German hearing speakers as a gesture in sentence contexts such as, for instance, *Pf, I don't care*. Instead of labeling the mouth pattern *pf* as AU 50, I prefer to descibe the activated muscles. For the analysis of the meaning of facial gestures by deaf and hearing people, see Chapter 6.

In the following chapters, I use the terminology of FACS for the description of nonmanual markers. For example, in sign language research, the term *tongue protrusion* is commonly used. However, according to the FACS terminology, in the following, I use the term *tongue show* or AU 19.

3 State of research on lexical nonmanuals and mouthings

In contrast to spoken words, the smallest phonological units of signs are widely simultaneously articulated and perceived. Signs are composed of the four manual components handshape, hand orientation, movement, and place of articulation. In addition, nonmanual markings and mouthings may belong to certain signs (cf. Boyes Braem 1995, 50; Becker 1997, 75-78).

So far, there is no consensus how the status of lexical nonmanuals has to be precisely defined. More empirically based studies are necessary to receive insights whether lexical nonmanuals have to be treated as phonological components comparable with the manual parameters of signs or which alternative theoretical classifications are promising. Moreover, it is central to closely analyze whether there are differences in the nature and frequency of i) facial expressions on the lower face, ii) facial expressions on the upper face, iii) head actions, iv) and upper body actions.

In the following, I give an overview on the state of research regarding lexical nonmanuals (see Section 3.1) subdivided into four parts. Firstly, I outline previous theoretical approaches and empirical studies on lexical nonmanuals in different sign languages (see Section 3.1.1). Secondly, based on the current state of research, I consider the question whether sign languages have nonmanual minimal pairs (see Section 3.1.2). Thirdly, I briefly discuss the issue whether sign languages have signs which are articulated only by nonmanuals (see Section 3.1.3). Fourthly, I sum up criteria for the classification of nonmanuals as phonological markings (see Section 3.1.4). After focusing on the core nonmanual components, the linguistic status of mouthings is treated based on previous studies on mouthings in different sign languages (see Section 3.2). Throughout the book, mouthings are considered as a special category of nonmanual components and the term *nonmanuals* is used in a narrow sense which excludes mouthings. Whenever explanations include mouthings, it is explicitly stated.

3.1 Lexical nonmanuals

3.1.1 Theoretical and empirical treatments of lexical nonmanuals

There are two main approaches regarding the status of lexical nonmanuals: i) Nonmanuals are not considered as phonological component(s) of signs next to the manual phonological components handshape, hand orientation, movement,

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place of articulation (cf. e. g. Ebbinghaus & Heßmann 2001, 134, 149; with respect to nonmanuals apart from mouth patterns, see Crasborn & van der Kooij 2013, 4). ii) Nonmanuals are treated as phonological component(s) of signs (cf. e. g. Coerts 1992, 35, 45; Jantunen 2006; Steinbach 2007, 142; Pfau & Quer 2010, 382). As an argumentation for the firstly mentioned approach, it could be stated that nonmanuals have a lower productivity on the phonological level than manual components. Whereas each sign is composed of a handshape, hand orientation, place of articulation, and usually a primary and/or secondary movement, there are many signs that are not lexically specified for nonmanuals. Nevertheless, it has to be questioned whether the previous manually based phonological models are comprehensive enough to adequately capture the means of expressions in sign languages or whether extended models have to be developed. The following description by Goldin-Meadow & Brentari (2017, 15) indicates as well that the linguistic statuts of lexical nonmanuals is not yet clarified, but it is important to consider these markers: ”It is generally accepted that handshape, motion, and location constitute the three parameters that characterize a manual sign (orientation may be a minor parameter, and non-manuals are relevant as well).”

Neidle et al. (2000, 40) describe that certain “signs would be ill formed without the associated facial expression” (cf. also Neidle et al. 2000, 47). Keller (2001, 193) states that mouth patterns are an obligatory part of “a small subset of signs” in DGS. “Only a few of these signs have any meaning at all if signed without the proper mouth gesture”. van der Kooij & Crasborn (2016, 267) judge that ‘[n]on-manual aspects play a rather modest role in the lexicon”. Most examples for lexical nonmanuals given in the research literature refer to mouth patterns. Crasborn & van der Kooij (2013, 4) state that “[a]side from the pervasive use of mouth actions across the whole lexicon [...], all other non-manual features only occur sporadically in the lexicon”. Nonetheless, examples for signs with other lexical nonmanuals can be found in the research literature. Although, these are often isolated examples. Zeshan (2000, 44f.) illustrates lexical facial expressions, positions of the body and head as well as directions of eye gaze with three signs in Indo-Pakistani Sign Language (IPSL). For ASL, Liddell (2003, 12f.) mentions that “for some signs, it is necessary not only to move the hands correctly, but also to correctly configure the face and potentially other parts of the body”. He gives the following six examples: RELIEVED, TORMENT, TAKE-IT-EASY, RECENTLY, GIVE-IN, and NOT-YET. Also for ASL, Wilbur & Patschke (1998, 282) give thirteen examples for verbs that show body leans in the citation form of the signs, e. g. RESIST, HESITATE, ENCOURAGE (for further examples of ASL, see also Reilly & Anderson 2002, 160). Lutzenberger (2018) figured out that, instead of mouthings, nonmanual features are fundamental for name signs in Kata Kolok (KK). Happ & Vorköper (2006, 240-243) mention DGS signs with a lexical mouth pattern (e. g.

RECENTLY), signs with a lexical facial expression (e. g. SAD), and signs with a lexical head/torso movement (e. g. REJECT; further individual examples of signs with lexical nonmanuals in DGS are given in Becker 1997; Keller 2001; Keller & Leuninger 2004; Happ 2005; Leuninger 2005; Steinbach 2007; Papaspyrou et al. 2008; Becker 2016).[1]

For ASL, Liddell (2003, 11) states that head movements, lip formations, and eyebrow positions can be distinctive. But, "these articulators tend to be more important in morphological and syntactic constructions than in individual lexical items". Jantunen (2006) studies lexical movements in lexemes of Finnish Sign Language (FinSL) and treats torso, head, and mouth as nonmanual articulators. He considers manual and nonmanual forms as commensurable. This decision is based on the following arguments: i) signs articulated only with manual movements and signs articulated only with nonmanual movements are both well-formed, ii) the nonmanual movements in signs that are articulated with manual and nonmanual movements are structurally equally crucial as the manual movements, iii) the articulation of the abstract form of movements is not dependent on the articulator. The last aspect concerns "the so-called movement migration phenomenon". This means that a manual movement may be enhanced by a similar shaped nonmanual movement (Jantunen 2006, 337). Moreover, Pfau & Quer (2010, 382) subsume manual and nonmanual parameters under phonological parts of signs:

> Phonological (or lexical) nonmanuals are assumed to be an essential part of sign's phonological description. That is, just like manual parameters such as handshape, movement and location, these nonmanuals have to be specified in the lexical entry of a sign.

Pfau & Quer (2010) consider head and body movements, facial expressions, and mouth patterns in this sense in different sign languages (cf. also Pfau 2001). Similarly, Herrmann (2013, 40) states that manual and nonmanual components "play an equally important role and are stored in the mental lexicon together with many signs".

In strong contrast, Ebbinghaus & Heßmann (2001, 134) dissociate from such classifications by introducing the term "simultaneous collocations" and come to the following determination:

1 Mally (1993) provides a compilation of 90 idioms and signs in the Munich dialect of DGS. Interestingly, all included items are signed with nonmanuals and Mally (1993) gives detailed information on the forms of these nonmanual parts.

> [..] to view mouth gestures as autonomous units seems to be more consistent with their formational properties. Manual and nonmanual signs originate in totally different articulators, and there is no substantial justification in treating their different products with the same descriptive apparatus. On the other hand, mouth gestures and other nonmanuals have much more in common with each other, as regards form and meaning. [...] We therefore come to the conclusion that mouth gestures in DGS are neither arbitrary nor obligatory and should not be construed as phonological components of manual signs. (Ebbinghaus & Heßmann 2001, 149)[2]

Nevertheless, Ebbinghaus & Heßmann (2001, 134) state that "[i]nformation about regular collocations with nonmanually produced units should be part of the lexicographic description of the manual lexicon". Becker (1998, 259) mentions that it is difficult if not impossible to capture the system of nonmanual means with phonological descriptions. She states that the single nonmanual elements can hardly be differentiated from one another and that these elements can not be listed as discrete units with distinctive function (see also Zahwe 1995). Hohenberger (2008, 271) refers to "a device for phonetic enhancement" (cf. also Leuninger et al. 2005, 342). An important issue is whether specific lexical nonmanual markings are used as phonological parts in different signs. Quer et al. (2017, 34) state that "[i]n many sign languages, many mouth gestures would appear to occur only in single lexical items".

It is worth considering to compare lexical nonmanuals with tone pitches or tones in tonal languages (cf. Köhler & Herrmann 2009; Diamantidis et al. 2010; Pendzich 2012; Herrmann 2013, 49f.; Pfau 2016). In many languages, the meaning of a word changes due to variation of tone pitch. Such tones are distinctive features. Tone languages exist in Asia, West Africa, North America, and Central America. The nature and number of lexical tones of a language differs. Central Thai, for example, has five tones: rising, falling, high, mid, and low (cf. Hall 2011, 31, 155; Burnham et al. 2015, 1460; for further information on tonal languages and autosegmental phonology, see Gussenhoven 2004 and Hall 2011). "Control of pitch during the production of a word could easily become a part of the word and some facial gestures could easily become part of signs" (Liddell 2003, 175).[3]

2 Ebbinghaus & Heßmann (1995, 51) say that nonmanual markings can be an obligatory part of signs.

3 Commonalities and differences between nonmanuals in sign languages and tonal features in spoken languages are also attested for the morphological and syntactic level (cf. Pfau 2008; Pfau 2016). For further discussion of the comparison of tones in spoken languages and nonmanuals in sign languages regarding the lexical level, see Section 8.1.

The arising difficulty of the definition of lexical nonmanuals is explicitly stated by Vogt-Svendsen (2001, 18) in relation to mouth patterns and mouthings for Norwegian Sign Language (NSL):

> Both mouth gestures and mouthings can occur as elements that are non-morphemic. They seem to have some sort of phonological function, but I am not sure if they can be called phonemes.

As illustrated with the different notions on lexical nonmanuals, up to now there is no consensus concerning the issue how the status of lexical nonmanuals should most reasonable be described. It is high time to carry out empirical studies based on different elicitation methods to achieve more insight into the nature of the different forms of lexical nonmanuals: facial expressions on the upper face, facial expressions on the lower face as well as head and torso movements. In their study on body leans in NGT, van der Kooij et al. (2006) also consider body leans which are lexically associated with signs. But, most present empirical studies focus on the analysis of mouth patterns (cf. e. g. Crasborn et al. 2008). However, when investigating lexical nonmanuals it should always be analyzed, whether in addition to a specific mouth pattern further nonmanuals are obligatorily articulated, such as an eyebrow action or a head action.[4]

In an earlier language production study (cf. Pendzich 2012; Pendzich 2013; Pendzich 2014), I used a word to sign translation task which was carried out with three deaf signers in order to gain insights into the nature of lexical facial expressions.[5] In that study, I compared lexical facial expressions i) with respect to the

4 Within their analysis of mouthings and mouth gestures Crasborn et al. (2008, 48) also ask the following question: "Is the mouth action an independent activity or part of a global facial expression?" But, they categorize such nonmanual markings as "[n]ot lexically associated" and this group is not considered further. They differentiate the following types of mouth actions: i) *mouthings*, ii) *adverbial mouth gestures*, iii) *semantically empty mouth gestures*, iv) *enacting mouth gestures*, and v) *mouth activity in the context of whole-face activity*. Only type i) and iii) are classified as "[l]exically associated" (Crasborn et al. 2008, 50).

5 Negative consequences of the chosen elicitation procedure in the form of collecting signs without context and using written words are the unnatural language situation and the possibility of an intensified use of mouthings. However, apart from this, the predominant positive effects of this elicitation procedure with regard to the specific research interest have to be emphasized: On the one hand, affective influences which can be reflected in facial expressions are largely reduced. On the other hand, it has to be kept in mind that lexical facial expressions can overlap with other grammatical facial expressions in sentence contexts whereby the analysis of lexical components is more difficult. Of course, the analysis of lexical nonmanuals in natural language situations and in full sentences is very important. But, this analysis can be more advantageous after clarifying the nature of lexical nonmanuals.

use within the twice articulated signs by each individual signer and ii) with regard to the articulated facial expressions by the different signers. The data set includes 57 different signs in 307 occurrences which seem to have lexical facial expressions according to the chosen methodology. It is noteworthy that even within the data elicitation without context optional emphasizing facial markings occur to a large extent and have to be demarcated from lexical facial expressions. One crucial result of the production study is that the relation between upper and lower face for lexical markings in DGS seems to be more balanced than previous research suggests. Most of the elicited signs with lexical facial expressions involve both face halves (e. g. ANNOY). Furthermore, signs with facial expressions only in one half of the face are part of my data set (e. g. lower face: OWN, upper face: TIRED). The numerical proportion of the occurrences of signs with facial expressions in both face halves, with facial expressions only on the lower face, and with facial expressions only on the upper face has to be verified with quantitative studies. Nonetheless, the study demonstrates that facial expressions on the upper face are lexically relevant.

Elliott (2013) and Elliott & Jacobs (2014) carried out a study on DGS signs for emotions. They use a similar elicitation method like Pendzich (2012), namely a translation task. The main differences between the two studies are as follows: i) Whereas Pendzich (2012) analyzes 57 signs in one condition but two runs per each of the three signers which allows studying inter-signer and intra-signer variability, Elliott (2013) and Elliott & Jacobs (2014) investigate the sign DISGUST in three conditions (translation of single German words, translation of a sentence in direct speech, translation of a sentence in reported speech) signed by 20 signers.[6] ii) Elliott (2013) and Elliott & Jacobs (2014) exclusively focus on signs for emotions and Pendzich (2012) studies signs of different content groups, e. g. ANNOY, BITE-OFF, DISGUST, FEAR, INTERESTING, OWN, TIRED, RECENTLY, SAD, and SUDDENLY. iii) Elliott (2013) and Elliott & Jacobs (2014) focus more on lower face actions than upper face actions and do not consider head/torso movements.[7] Based on the empirical

6 "In this study we only look at a subset of the corpus, namely elicited sentences and single words for the emotion concept sign EKEL 'disgust'. The other sections of the corpus will not be further discussed here" (Elliott 2013, 52).

7 Elliott (2013, 53) explains the focusing on the sign DISGUST as follows: "We chose to analyze signs for 'disgust' as the action units associated with this emotion concept according to Ekman et al. (2002a) largely involve the mouth and not the upper face. Since the upper face is known to have functions at the prosodic level in signed languages, choosing signs that would primarily engage the mouth would make it easier to disentangle actions occurring at the lexical level from those occurring at higher levels".

analysis of different DGS signs for *disgust*, Elliott & Jacobs (2014, 129) propose, on the one hand, that

> facial movements that are lexically related to signs for emotion concepts [...] are phonological elements – mental representations of form units whose primary function is to provide perceptually salient cues for identification of the sign – with some morphological (meaning bearing) properties (see also Elliott & Jacobs 2014, 125, 163; Elliott 2013, 66).

On the other hand, with respect to the nonmanuals of the signs for *disgust*, Elliott & Jacobs (2014, 164) suggest

> that this facial movement element is part of an information layer temporally parallel to words/signs, in the same way that intonation and gesture exist as information layers temporally parallel to words/signs and interdependent on them.

Johnston & Schembri (2010, 26f.) concisely state the main difference between the phonological units of signed and spoken languages:

> [U]nlike the phonemes of SpLs, the five basic formational components of signs in all SLs (handshapes, orientations, locations, movements, and non-manual facial expressions) can be individually meaningful as a function of iconicity or language-specific form-meaning conventionalizations, or both.

Usually, the meaningful property of morphemes functions as a differentiation criterion to phonemes, which are meaningless. However, in sign languages, a complex overlap arises which leads to theoretical challenges for the differentiation between phonemes and morphemes (cf. also Schwager & Zeshan 2008; Meir 2012; see Section 7.1).

Regarding the quote by Johnston & Schembri (2010), the following remark is important: They add to the four manual components only facial expressions (without considering head and upper body actions) and assume five components of signs.[8] Twilhaar & van den Bogaerde (2016, 23) list five parameters as well: location, handshape, orientation, movement, and non-manual part. The non-manual part includes “facial expression, the tilt of the head or the upper body and mouth movements”. This leads to the following important question: Is it adequate to treat different lexical nonmanuals as i) one lexical nonmanual component (= facial expressions/head actions/torso actions), ii) two lexical nomanual components (= facial expressions and head/torso actions), iii) three lexical nonmanual compo-

8 However, in Johnston & Schembri (1999, 132), head and torso movements are mentioned as well. Nevertheless, they assume “five constituent aspects of handshape, orientation, location, movement and nonmanual features”.

nents (= facial expressions, head actions, and torso actions), or iv) four lexical nonmanual components (= facial expressions on the lower face, facial expressions on the upper face, head actions, and torso actions)? This question will be discussed in Chapter 7.

3.1.2 Do sign languages comprise nonmanual minimal pairs?

As evidence for the phonological status of the four manual components of signs, inter alia, the minimal pair method is used. Minimal pairs consist of two signs with different meanings which are based on only one phonological difference within one of the four manual parameters. Manual minimal pairs provide evidence that handshapes, hand orientations, movements, and places of articulation in sign languages have a similar status as phonemes in spoken languages (cf. Pfau 2001; Steinbach 2007; Papaspyrou et al. 2008).

To define the linguistic status of lexical nonmanuals, it is essential to investigate whether minimal pairs based on nonmanual differences exist. With respect to nonmanual components, Coerts (1992, 34) states:

> For all sign languages where research into nonmanual components has been done, examples have been found of nonmanual components with a contrastive function. Therefore it is argued that a nonmanual parameter must be included in the phonological description of signs along with the four manual parameters, even though this parameter is not always realized.

Regarding the mentioned research into nonmanual components, Coerts (1992) mentions American Sign Language (ASL), Norwegian Sign Language (NSL), Swedish Sign Language (SSL), British Sign Language (BSL), and Sign Language of the Netherlands (NGT). As cited, Coerts (1992) makes reference to the already above mentioned lower productivity of nonmanuals compared to manual components: nonmanuals are not relevant for all signs. Nonetheless, nonmanuals are important for the phonological description. Accordingly, Brentari (1998, 100) notes that "[n]onmanual behavior has been shown to have the same ability to carry lexical contrast as features of handshape, place, orientation, and movement". With respect to the nature of nonmanual minimal pairs, Coerts (1992, 35) mentions that most nonmanual minimal pairs are composed of one sign with a nonmanual component and one sign without a nonmanual component. This assumption needs to be proven by further empirical investigations based on different sign languages. Searching for nonmanual minimal pairs given in the research literature reveals, on the one hand, pairs in which both signs are specified for a nonmanual marking, and on the other hand, pairs in which only one sign is specified for a nonmanual marking. Furthermore, the factor mouthing plays an important role. It seems to be frequently the case that one sign is accompanied by a lexical nonmanual marking and the other sign by a mouthing. At this, it also has to be analyzed whether mouthings occur in conjunction with nonmanuals. It is striking that sign pairs which can be classified as minimal pairs due to a nonmanual component have hardly been investigated on a comprehensive empirical basis for DGS and other sign languages so far. However, for an adequate definition of the status of lexical nonmanuals, it is of central importance to analyze whether distinctive nonmanual components exist in different sign languages.

Pfau & Quer (2010, 383) give an example for two signs in Catalan Sign Language (LSC) that are distinguished by facial expressions: PITY – FALL-IN-LOVE. Whereas the sign PITY is articulated with a negative facial expression, the sign FALL-IN-LOVE is accompanied by a positive, relaxed facial expression. Likewise, Sandler & Meir (2008, 30, 172) make references to minimal pairs in ISL which are based on different facial expressions, such as DANGEROUS – AWESOME. Furthermore, the signs POLITE – RESPECT/HONOR are distinguished by a specific head position as part of the sign POLITE (cf. Sandler & Meir 2008, 171f.). An example for lexical distinction due to eye gaze is instanced by Sutton-Spence & Woll (1999, 94) for BSL. They state that the sign pair GOD – BOSS is solely distinguished by eye gaze.[9] For NGT, van der Kooij et al. (2006, 1600) mention, for instance, that the signs FINALLY-UNDERSTAND – TIRED are distinguished only by lexical nonmanuals. FINALLY-UNDERSTAND is articulated with a phonological mouth pattern and an upward head action. Crasborn & van der Kooij (2013, 4) state that nonmanual features apart from mouth patterns do not appear as “distinctive phonological features” in NGT. Zeshan (2000, 46) points out that in IPSL “some minimal and near-minimal pairs” occur in which signs are differentiated by nonmanuals. Moreover, Ajello et al. (2001, 241) give examples for Italian Sign Language (LIS): IMPOSSIBLE – DEAD and NOT-YET – FRESH. Each pair is based on a mouth pattern as part of the firstly mentioned signs and a mouthing with the secondly mentioned signs. Woll (2001, 88f.) mentions one sign pair which is disambiguated by mouthings and one which is disambiguated by mouth gestures in BSL.[10]

For DGS, Becker & von Meyenn (2012, 51) state that no minimal pairs occur which differ only in nonmanual components. Similarly, Becker (2016, 213) specifies that nonmanual elements do not have a lexically distinctive function in DGS.

9 However, it has to be noted that in the figure given by Sutton-Spence & Woll (1999) the sign GOD is additionally articulated with a head up.

10 Further examples of nonmanual minimal pairs are given in Vogt-Svendsen (1983, 90f.) and Vogt-Svendsen (2001, 19) for NSL, Leeson & Saeed (2012, 81) for Irish Sign Language (Irish SL), and Taub (2001, 28) for ASL.

In contrast, Köhler & Herrmann (2009) name SCEPTICAL – MAYBE and DIFFERENT – STRANGE and ask whether these are true minimal pairs based on nonmanual markings (see also Herrmann 2013, 47f.). One more pair "that might fit the requirements of tonal distinctiveness" is given by Herrmann (2013, 48): STAY – IGNORE. Diamantidis et al. (2010, 85) mention that signs may be distinguished only by a facial expression, a head posture, or a position of the eyebrows. Pendzich (2012, 124-127) gives six examples for potential nonmanual minimal pairs in DGS. Figure 3.1 illustrates the sign pair TIRED – EFFORT.

Fig. 3.1: Potential nonmanual minimal pair TIRED – EFFORT (Pendzich (2012))

Whereas the sign TIRED is articulated with small opened eyes (AU 43), a brow lowerer (AU 4), and a mouthing (AU 50), the sign EFFORT is articulated with a brow lowerer (AU 4), an inner brow raiser (AU 1), a blow (AU 33), a head position down (AU 54), and a head position forward (AU 57).[11]

The overview on minimal pairs based on nonmanual distinction given in the research literature illustrates the need for comprehensive empirically based studies on such sign pairs in different sign languages. It has to be analyzed whether the appearing predominance of minimal pairs based on mouth patterns meets the factual nature of sign languages or whether this is due to the frequent research concentration on mouth patterns instead of the analysis of nonmanuals as a whole.

According to the current state of research, differences in the frequency and productivity between manual and nonmanual minimal pairs arise. It seems that overall fewer nonmanual minimal pairs exist than minimal pairs for the manual

11 Similarly, Prillwitz (2005, 33) describes the lexical specification with facial expression in the upper and lower face as well as head position for the sign EFFORT in DGS.

components.[12] This could be seen as an indicator that nonmanual components have a different status than manual phonological parameters. But, before drawing such a conclusion comprehensive empirical studies are necessary. In addition, it has to be taken into account that manually very similar signs often clearly differ with respect to the lexical nonmanual marking. It can be assumed that nonmanual markings accentuate the semantic difference between such manually similar signs and contribute to a faster identification of the respective signs (cf. Pendzich 2012). An example for a manual minimal pair of signs which are strongly differentiated by lexical nonmanual marking is the sign pair WANT – PITY (see Figure 3.2).

Fig. 3.2: Manual minimal pair WANT (left) – PITY (right), which additionally differs with regard to the lexical nonmanual marking of PITY

The handshape, hand orientation, place of articulation, and direction of the movement from the neutral signing space to the torso are identical for both signs. But, the movement of WANT is articulated once and the movement of PITY is reduplicated. In addition, it sticks out that the sign PITY shows a lexically specified nonmanual marking, whereas WANT has no specification for a nonmanual marking.[13] When imagining a signer wants to express by means of reduplication of the sign WANT that something is *continuously wanted*, than the manual similarity of both signs increases further. At the same time, both signs are clearly distinguished by nonmanuals. “If the phonological significance of non-manual activity

12 In contrast, DGS and other sign languages contain numerous sign pairs which are distinguished only by mouthing, e. g. MORNING – BRIGHT in DGS. For further information on mouthing, see Section 3.2.

13 This assumption is based on a qualitative interview with two deaf signers (cf. Pendzich 2012) and a subsequent discussion with another native signer.

is accepted, then this will have implications for the status of the manual components" (Deuchar 1984, 75). When defining nonmanual parts of signs as phonological components which are equated to the manual phonological parameters of signs, then some of the signs that were classified as minimal pairs would be distinctive in more than only one parameter and would not be minimal pairs anymore (cf. Deuchar 1984, 75f.; Pendzich 2012).

3.1.3 Do sign languages comprise nonmanual signs?

A further question that arises is whether signs exist which are articulated only by nonmanuals (see also Coerts 1992). Quer et al. (2017, 28) bring up that "[t]here may also be signs where none of the extremities are involved in the articulation. While this is common for bound morphemes such as adverbial mouth gestures [...], it appears to be less common for free morphemes that are content words". Jantunen & Takkinen (2010, 316, 327f.) mention the FinSL sign YES and explain that this sign is articulated only with a repeated mouth pattern in the form of a kissing gesture.[14] Dively (2001) argues that ASL comprises signs that are performed only by nonmanuals and introduces the term *nonhanded signs*. The following eight examples are given: YES, NO, THEN, OH-I-SEE, WRONG, OR, PUZZLED, and TIME-PASSED-BY. Dively (2001) assumes "that ASL has three categories of free morphemes: nonhanded signs, manual signs, and fingerspelled signs" (Dively 2001, 62). For DGS, the dictionary by Kestner and Hollmann[15] includes the following "nonmanual signs": WHISTLE-WITH-THE-LIPS, SOB, SULK, and TWITCH. One of my deaf informants states that he articulates *whistle-with-the-lips* or *musical-whistle* only with the lips and *shrug-one's-shoulders* only with the shoulders. However, it has to be questioned whether these articulations can really be considered as lexical signs.[16] *Shrug one's shoulders* could be analyzed as a gesture and *whistle with*

14 Jantunen (2006, 337) mentions three FinSL signs and states that these signs "contain[ing] only nonmanual movements". But, no further information about these signs is given. Due to the pictures that are provided for these signs in Jantunen & Takkinen (2010), it becomes clear that Jantunen (2006) does not differentiate between i) manual signs without a manual movement but a nonmanual movement and ii) signs without any manual component which consist of just a nonmanual movement. This differentiation is of central importance when discussing structural properties of signs.

15 Kestner, Karin and Tiemo Hollmann. 2009-2010. *Das große Wörterbuch der Deutschen Gebärdensprache*. Verlag Kestner.

16 It would be worthwhile to use the Hamburg DGS Corpus (http://www.sign-lang.uni-hamburg.de/dgs-korpus/index.php/dgs-korpus.html.) for a closer investigation whether nonmanual signs exist in DGS.

the lips, sob, and *sulk* could be considered as instances of action role shift (for further information on action role shift, see Section 2.2.1). Also, Herrmann (2013, 40) argues that nonmanual signs “do not seem to be lexical in the strict sense and are rather used for discourse structural purposes”. However, an adequate example for a nonmanual sign seems to be the sign MENSTRUAL-PERIOD in NGT. This sign is articulated solely by a tongue action against the cheek (cf. Quer et al. 2017, 28, 34).

For ASL, Liddell (1980, 17) explains that the sign NOT-YET which includes manual and nonmanual components can be articulated only by the nonmanual marking in the form of tongue show and head shake:

> For example, to indicate that he had not eaten yet, a signer could say, PRO.1 NOT-YET EAT (with the appropriate facial expression and headshake with the sign NOT-YET). Alternatively, he could forego using his hands in signing NOT-YET while keeping the nonmanual signals in the same place (between PRO.1 and EAT), and the interpretation would be the same.

It would be very interesting to study the conditions and the frequency of this phenomenon of dropping manual components in favor of nonmanual components more closely with respect to various signs in different sign languages.

Furthermore, for ASL, Neidle et al. (2000, 40) state that “[s]ometimes, a nonmanual marking characteristically associated with a lexical item can be used with other lexical items more generally”. Given examples are the signs CARELESS and RECENTLY. Such cases in which the nonmanuals carry a supplementary meaning (cf. Neidle et al. 2000, 40) and co-occur with other signs point to the fluent boundary between lexical and morphological markings. An important issue for further research on different sign languages is to closely investigate which nonmanual morphological markings used for adjectival and adverbial modifications are based on lexical signs which have the same meaning and have the same nonmanual marking as inherent part in addition to manual components.

3.1.4 Criteria for the classification of nonmanuals as phonological markings

In particular, the following criteria seem to be essential in order to classify certain nonmanuals as phonological components (cf. also Deuchar 1984, 76; Coerts 1992, 20f., 27f.):

1. The nonmanual marking is an obligatory part of signs.
2. The nonmanual marking has a distinctive function.
3. Variation within the articulation of the nonmanual marking occurs only within certain limits because it must be clearly recognizable as a linguistic unit.

As designated in point 1), to be treated as phonological the nonmanual marking must not be an optional element. Nevertheless, it has to be analyzed whether specific conditions exist which can lead to an omission of the nonmanual marking which obligatorily belongs to a sign in citation form.

With respect to point 2), it has to be investigated whether nonmanual minimal pairs exist. At the same time, it should be studied whether such pairs are based on simultaneously articulated different nonmanual elements (e. g. facial expression on the upper and lower face and head movement) as well as on single nonmanual elements (e. g. head movement). Moreover, the following factors have to be taken into account: i) specification of one or both signs for a nonmanual marking, ii) the impact of mouthings. Subsequently, based on an comprehensive empirical basis, it has to be analyzed whether such nonmanual minimal pairs are comparable to manual minimal pairs.

Regarding point 3), it has to be investigated whether facial expressions, head actions, and upper body actions show higher variability in the articulation than the four manual phonological components. This would suggest that nonmanual markings have another phonological status than the manual components (cf. Pendzich 2012). Ajello et al. (2001, 244) refer to the importance of the investigation of variability in the articulation with respect to mouth patterns:

> It is important to establish whether it is an individual variability (but of an allophonic or of a paralinguistic type?) or whether it is connected to a variation of meaning, as the parameter of different degrees of lip aperture would seem to indicate.

This approach can be widened for the other nonmanual markers as well.

3.2 Mouthings

Mouthings[17] are voicelessly expressed words or parts of words from the surrounding spoken language (e. g. German in the case of DGS) and articulated simultaneously with certain signs (cf. Ebbinghaus & Heßmann 1994; Papaspyrou et al. 2008; Pfau & Quer 2010; Konrad 2011). There is some controversy about the status of mouthings in different sign languages (cf. Ebbinghaus & Heßmann 1995; Boyes Braem & Sutton-Spence 2001; Crasborn et al. 2008; Konrad 2011; Ebbing-

17 Further terms used in the research literature are e. g. *spoken components* (cf. Boyes Braem & Sutton-Spence 2001; Woll 2001), *wordpictures/word pictures* (cf. Coerts 1992; Boyes Braem & Sutton-Spence 2001), *speech-components* (cf. Coerts 1992); *Ablesewörter* ('words for reading off'; cf. Becker 2016).

haus 2012). In the research literature on various sign languages, there are two main perspectives: On the one hand, mouthings are viewed as a consequence of code mixing. On the other hand, mouthings are considered as borrowed elements which are part of the lexicon and grammar of sign languages (cf. Sande & Crasborn 2009, 78). For instance, Hohenberger & Happ (2001, 153) treat mouthings as "belong[ing] to a theory of performance" and contrast their view "with the proposal that mouthings are an integral part of sign languages in general and DGS in particular". Jantunen (2006, 337) follows Hohenberger & Happ (2001) and "consider[s] only mouth gestures to be lexical elements" and treats mouthings as "phonologically irrelevant though frequently occurring code-mixing". In contrast, for instance, Sande & Crasborn (2009, 79) support the perspective that mouthings are borrowed items and state that "[t]hey could be considered a phonological component of signs, on a par with handshape or location, for example" (see also Sande & Crasborn 2009, 88; Woll 2009, 209; Woll 2014, 4; Pfau & Steinbach 2016, 274).

Pursuant to the second approach, mouthings are described as a modality specific process of word formation in which elements borrowed from the surrounding spoken language are combined with signs (cf. Boyes Braem 1995; Steinbach 2007; Becker 2003).[18] Although mouthings derive from spoken languages, they obviously have a function in DGS and many other sign languages investigated so far. They are inserted according to the grammatical structure of sign languages. Mouthings are not used with all signs. In particular, they occur with content words and more often with nouns than verbs. Mouthings are synchronized with the respective sign(s). They express either the corresponding word of the spoken language fully or in a reduced form. If words are reduced, usually, this is oriented on the root word and in such a manner that the recognition of the word remains possible. Mostly, inflections are omitted. Reductions may be based on an adaption of mouthings to the structure of the respective sign. In other cases, mouthings spread over one additional sign or sometimes even more signs.[19] The extent of the use and relevance of mouthings varies for different sign languages.

18 For counterarguments regarding the term *borrowing*, see Becker (2003, 98, 130); Ebbinghaus & Heßmann (2001, 139) and the following argumentation by Fontana (2008, 116): "The peculiar nature of mouthings lies in the fact that although they originate from a spoken language, they cannot be considered as borrowings because they do not fill any lexical gaps and they seem to play a very important role in signing both on the syntagmatic and on the pragmatic level". One could counter that mouthings indeed fill lexical gaps as mouthings are often combined with existing sings in order to create new sign meanings.

19 Based on data of BSL, NGT, and SSL, Crasborn et al. (2008) investigate in detail the spreading behavior of mouthings and mouth patterns. See also Sande & Crasborn (2009).

For instance, whereas ASL shows little use, mouthings in DGS are frequently used (cf. Boyes Braem 1995; Ebbinghaus & Heßmann 1995; Zeshan 2000; Hohenberger & Happ 2001; Vogt-Svendsen 2001; Becker 2003; Perniss et al. 2007; Steinbach 2007; Crasborn et al. 2008; Papaspyrou et al. 2008; Sandler & Meir 2008; Pfau & Quer 2010; Ebbinghaus 2012; Becker 2016).

Crasborn et al. (2008) investigate the use of mouth actions in narratives signed in the three sign languages BSL, NGT, and SSL. Their study reveals that mouthings are the type of mouth actions that occurs most frequently. Mouthings are used with 30% to 50% of all signs.

Two main types of mouthings can be distinguished: i) redundant mouthings and ii) disambiguating and specifying mouthings. Mouthings of type i) seem to have no linguistic function which is not fulfilled by other components of the signs. "[E]specially for the group of redundant mouthings, it is a matter of debate whether they really constitute an integral part of a sign language" (Pfau & Quer 2010, 384). Such mouthings "add no lexical or morphological information" (Coerts 1992, 36). Mouthings of type ii) disambiguate between different meanings of otherwise manually identical signs or specify the meaning of manual signs. Examples of DGS are the homonymous signs EVIDENCE – EXAMPLE, TOPIC – COMPANY, COLOR – MARMALADE, and POLITICS – TECHNOLOGY. Further examples are hypernyms and hyponyms such as BIRD – BLACKBIRD and FLOWER – ROSE (cf. Coerts 1992; Boyes Braem 1995; Ebbinghaus & Heßmann 1995; Becker 1997; Ebbinghaus & Heßmann 2001; Woll 2001; Langer et al. 2002; Steinbach 2007; Papaspyrou et al. 2008; Sandler & Meir 2008; Pfau & Quer 2010).

For ISL, Sandler & Meir (2008, 177f.) state that just like certain signs are obligatorily articulated with a facial expression, some signs are obligatorily signed with a mouthing. The answering of the question which mouthings can be classified as obligatory is made more difficult due to the relevance of different sociolinguistic variables. In this context, a possible impact of the familiar language background on the use of mouthings has to be taken into account. It may play a role whether a signer has deaf or hearing parents or whether he/she is a native signer or not. If the latter is the case, the age of acquisition of sign language has to be considered as a factor. Further factors may be the influences of different school systems, oral education systems, registers, dialects, gender, age, and the amount of non-signers in the immediate social environment (cf. Coerts 1992; Zeshan 2000; Boyes Braem & Sutton-Spence 2001; Hohenberger & Happ 2001; Keller 2001: Sutton-Spence & Day 2001; Mohr 2014). Hohenberger & Happ (2001, 157, 164) emphasize the inter-individual variation. For NGT, Sande & Crasborn (2009) show that the use of mouthings is indeed dependent on registers. They investigate the use of mouthings in a narrative register and an interactive register and reveal that significantly more mouthings are used in the interactive register.

With respect to DGS, Hillenmeyer & Tilmann (2012, 268) state that mouthings used in formal contexts may be replaced in part by mouth patterns in informal contexts (e.g. LIFE-PARTNER). Another observation for informal contexts is that certain signs may not be signed but instead be expressed solely by the respective mouthing (e.g. WHY; cf. Hillenmeyer & Tilmann 2012, 268).

It is interesting to investigate the relation between the syllable structures of simultaneously articulated signs and mouthings. The following two issues have to be analyzed: i) Can reduced realized mouthings be systematically explained with an alignment to the syllable structure of the respective simultaneously articulated sign? ii) Is the number of repetitions within reduplicated signs linked to the syllable structure of simultaneously used mouthings? (the latter question is also raised by Pfau & Steinbach 2006b, 158; cf. Pendzich 2016a). Keller (1998, 434f.) mentions that hearing learners of DGS reduplicate the movement of a sign in accordance with the syllables of the German word. He gives the examples YESTERDAY and THE-DAY-BEFORE-YESTERDAY. Furthermore, Keller (1998, 435) states that competent signers of DGS show the contrary tendency: they rather reduce parts of the mouthing.

In some cases it is difficult to differentiate between mouth patterns and mouthings (cf. Ebbinghaus & Heßmann 1995, 54). "There are also some examples of mouth movements where signers say that they don't know whether it is a mouth gesture or a mouthing" (Vogt-Svendsen 2001, 32). Mouth patterns and mouthings show a special relation: i) These different types of mouth movements can merge with each other.[20] ii) From a diachronic perspective, a mouthing can change into a mouth pattern: "Some mouth patterns seem to have undergone such changes that their original form in the spoken language is unclear. Such cases are not treated as wordpictures" (Coerts 1992, 32). iii) Mouth patterns can be displaced by mouthings and the articulation of signs can vary between these two types of mouth actions. Bank et al. (2011) found out that many signs in NGT can either be articulated with a mouthing or a mouth pattern. iv) Some signs may be articulated with mouthings by deaf children before they have acquired the corresponding word of the respective spoken language. In these cases, mouthings belong to the phonological form of signs (cf. Keller 2001; Rainò 2001; Emmorey

20 On the contrary, see Hohenberger & Happ (2001, 165, 177): "If mouth gestures are present in a sign token, mouthings are absent"; "Furthermore, the incompatibility of both functions naturally forces the signer to decide for one or the other function". At this point the question arises which mouth actions are included in the category mouth gestures. If, for instance, actions of the lip corners are considered under this category, it is obvious that the combination of a mouthing and a mouth pattern is possible. One example is the sign HAPPY which can be simultaneously articulated with a mouthing and a lip corner puller.

2002, 39f.). Such examples illustrate the fluent boundary between mouthings and mouth patterns. In this respect, it is also interesting to study in depth the use of mouthings by signers who learn another sign language as foreign language without learning the respective spoken language. Fontana (2008, 115) says that "observational evidence shows that when learning another sign language deaf people tend to acquire the sign and the mouthing as a whole". Woll (2009, 209) mentions that signers can acquire mouthings even though they do not know the source language. She cites this as an argument that mouthings are borrowings (see also Woll 2014).

For the lexical and phonological description of signs, it should be taken into account that signs often occur in combination with different mouthings, as it is the case for hypernyms and hyponyms. The spectrum between, on the one hand, regular combinations of mouthings and signs and, on the other hand, uses of signs without mouthings has to be considered (cf. Ebbinghaus & Heßmann 1995; Ebbinghaus & Heßmann 2001; Konrad 2011). Mouthings and signs show a dynamic relationship with relatively fixed combinations as well as loose combinations (cf. Ebbinghaus & Heßmann 1995; Ebbinghaus & Heßmann 2001; Langer et al. 2002). The meaning of a mouthing is not always identical with the meaning of the simultaneously articulated sign (cf. Langer et al. 2002, 89) and the use of mouthings can be seen as an extremely productive method for the generation of meaning (cf. Konrad 2011, 144, 227).

Given that mouthings originate from spoken languages and their linguistic status in relation to the genuine parts of sign languages is still not completely clarified, I consider mouthings as a special category of nonmanual components.

Part II: **Empirical studies**

4 Study I: Lexical judgment and the meaning of signs

4.1 Research question

The study *Lexical Judgment and the Meaning of Signs* focuses on the question whether nonmanuals, such as torso/head actions and muscle contractions in the lower face as well as in the upper face, are inherent parts of certain lexical signs in DGS. With the empirical perception study I investigate how crucial nonmanuals are i) regarding judgments of adequacy for lexical signs and ii) regarding the meaning of lexical signs. The study is based on a video questionnaire with a lexical judgment task and a subsequent three-part interview with a translation task, a repetition of the lexical judgment task including explanatory statements by the participants, and a mouthing classification task. The significance of lexical nonmanuals is investigated by showing stimulus videos with nonmanual features (NMF) and manipulated stimulus videos without these nonmanual features (m-NMF). The following five subquestions are decisive:

1. Are muscle contractions in the lower and upper face, head actions, and actions of the upper part of the body components of lexical signs in DGS?
2. Do acceptability judgments for NMF signs and m-NMF signs on a six-point-scale reveal which signs have inherent lexical nonmanual features? Is the rating of the nonmanually manipulated signs significantly worse than the rating of the non-manipulated signs?
3. Are lexical nonmanuals subject to diachronic change? Do these markers play a different role for the younger and older signer generation?
4. Are manually manipulated signs rated worse than nonmanually manipulated signs?
5. Are sign pairs formed by the NMF and m-NMF conditions adequately described with the following categories? a) The m-NMF sign does not have a different meaning than the NMF sign, i.e., both signs are attributed to the same meaning. b) The m-NMF sign does not have a meaning. c) The m-NMF sign is ambiguous and leads signers to name different meanings. d) The NMF sign and the m-NMF sign have different meaning(s). This would mean that minimal pairs based on nonmanual markers exist in DGS.

In the following, the methodology of the study is described including the precise design (Section 4.2.1) and the metadata of the participants (Section 4.2.2). Subsequently, I provide an overview of the elicited data set (Section 4.3) and the results

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of the study are presented in deatil (Section 4.4). Firstly, I show the various statistical analyses (Section 4.4.1).[1] Secondly, I present the results of the qualitative analyses of the participants' explanatory statements for the lexical judgments (Section 4.4.2), the translation task (Section 4.4.3), and the mouthing classification task (Section 4.4.4). The chapter closes with a summary and discussion (Section 4.5).

4.2 Methodology

4.2.1 Study design

The empirical perception study on lexical nonmanuals in DGS is divided into two separate main parts. The second main part consists of three different tasks:
1. Video questionnaire with lexical judgment task
2. Interview with three tasks: i) translation task, ii) lexical judgment task in direct comparison of m-NMF signs vs. NMF signs and with participants' explanatory statements, iii) mouthing classification task

In the following, I explain the design of the stimuli and fillers (Section 4.2.1.1). The structures of the questionnaire and the interview are described in Section 4.2.1.2 and Section 4.2.1.3.

4.2.1.1 Stimuli and fillers

For the stimuli that are assumed to have lexical nonmanuals, two factors are decisive: *presence of nonmanual features* (factor I) and *nonmanual sign type* (factor II). Factor I refers to the creation of sign pairs. Each of these pairs consists of one sign with the assumed lexical nonmanual features (NMF) and the same sign with a manipulation regarding the nonmanual features (m-NMF). The m-NMF signs are manually exactly the same as the NMF signs but are articulated without the assumed lexical nonmanual features.[2] Factor II implies three different *nonmanual sign types*: i) signs with a lexical facial expression, ii) signs with a lexical facial ex-

1 All statistical analyses were carried out in collaboration with Alexander Silbersdorff, Chair of Statistics, University of Göttingen.

2 Another approach for the present perception study would have been the extension of the factor *presence of nonmanual features* with respect to a third condition, that is using incorrect nonmanual features (inc-NMF). Thereby, a good result might occur when m-NMF signs were judged as badly as inc-NMF signs. However, the condition inc-NMF would be based on too many yet unknown assumptions how to categorize accompanying nonmanuals as clearly 'incorrect'. As the present study indicates, we have to deal with a complex interplay between lexical nonmanuals

pression and torso/head action, iii) signs with a lexical torso/head action. Based on these two factors, the study has a six-condition design (see Table 4.1). Each condition pair A/D, B/E, C/F is represented by six different signs commonly used in DGS.

Tab. 4.1: Design of the stimuli

Factor I: presence of NMF	**Factor II: nonmanual sign type**	**Condition**	**Items**
yes	i) facial expression with muscular activity in the lower and/or upper face	A	6
yes	ii) facial expression with muscular activity in the lower and/or upper face and torso/head action	B	6
yes	iii) torso/head action	C	6
manipulated	i) facial expression with muscular activity in the lower and/or upper face	D	6
manipulated	ii) facial expression with muscular activity in the lower and/or upper face and torso/head action	E	6
manipulated	iii) torso/head action	F	6
Number of stimuli			= 36

and pragmatic factors. As the omission of specific lexical markers can be used for the expression of irony, it can be assumed that specific ‘false’ nonmanuals can be used for this purpose as well (see Section 7.3). Another disadvantage of the inc-NMF condition is that the participants would see the same sign in three different articulations. To avoid this, different stimuli lists for the participants would have been necessary. However, it is good to receive the acceptability judgments of all conditions per sign by each participant because otherwise the additional influence of dialectal variation may carry more weight. In view of these aspects, I decided to use the two-stage factor *presence of nonmanual features*.

Table 4.2 comprises the selected stimuli within the three nonmanual sign types (see Appendix A for illustrations of each stimulus sign).[3] All sign videos have an approximate length of four seconds.

Tab. 4.2: Stimuli

Nonmanual sign type	Signs
i) Signs with a lexical facial expression	ALWAYS/REGULAR, BROKEN, FAVORITE, STRESS, SUPER, WINK
ii) Signs with a lexical facial expression and torso/head action	ARROGANT, BLURRY, CONCENTRATE, LAZE, SHOCK, WITHOUT
iii) Signs with a lexical torso/head action	NOD, NOT-YET, PROTECTION, REVERE, SEARCH, SLEEP

Prior to the video recording of the stimuli, the categorization regarding the three nonmanual sign types was discussed with two deaf DGS informants (one female, one male). Moreover, the selection of the signs for the nonmanual sign types i) and ii) was controlled for the occurrence of signs with muscle contractions in the lower face, in the upper face, and a combination of muscle contractions in the lower and upper face. Another criterion for the selection of the stimuli was the occurrence of the following five *semantic categories* which are, in my view, crucial for the theoretical description of lexical nonmanuals: i) lexical nonmanual imitation of action (e. g. SLEEP), ii) lexical nonmanual highlighting of a characteristic aspect of the sign meaning (e. g. ARROGANT), iii) lexicalized affective nonmanuals (e. g. SHOCK), iv) lexicalized gestural nonmanuals (e. g. NOT-YET), and v) lexical non-iconic nonmanuals (e. g. BROKEN, see Section 7.3 for further information on the semantic categorization).

To ensure that the attention of the participants is not explicitly directed to nonmanual markers, I integrated four filler types: i) correct signs which do not have a lexical nonmanual marking, ii) manipulated signs with a manual error which do not have a lexical nonmanual marking, iii) manipulated signs with a manual error which have a lexical nonmanual marking, and iv) signs merged from two signs by taking the manual components of one sign and the nonmanuals of another. One example for the latter type is the combination of the manual components of the sign HAPPY with the lexical nonmanual marking of DISGUST (see Figure 4.1).

3 In Table 4.2, the sign ALWAYS/REGULAR is transcribed with two English words as some signers associate the sign with the meaning *always* and other signers rather with the meaning *regular*. In the following, the label ALWAYS is used.

Fig. 4.1: Example of the filler group iv): the manual components of HAPPY and the nonmanual marking of DISGUST. Initial point of the sign (left), ending point of the sign (right)

The 36 filler signs are evenly distributed across the mentioned four types (see Table 4.3). The manual manipulations in the filler groups ii) and iii) are balanced regarding the affected manual component: handshape, hand orientation, place of articulation, movement (primary and secondary). Both filler groups include three signs with an error in the handshape, two signs with an error in the hand orientation, two signs with an error in the place of articulation, and two signs with an error in the primary or secondary movement (see Appendix B for a detailed list).

In order to control the impact of mouthings, the deaf sign model was instructed to omit mouthings within the possibilities of natural signing while articulating the stimuli and fillers. Regarding five signs in the NMF condition, it was impossible to completely omit mouth movement without losing semantics of the sign. Hence, the stimuli NOT-YET, PROTECTION, REVERE, SEARCH, and STRESS are signed with a slight mouth movement. These mouth movements do not appear as clear word articulations. Thus, all fillers and stimuli in the m-NMF condition are signed completely without mouthing, stimuli in the NMF condition are signed without mouthing or with a slight tendency of a mouthing.[4]

For the detailed description of the facial muscle contractions shown in the stimuli, the Facial Action Coding System (FACS; cf. Ekman et al. 2002b) was used. Table 4.4 provides an overview of the Action Units (AUs) occurring as assumed lexical features in the stimuli (see Section 2.3.2 for detailed explanations of the AUs). As described in Section 2.3.1, according to FACS, the letters R and L are used to indicate the side of a unilateral action. For DGS and presumably for more

4 All stimuli and fillers were recorded with a Sony HDR-CX550VE full-HD camera and cut with the video editing software application Adobe Premiere Pro.

Tab. 4.3: Fillers

Filler type	Signs
i) Correct signs without lexical nonmanuals	ASK, BOOK, CAR, CHEAP, DRIVE, EAT, INTERNET, NEW, PARIS
ii) Manually manipulated signs without lexical nonmanuals	CALCULATE, COMPARE, DOCTOR, GET-TO-KNOW, HOUSE, NAME, REASON, SPORT, YOUNG
iii) Manually manipulated signs with lexical nonmanuals	CLUMSY, ENVIOUS, EXPULSION, HURRIED, IGNORE, NO-IDEA, SHY, SQUANDER, WHY
iv) Signs merged from two signs by taking the manual components of one sign and the nonmanuals of another	EVIL <> HAPPY DISGUSTING <> LAUGH GLAD <> SAD HAPPY <> DISGUSTING ILL <> GLAD JOYFUL <> RESISTANCE LAUGH <> EVIL RESISTANCE <> ILL SAD <> JOYFUL

sign languages, it is an interesting finding that unilateral facial expressions and actions of the head seem to depend on the dominant hand (cf. Pendzich 2013, see Section 4.4.2.3 and Section 7.2.5). In Table 4.4, the abbreviation R in front of an AU is used as the sign model dominantly signs with the right hand and, accordingly, with the right face half. For a left dominant signer, the facial expressions would appear on the left side and would be scored with L.[5] Likewise, lexical actions of the head correspond to the dominant hand. One example is the stimulus SLEEP. As the sign model is a right dominant signer he articulates the lexical head tilt to the right. With respect to head actions, the letters L and R are not used. Instead, there are different FACS codes for movements to the right or left side, e. g. 56 for tilt right and 55 for tilt left.

5 The stimulus WINK has an exceptional character. As can be seen from Table 4.4, the sign model articulates AU 46 with the left instead of the right eye. As the place of articulation of the sign is very close to the right eye it could be a conscious strategy to articulate the wink with the left eye so that this facial expression can be seen easier. Another reason could be a difficulty in the articulation of the wink with the right eye. It often seems to be the case that people can articulate some facial expressions easier with one side of the face. It is interesting to pursue whether the use of the non-dominant face half within the sign WINK has an effect on the lexical judgments by the participants (see Section 4.4.2.3).

Tab. 4.4: Action Units (AUs) for lexical markings within the stimuli

Stimulus	Condition	AUs
ALWAYS	A	17+R25+R33
BROKEN	A	17+R25+R33
FAVORITE	A	18
STRESS	A	4+7+50
SUPER	A	1+7+17+R25+R33+43
WINK	A	L46 (2x)
ARROGANT	B	19+25+26+43+53
BLURRY	B	1+7+19+25+26+43+58+108
CONCENTRATE	B	4+7+54+57
LAZE	B	19+25+26+108
SHOCK	B	1+2+5+25+26+58+108
WITHOUT	B	18+25+33A+84
NOD	C	85
NOT-YET	C	50+84
PROTECTION	C	50+108
REVERE	C	50+54
SEARCH	C	50+54+84
SLEEP	C	56

In addition to the overview in Table 4.4, some more comments are important. One crucial point is that slight individual facial AUs and torso/head actions which are not articulated by every signer with the respective sign should be considered as individual style. Such nonmanuals are not included in Table 4.4. Individual style in sign languages can be directly compared with the behavior of spoken language users. If somebody emphasizes one part of a spoken utterance with voice quality, he/she can additionally use gestural nonmanuals. We can easily imagine that someone talks about a delicious dinner and, during the pronouncing of *delicious*, uses a gesture in the form of widely opened eyes and raised eyebrows or in the form of squinted eyes. In sign languages, it is a particular challenge to differentiate between such optional gestural nonmanual markings and lexical nonmanual components as well as further linguistic nonmanual features. For example, the sign ALWAYS may be articulated with an underlining slight forward head action which seems to be not lexically relevant.

On top of that, there are more subtle articulation differences which are not lexically relevant. Signs like ALWAYS, BROKEN, SUPER, and WITHOUT can be articulated with or without jaw drop (AU 26). The presence or absence seems to be a phonetic variation. In Table 4.4, AU 26 is not scored when the sign may occur with or without this AU.

Another point to note is that lexical nonmanuals may be articulated with different intensities. For example, the sign BLURRY can be articulated with different degrees of tongue show (AU 19). Thereby, it often seems to be optional if AU 19 pushes the lower lip forward or not. For example, the lower lip is pushed forward by the tongue in the stimulus LAZE but not in the stimulus ARROGANT. Regarding the upper face, it can be assumed that lexically specified tight lids (AU 7) can be optionally intensified by cheek raise (AU 6), e. g. in the sign STRESS. This is one example for an optional intensification by an AU supplement. Here, it should be noted that the transition to morphological intensification is fluent (see Section 7.5).

In this study, torso and head actions are grasped as one category of lexical nonmanuals. If a stimulus video includes a torso action which is assumed to be lexically relevant, it is listed in Table 4.4. The assumption is that the action of the torso can be minimized and be performed solely with the next smaller articulator, the head, depending on the language context and communication situation. Likewise, a lexical head action can additionally be performed with the next bigger articulator. For example, in the stimulus video, the sign REVERE is articulated with a head action down but may optionally be signed with a forward body lean.[6]

Finally, it is important to note that the overview in Table 4.4 does not claim to be exhaustive. Due to high dialectal variation in DGS,[7] it can be assumed that further phonetic variabilities and nonmanual sign variants exist. Furthermore, due to different articulation patterns, some lexical nonmanuals show an inherent variability in the articulation (see Section 7.2.2). As mentioned above, lexical nonmanuals reveal a fluent boundary to morphological decrease and increase (see Section 7.5).

6 The method of treating head and torso actions as one category is in line with the findings by van der Kooij et al. (2006, 1611) for body leans that fulfill different functions in NGT: “Based on the description of body lean in ASL, we assumed that head and body work together in the articulation of the forward or backward body lean. A lean forward or backward may be realized by the body or the head, or a combination of the two. This is in fact what we found for forward and backward leans”. Also, for FinSL, it is observed that the head and the torso “in many cases move as one” (Jantunen & Takkinen 2010, 317). Nevertheless, the head and the torso may realize different functions simultaneously in certain utterances. For instance, a body lean may be used for a contrastive function and a parallel head shake expresses negation (cf. van der Kooij et al. 2006).

7 The current DGS Corpus project of the University of Hamburg and the *Akademie der Wissenschaften in Hamburg* is an important milestone for the investigation of dialectal variation all over Germany. For more information, see http://www.sign-lang.uni-hamburg.de/dgs-korpus/index.php/projekt.html. For information on dialectal variation in DGS, see also e. g. Hillenmeyer & Tilmann (2012) and Macht & Steinbach (2019).

4.2.1.2 Design of the questionnaire

The instructive videos were signed in DGS by one female deaf signer. The stimulus videos were signed by one male deaf signer. The questionnaire was created with the programming language BlitzBasic and was divided into seven parts:

1. Welcome video
2. Metadata questionnaire: information about the name, gender, age of birth, place of birth, place of residence, age of deafness, hearing status of the parents, preferred language, age of DGS acquisition, and school
3. Instruction video: explanation of the task
4. Practice session
5. Second short instruction video: option to go back to the first instruction video (part 3), to do the practice session again (part 4) or to start with the actual task (part 6)
6. Task
7. Video of thanks with a field for entering an e-mail address

The practice session consisted of four practice videos designed in the same way as the stimuli and fillers. By this means, participants were familiarized with the task.

In the video questionnaire, participants had to evaluate 72 signs (= 36 stimuli and 36 fillers) on a six-point-scale with number one as the lowest value (= the signer and his deaf friends, colleagues, and family do not use the sign in the presented way) and six as the maximum value (= the signer and other deaf people use the sign in exactly the same way). When each individual video had finished, a judgment scale from one to six in the form of vertical lines (I II III IIII IIIII IIIIII) and a button for repeating the video appeared (see Figure 4.2). Each video could be watched several times. As soon as a rating was given, the next stimulus video was displayed.

The 36 stimuli and 36 fillers were randomized. To ensure that the position of the stimuli had no influence on the judgments, the data were elicited in balanced ratio with two different lists (= randomization list A) and B)). Randomization list B) had the reversed order of list A). The participants judged each sign twice: once with and once without the lexical nonmanuals (see Figure 4.3). To ensure that the participants saw a sufficient number of other signs between the two signs of each sign pair, the randomization was manually revised. Between the NMF sign and m-NMF sign of each sign pair at least eight other signs occur. A further manual revision concerns the first and last sign in the randomization lists. Because the last sign in randomization list A) is the first sign in list B), I selected filler signs for both positions. The reason for this is that after the practice session a short instruction video follows with the question if the participant wants to practice again, see the task explanation again or would like to start. After this short break, for reasons of acclimatization to the task, it is better to begin with a filler sign instead of a critical item.

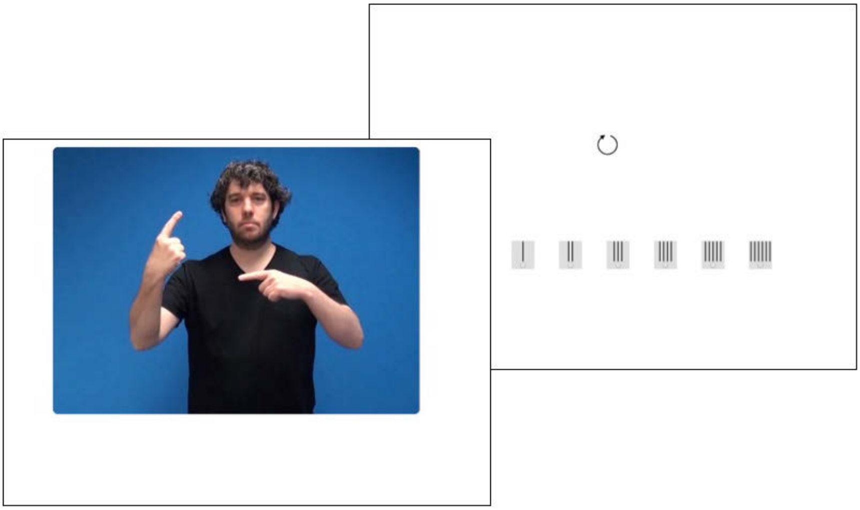

Fig. 4.2: Design of the judgment task in the questionnaire: endpoint of the m-NMF sign BROKEN, button for repeating the video, and judgment scale

Fig. 4.3: Stimulus pair ALWAYS, NMF sign (left) and m-NMF sign (right)

4.2.1.3 Design of the interview

After a sufficient break for the participants three further tasks followed: i) translation task, ii) lexical judgment task in direct comparison of NMF signs and m-NMF signs with participants' explanatory statements for the judgments, and iii) mouthing classification task. These tasks are based on the 36 stimulus videos without the fillers. For each task, a PowerPoint presentation containing the stimulus videos and a handout with fields for notes was used. The communication between the participants and the instructor took place in DGS. If the participants agreed, all discussions were recorded. Two video camcorders were used: one camcorder to film the whole communication situation between the participant and the instructor and a second camcorder to capture the signer's face.

The *translation task* was conducted for two purposes: On the one hand, the task was used to ensure the correct classification of the judgments given by the participants. On the other hand, it is essential for the analysis of the impact of nonmanuals on the meaning of lexical signs. To check whether the judgments refer to the intended meanings of the signs, is especially important with regard to the signs in the m-NMF condition. Four possible cases are relevant: a) the m-NMF sign does not have a different meaning than the NMF sign, b) the m-NMF sign does not have a meaning, c) the m-NMF sign is ambiguous and leads signers to name different meanings, d) the m-NMF sign has a different meaning than the NMF sign. Within the task, the 36 stimuli were randomly displayed in a PowerPoint presentation. The participants explained the meaning of each sign in DGS and they or the instructor wrote down the corresponding German translation(s).

In the second part of the interview *lexical judgment task in direct comparison of NMF and m-NMF signs with participants' explanatory statements*, the two signs of each stimulus pair were shown successively. Each pair started with the m-NMF sign followed by the NMF sign. The stimulus pairs were randomized. The participants judged each stimulus video again but this time with printed scales. This renewed judgment task in direct comparison of the two conditions enables to get ratings for the intended meanings of the m-NMF signs explicitly. Furthermore, it can be analyzed whether both judgment rounds differ extensively and whether the participants rate more critically when they see the m-NMF sign and NMF sign successively. Besides, the explanatory statements for the given ratings enable to get deeper insights into the reasons for a high or low rating of each stimulus. For example, it could be possible that a low rating by a participant is due to dialectal variation.

The *mouthing classification task* is essential for identifying the significance of mouthings on the judgments made; the participants saw a second PowerPoint presentation, though this time with only the NMF signs. They had to choose between the following four classification criteria: a) mouthing has to be there, b) mouthing is never used, c) mouthing is sometimes used, and d) mouthing can be used if... Option d) could be selected when there are particular conditions for the use of a mouthing.

4.2.2 Participants

The study is based on the participation of 17 signers: nine women and eight men. All participants were between 14 and 61 years old. Table 4.5 summarizes the relevant anonymized metadata, listing a fictive name abbreviation (A, B, C, ...), gender, age at participation, age of deafness, age of DGS acquisition, hearing status of the parents, and the signer's preferred language. Because of privacy reasons, the cities or regions the participants came from and/or lived in are not listed in Table 4.5.

Originally, the study was carried out with 21 participants. Although, during the acquisition of participants it was stated explicitly that only deaf persons with early sign language acquisition can participate, at two meetings it became clear that the person did not fulfill the metadata criteria. These two persons were not deaf, had no deaf parents, and started to learn DGS after the age of 17. Another person had been excluded from the evaluation because she was not able to do the task on the computer on her own and jointly worked on it with a hearing friend. Hence, the influence on the ratings by the hearing person cannot be ruled out. For the fourth precluded participant, a different reason is decisive. This test person explicitly said that she did the lexical judgment tasks not only with regard to the signing of deaf people but also with regard to hearing people. She judged which signs can be understood.[8] It cannot be completely ruled out that this had an influence on the judgments of the other participants as well, but nobody mentioned this. Furthermore, there are no indications that other participants understood the task similarly and, in the instruction video, the reference point on signing by deaf people was made clear.

8 Two examples which illustrate the misunderstanding of the task by the mentioned participant are the judgments for the signs CONCENTRATE and ARROGANT. The participant said that more hearing persons sign as shown in the m-NMF videos, whereas the NMF videos are typical for deaf persons. Nevertheless, the NMF videos and the m-NMF videos were rated with the highest value of the six-point scale.

Tab. 4.5: Metadata of the participants

Signer	Gender	Age	Deaf at age	DGS at age	Deaf parents	Preferred language
A	m	61	0	6	no	DGS
B	f	51	1.5	6	no	DGS
C	m	53	2	6	no	DGS
D	m	14	5[a]	0	yes	DGS
E	f	31	0[a]	0	yes[b]	DGS
F	f	29	0	3	no	DGS
G	f	28	0	2	no	DGS
H	m	25	0	0	yes	DGS
I	m	28	0	0	yes	DGS
J[c]	f	25	0	6	yes	DGS
K	f	52	0	5	no	DGS
L	m	26	0	0	no	DGS
M	m	55	0	0	yes	DGS
N	f	20	0	0	yes	DGS
O	f	20	0	0	yes	DGS
P[d]	f	24	0	0	yes	DGS
Q[d]	m	17	0	0	yes	DGS

[a] = hard of hearing
[b] = mother: deaf, father: hard of hearing
[c] = first native language: Polish Sign Language (PJM)
[d] = father from Turkey

In short, from the 17 participants (mean age: 32.9), ten participants were native signers and seven were near-native signers (see Section 1.2 for definitions of the terms *native* and *near-native*). Everybody acquired DGS before the age of seven. DGS is the preferred language of all participants. The study was carried out in the SignLab of the Georg-August-University Göttingen, in the Deaf center in Braunschweig, in public areas in a library of the Humboldt-University Berlin, and at participants' residences in Berlin as well as in Hamburg.

4.3 Data

4.3.1 Lexical judgment task (questionnaire) and translation task (interview)

In the *lexical judgment task of the questionnaire*, each participant rated 72 signs. In this way, I got 306 ratings of the NMF signs, 306 ratings of the m-NMF signs and 612 ratings of the filler signs. This results in 1224 ratings.

In the subsequent *translation task*, the participants translated the stimulus signs. Thereby, I got 599 translations, each of which included one or more terms for the description of the sign meaning. In 13 cases, the sign was not translated. Apart from two cases in which a sign pair was not translated in both conditions, the other 11 missing translations refer to m-NMF signs, which do not have a clear translation for some participants due to the nonmanual manipulation. Hence, the missing translations are not due to elicitation issues but due to unknown or nonexistent signs.

If the participants agreed, the translation task was recorded.[9] One video camcorder was used to film the communication situation between the participant and the instructor and one video camcorder to capture the signer's face. Afterwards, I annotated videos using the professional tool ELAN. In Section 4.4.3, the translations given by the participants are summarized and discussed. In total, the video material of the translation task has a duration of 291 minutes. On average, the translation task took 19 minutes per participant.

Using the data of the *translation task*, it is possible to include the variable of meaning in the statistical analysis of the *lexical judgment task in the questionnaire* and the *lexical judgment task in the interview*. For this purpose, I analyzed which stimulus signs were attributed to a non-intended meaning by the participants. In the evaluation table for the statistical analyses with all judgments given in the questionnaire and interview, I added the column *intended meaning* and checked for each judgment to which meaning it belongs. Meaning category 0 is used if a) another as the intended meaning is named or if b) for a sign in the NMF and m-NMF condition no translations are given which means that the signer does not know the sign. The latter case occurred only once. Meaning category 1 indicates that a) the intended translation is designated, b) the given translation is semantically very close to the intended translation, or c) no translation is given for the m-NMF sign but for the NMF sign of the same sign pair. For case 1c), it can be assumed that the absence of a meaning is due to the nonmanual manipulation and, thus, the given judgment refers to the intended sign. Meaning category 2 stands

9 One participant did not want to be filmed. Another participant was not recorded as the study was carried out in public areas in a library of the Humboldt-University Berlin.

for cases in which several different translations are given and the intended meaning is mentioned in addition to one or more other meanings. Hence, it is not clear to which meaning the judgment belongs.[10]

All ratings that fall in meaning category 1 generate a set of 288 ratings of the NMF signs and 165 ratings of the m-NMF signs. 15 ratings of the NMF signs and 74 ratings of the m-NMF signs are counted among category 2. Three ratings of the NMF signs and 67 ratings of the m-NMF signs belong to category 0. This numerical proportion of the three categories clearly shows the relevance of nonmanual markers on the lexical level. Particularly crucial is the high number of meanings for the m-NMF signs that fall in meaning category 0 and 2. With lacking nonmanual markers certain signs are ambiguous or have different meaning(s) than the corresponding NMF signs. Thus, including the variable of meaning in the statistical analysis, is especially important regarding the m-NMF signs. One interesting example is the sign ARROGANT. Given translations that refer to the intended sign are *arrogant, snooty*, and *conceited*. In contrast, the translation *proud* given in the m-NMF condition clearly refers to a semantically different sign (for nonmanual minimal pairs, see Section 4.4.3 and 7.4.3).

4.3.2 Lexical judgment task with participants' explanatory statements (interview)

The *lexical judgment task in the interview* yielded 305 ratings of the NMF signs and 306 ratings of the m-NMF signs. Apart from one participant who gave no rating for one stimulus, each participant rated 36 signs. The filler signs were not included in this lexical judgment task. As mentioned above, the task was combined with the possibility for the participants to explain why they rated each sign with the selected value.

Again, with the exception of two participants, the task was recorded. Subsequently, the videos were evaluated using ELAN and the explanatory statements given by the participants were summarized in tabular form. The video material of

10 It should be noted that the influence of concurrently activated other meanings on the participants' judgments is not always unequivocal as the *translation task* was carried out subsequently. In contrast to the *lexical judgment task in the questionnaire*, in the *lexical judgment task in the interview* it was the explicit task to provide judgments that refer to the intended signs. Partially, the participants made two ratings when they connected a different meaning with a sign. In these cases, only the judgment for the intended sign is included in the evaluation table for the statistical analyses.

the 15 recorded participants has a duration of 273 minutes. On average, the task had a length of 18 minutes.

4.3.3 Mouthing classification task (interview)

Within the *mouthing classification task*, 298 classifications of the status of mouthing for the intended 18 NMF signs were gathered. As mentioned above, the participants had to decide between the following options: a) mouthing has to be there, b) mouthing is never used, c) mouthing is sometimes used, and d) mouthing can be used if… Except for two participants, the mouthing classification task was recorded. The classifications are summarized and discussed in Section 4.4.4. In total, the video material has a duration of 111 minutes. The average duration per participant amounts to 7 minutes.

4.4 Results

4.4.1 Statistical analyses of the lexical judgment tasks (questionnaire and interview)

4.4.1.1 NMF signs vs. m-NMF signs

For the statistical analysis of the overall rating regarding the NMF signs and m-NMF signs in the questionnaire as well as in the interview a classical one-way analysis of variance (ANOVA) is used. Analyses were carried out using R (cf. R Core Team 2015). The conducted ANOVA assesses the following two hypotheses:

$\mathcal{H}_0$: The ratings of m-NMF signs are the same as the ratings of NMF signs.
$\mathcal{H}_1$: The ratings of m-NMF signs are not the same as the ratings of NMF signs.

Pursuant to the null hypothesis $\mathcal{H}_0$, the ratings of signs in both conditions would be the same or rather do not widely differ. In contrast, according to the alternative hypothesis $\mathcal{H}_1$, ratings of m-NMF signs and NMF signs clearly differ. Thereby, it is assumed that the nonmanual manipulation has a significant impact on the ratings by the participants.

In the first step, the statistical analysis of the overall ratings of NMF signs and m-NMF signs is based on the complete elicited data regarding the *lexical judgment task in the questionnaire* (see the statistical results of the first evaluation (= meaning categories 0, 1, 2) in Table 4.6). This reveals that the 18 signs shown with the assumed lexical nonmanuals are rated on average with 5.61 on the six-point scale and the same 18 signs without these nonmanuals with 3.82. This difference between the ratings of NMF signs and m-NMF signs is significant at all usual significance levels with $p < 0.001$. Figure 4.4 illustrates the distribution of the ratings. For all histograms in this chapter, light red denotes the ratings of nonmanually manipulated signs, blue denotes the ratings of signs without manipulation, and dark red indicates the overlap between both.[11] The histogram in Figure 4.4 clearly shows that the ratings of the signs without manipulation largely amount to the highest value. By contrast, it is striking that the ratings of the nonmanually manipulated signs spread markedly wider over the whole scale although the most frequent value is still six.

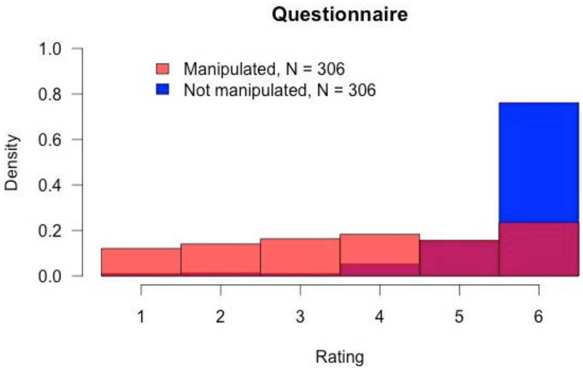

Fig. 4.4: Statistical distribution of all ratings for stimulus signs in the questionnaire

Using the results of the *translation task*, it is possible to include the variable of meaning in the statistical analysis (see Section 4.3.1). With lacking lexical nonmanuals, several signs were associated with different meanings. Thus, these signs were not perceived as incomplete versions of the NMF signs but rather as different signs. In order to get the statistical results of the *lexical judgment task in the questionnaire* regarding exclusively the ratings of the intended meanings, an ANOVA for all ratings in meaning category 1 was carried out (see Table 4.6). This analysis reveals that the 18 NMF signs were rated on average with 5.64 and the 18 m-NMF signs with 3.92. Hence, both average overall ratings are higher than in the first analysis step which includes all ratings. Again, the difference between both average overall ratings of the two stimulus groups is highly significant: $p < 0.001$.

11 In monochrome print, light red corresponds to light grey, blue to dark grey, and dark red to medium grey.

Figure 4.5 presents the distribution of the ratings for the intended meanings of the signs.

When comparing Figure 4.4 and Figure 4.5, it becomes apparent that both distributions are similar. However, a clear difference can be observed by looking at value 4. A possible reason may be the tendency of participants to choose central values when seeing signs which cause uncertainty (meaning categories 0 and 2).

For the purpose of getting the whole picture, additionally, an ANOVA for all ratings belonging to the meaning categories 1 and 2 was carried out (see Table 4.6). The results are similar to the previous ones: The 18 NMF signs were rated on average with 5.64 and the 18 m-NMF signs with 3.84. Again, the difference between the overall ratings of both stimuli groups is highly significant: $p < 0.001$ (see Appendix C for an illustration of the distribution of these ratings).

In terms of the questionnaire results, the ANOVA for the ratings in meaning category 0/1/2 (NMF signs: 5.61, m-NMF signs: 3.82), the ratings in category 1 (NMF signs: 5.64, m-NMF signs: 3.92), and the ratings in meaning category 1/2 (NMF signs: 5.64, m-NMF signs: 3.84) are very similar.

In the next step, the statistical analysis of the *lexical judgment task in the interview* was carried out. As already mentioned, in this task, the participants saw the two signs of each stimulus pair successively: Firstly, the m-NMF sign and, secondly, the NMF sign. The participants judged the stimuli with a printed scale for each stimulus. This judgment task with the direct comparison of the signs in both conditions enables me to get ratings for the intended meanings of the signs explicitly. Moreover, it is interesting to examine whether both judgment rounds differ widely.

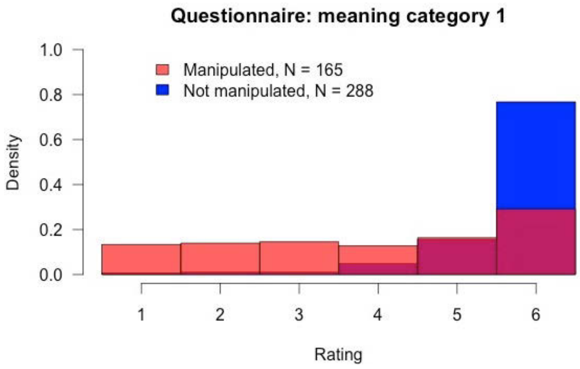

Fig. 4.5: Statistical distribution of the ratings regarding meaning category 1 in the questionnaire

The statistical analysis was implemented exclusively for the judgments regarding the intended meaning (= meaning category 1). The 18 signs with lexical nonmanuals were rated on average with 5.74 and the 18 signs without these nonmanuals with 2.44 (see Table 4.6). Again, the difference between the ratings of the NMF signs and m-NMF signs is significant at all usual significance levels with $p < 0.001$. Figure 4.6 illustrates the distribution of the ratings regarding the intended meanings of the signs in the interview.

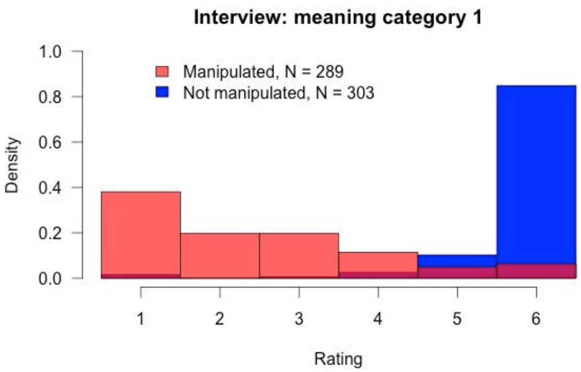

Fig. 4.6: Statistical distribution of the ratings regarding meaning category 1 in the interview

By comparing the average overall ratings in the *judgment task in the questionnaire* and the *judgment task in interview*, it becomes clear that the ratings of the m-NMF signs are more pronounced when the participants see the m-NMF sign and the NMF sign of each sign pair successively. But, the comparison also reveals consistency and reliability of the given judgments as the average overall ratings regarding meaning category 1 in the questionnaire and interview are almost equal for the NMF signs (see Table 4.6). The results show that signers have clear intuitions what is lexically correct or incorrect and accordingly judge linguistic material.

Looking again at Figure 4.5 and Figure 4.6, the ratings of m-NMF signs with value six stick out. This may be due to the following causes: i) It might indicate that one or more of the stimuli which are assumed to have lexical nonmanuals are doubtful cases. In Section 4.4.1.2, the statistical analysis of each single sign pair is carried out. ii) It may be an indication that nonmanuals are not equally important for all subjects due to a diachronic change. Regarding this, in Section 4.4.1.3, the judgments by younger and older participants are statistically compared. iii) As the translation task was performed subsequently, regarding the lexical judgment task in the questionnaire, the possibility cannot be ruled out that some partici-

Tab. 4.6: Statistical analyses of the overall ratings in the questionnaire and the interview

Task	Meaning categories	NMF	Statistical results
Rating:			
questionnaire	0, 1, 2	yes	N = 306, $\overline{x}$ = 5.61, SD = 0.87
	0, 1, 2	no	N = 306, $\overline{x}$ = 3.82, SD = 1.7
			F = 269.21, p-value $<$ 0.001
Rating:			
questionnaire	1, 2	yes	N = 303, $\overline{x}$ = 5.64, SD = 0.81
	1, 2	no	N = 239, $\overline{x}$ = 3.84, SD = 1.71
			F = 261.47, p-value $<$ 0.001
Rating:			
questionnaire	1	yes	N = 288, $\overline{x}$ = 5.64, SD = 0.81
	1	no	N = 165, $\overline{x}$ = 3.92, SD = 1.8
			F = 193.75, p-value $<$ 0.001
Rating:			
interview	1	yes	N = 303, $\overline{x}$ = 5.74, SD = 0.78
	1	no	N = 289, $\overline{x}$ = 2.44, SD = 1.51
			F = 1125.8, p-value $<$ 0.001

pants had in mind a different meaning for individual signs than later indicated. Finally, it can be emphasized that the statistical results for the average overall ratings in the *lexical judgment task in the questionnaire* and the *lexical judgment task in the interview* clearly show the fundamental importance of nonmanuals on the lexical level in DGS. Hence, $\mathcal{H}_0$ is rejected.

4.4.1.2 Single signs

To get an impression of the average ratings of the individual signs in the NMF condition and m-NMF condition, a statistical analysis in terms of all separate sign pairs was carried out. The analysis assesses the following hypotheses:

$\mathcal{H}_0$: The ratings of the m-NMF sign of a sign pair are the same as the ratings of the NMF sign of the same sign pair.
$\mathcal{H}_1$: The ratings of the m-NMF sign of a sign pair are not the same as the ratings of the NMF sign of the same sign pair.

For each sign pair, a classical one-way ANOVA was implemented. The statistical analysis refers to the ratings belonging to meaning category 1 and is done for the questionnaire as well as for the interview. The results are summarized in Table 4.7. The difference between the NMF sign and m-NMF sign of the sign pairs in the questionnaire is statistically significant for each sign pair except for the sign pairs

ALWAYS, CONCENTRATE, and LAZE. However, it has to be noted that this insignificance seems to be due to the too small sample as the m-NMF signs were often perceived as signs with a different meaning.[12] Regarding the m-NMF sign ALWAYS, only three ratings by the participants refer to the intended sign. For the m-NMF sign CONCENTRATE, six ratings relate to the intended sign and, regarding the m-NMF sign LAZE, actually no rating fits meaning category 1. In the interview, for all stimulus pairs, the difference between the NMF sign and m-NMF sign is significant at all usual significance levels.

Two examples for very similar mean values in the questionnaire and interview are the signs SEARCH and SUPER. For the NMF sign SEARCH, the mean value is 5.88 in the questionnaire vs. 5.76 in the interview and, for the m-NMF sign, 2.67 in the questionnaire vs. 2.27 in the interview. The mean value for the NMF sign SUPER is 5.82 in the questionnaire vs. 5.94 in the interview and, for the m-NMF sign, 3.38 in the questionnaire vs. 2.82 in the interview (see Table 4.7). Whereas the statistical distributions of the ratings of the NMF signs SUPER and SEARCH turn out very similar in the questionnaire and the interview, the statistical distribution of the ratings of the m-NMF sign SUPER shows differences in both data elicitations (see Figure 4.7[13]). Regarding the m-NMF sign SUPER, it is striking that the participants more often selected especially value three in the questionnaire and value one in the interview. The distribution of the ratings of the m-NMF sign SEARCH, only at first glance, may appear in both data elicitations differently. Here, it has to be noted that the mean value for the m-NMF sign SEARCH in the questionnaire is based on only three ratings due to the fact that this sign was often interpreted as the sign ORAL (see Section 4.4.3).

The ratings of the sign FAVORITE show a contrast regarding the percentage difference between the NMF sign and m-NMF sign in the interview compared to the percentage difference in the questionnaire. For both task rounds, the results are based on 17 ratings of the signs in both conditions. The percentage difference between the NMF sign and m-NMF sign amounts to 11% in the questionnaire and 52% in the interview (see Table 4.7). Accordingly, the statistical distributions of the ratings in particular for the m-NMF sign FAVORITE are very different in the questionnaire and interview (see Figure 4.8). However, this large contrast can easily be explained. The lexical facial expression of FAVORITE is a kiss mouth (AU 18)

12 For the stimulus pairs STRESS, ARROGANT, SHOCK, and SEARCH the samples are similarly small in the questionnaire data, but revealed larger percentage differences between the NMF signs and the m-NMF signs and the differences achieved statistical significance.

13 For all histograms in this section, light red denotes the ratings of nonmanually manipulated signs, blue denotes the ratings of signs without manipulation, and dark red indicates the overlap between both.

which is difficult to see due to the hand movement which starts at the mouth. In the interview, the participants saw the m-NMF and NMF sign FAVORITE one after the other and explicitly included the absent kiss mouth in their ratings.

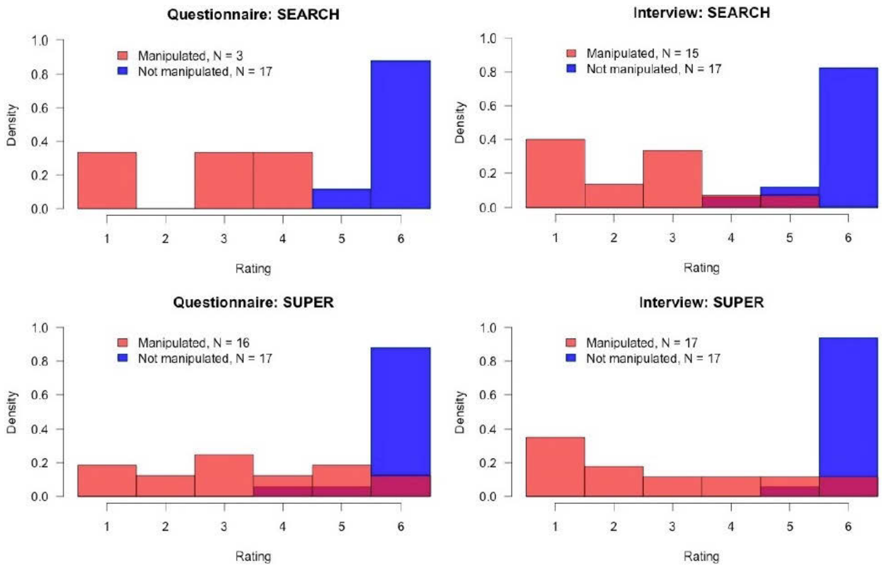

Fig. 4.7: Statistical distributions of the ratings of SEARCH and SUPER in the questionnaire and the interview

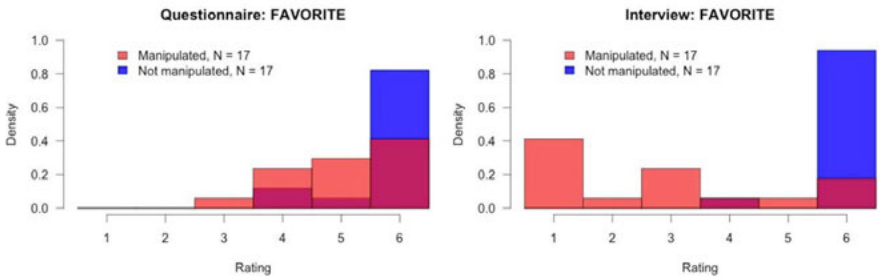

Fig. 4.8: Statistical distributions of the ratings of FAVORITE in the questionnaire and the interview

For each stimulus pair, the rating difference between the NMF sign and the m-NMF sign is between 47% and 71% in the interview. The 47% refers to BROKEN (see Figure 4.9) and the 71% relates to LAZE (see Figure 4.10). The ratings of the m-NMF and NMF sign LAZE differ very sharply and split up with no occurrence of overlapping ratings.

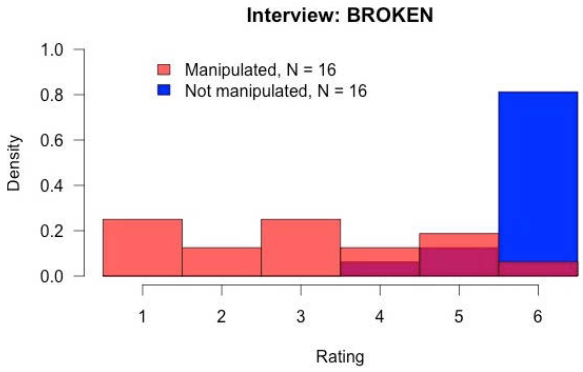

Fig. 4.9: Statistical distribution of the ratings of BROKEN in the interview

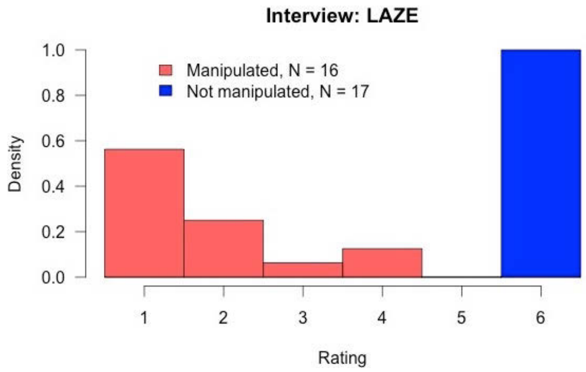

Fig. 4.10: Statistical distribution of the ratings of LAZE in the interview

Tab. 4.7: Statistical analyses of single signs

Task	Stimulus	NMF	Statistical results
Rating:			
questionnaire	ALWAYS	yes	N = 16, $\overline{x}$ = 5.62, SD = 0.72
	ALWAYS	no	N = 3, $\overline{x}$ = 5.00, SD = 1.73
			F = 1.2, p-value = 0.285
			% difference NMF vs. m-NMF: 11
Rating:			
interview	ALWAYS	yes	N = 16, $\overline{x}$ = 5.94, SD = 0.25
	ALWAYS	no	N = 15, $\overline{x}$ = 2.53, SD = 1.73
			F = 61.0, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 57
Rating:			
questionnaire	BROKEN	yes	N = 13, $\overline{x}$ = 5.77, SD = 0.44
	BROKEN	no	N = 11, $\overline{x}$ = 4.64, SD = 1.63
			F = 5.8, p-value = 0.025
			% difference NMF vs. m-NMF: 20
Rating:			
interview	BROKEN	yes	N = 16, $\overline{x}$ = 5.75, SD = 0.58
	BROKEN	no	N = 16, $\overline{x}$ = 3.06, SD = 1.65
			F = 37.7, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 47
Rating:			
questionnaire	FAVORITE	yes	N = 17, $\overline{x}$ = 5.71, SD = 0.69
	FAVORITE	no	N = 17, $\overline{x}$ = 5.06, SD = 0.97
			F = 5.1, p-value = 0.031
			% difference NMF vs. m-NMF: 11
Rating:			
interview	FAVORITE	yes	N = 17, $\overline{x}$ = 5.88, SD = 0.49
	FAVORITE	no	N = 17, $\overline{x}$ = 2.82, SD = 1.94
			F = 39.6, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 52
Rating:			
questionnaire	STRESS	yes	N = 17, $\overline{x}$ = 6.00, SD = 0
	STRESS	no	N = 6, $\overline{x}$ = 4.83, SD = 2.04
			F = 6.1, p-value = 0.022
			% difference NMF vs. m-NMF: 19

Task	Stimulus	NMF	Statistical results
Rating:			
interview	STRESS	yes	N = 17, $\overline{x}$ = 5.94, SD = 0.24
	STRESS	no	N = 16, $\overline{x}$ = 2.69, SD = 1.89
			F = 49.7, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 55
Rating:			
questionnaire	SUPER	yes	N = 17, $\overline{x}$ = 5.82, SD = 0.53
	SUPER	no	N = 16, $\overline{x}$ = 3.38, SD = 1.71
			F = 31.8, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 42
Rating:			
interview	SUPER	yes	N = 17, $\overline{x}$ = 5.94, SD = 0.24
	SUPER	no	N = 17, $\overline{x}$ = 2.82, SD = 1.85
			F = 47.7, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 52
Rating:			
questionnaire	WINK	yes	N = 16, $\overline{x}$ = 4.81, SD = 1.72
	WINK	no	N = 9, $\overline{x}$ = 2.89, SD = 1.69
			F = 7.3, p-value = 0.013
			% difference NMF vs. m-NMF: 40
Rating:			
interview	WINK	yes	N = 17, $\overline{x}$ = 5.06, SD = 1.68
	WINK	no	N = 16, $\overline{x}$ = 2.12, SD = 1.02
			F = 36.2, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 58
Rating:			
questionnaire	ARROGANT	yes	N = 17, $\overline{x}$ = 5.94, SD = 0.24
	ARROGANT	no	N = 2, $\overline{x}$ = 3.50, SD = 3.54
			F = 13.5, p-value = 0.002
			% difference NMF vs. m-NMF: 41
Rating:			
interview	ARROGANT	yes	N = 17, $\overline{x}$ = 5.82, SD = 0.39
	ARROGANT	no	N = 16, $\overline{x}$ = 2.62, SD = 1.45
			F = 76.4, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 55

Task	Stimulus	NMF	Statistical results
Rating:			
questionnaire	BLURRY	yes	N = 14, $\overline{x}$ = 5.93, SD = 0.27
	BLURRY	no	N = 8, $\overline{x}$ = 3.38, SD = 2.13
			F = 20.2, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 43
Rating:			
interview	BLURRY	yes	N = 17, $\overline{x}$ = 5.82, SD = 0.53
	BLURRY	no	N = 16, $\overline{x}$ = 2.44, SD = 1.55
			F = 72.5, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 58
Rating:			
questionnaire	CONCENTRATE	yes	N = 14, $\overline{x}$ = 5.64, SD = 0.74
	CONCENTRATE	no	N = 6, $\overline{x}$ = 4.67, SD = 2.16
			F = 2.4, p-value = 0.142
			% difference NMF vs. m-NMF: 17
Rating:			
interview	CONCENTRATE	yes	N = 17, $\overline{x}$ = 5.94, SD = 0.24
	CONCENTRATE	no	N = 16, $\overline{x}$ = 2.91, SD = 1.73
			F = 51.1, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 51
Rating:			
questionnaire	LAZE	yes	N = 14, $\overline{x}$ = 5.86, SD = 0.53
	LAZE	no	N = 0, $\overline{x}$ = NA, SD = NA
			F = NA, p-value = NA
			% difference NMF vs. m-NMF: NA
Rating:			
interview	LAZE	yes	N = 17, $\overline{x}$ = 6.00, SD = 0
	LAZE	no	N = 16, $\overline{x}$ = 1.75, SD = 1.06
			F = 271.5, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 71
Rating:			
questionnaire	SHOCK	yes	N = 16, $\overline{x}$ = 5.62, SD = 0.81
	SHOCK	no	N = 6, $\overline{x}$ = 3.50, SD = 1.64
			F = 17.0, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 38

Task	Stimulus	NMF	Statistical results
Rating:			
interview	SHOCK	yes	N = 16, $\overline{x}$ = 5.94, SD = 0.25
	SHOCK	no	N = 15, $\overline{x}$ = 1.80, SD = 1.21
			F = 180.1, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 70
Rating:			
questionnaire	WITHOUT	yes	N = 17, $\overline{x}$ = 5.82, SD = 0.39
	WITHOUT	no	N = 16, $\overline{x}$ = 4.19, SD = 1.56
			F = 17.6, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 28
Rating:			
interview	WITHOUT	yes	N = 17, $\overline{x}$ = 5.94, SD = 0.24
	WITHOUT	no	N = 17, $\overline{x}$ = 2.35, SD = 1.32
			F = 121.5, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 60
Rating:			
questionnaire	NOD	yes	N = 16, $\overline{x}$ = 5.00, SD = 1.37
	NOD	no	N = 14, $\overline{x}$ = 3.14, SD = 1.66
			F = 11.3, p-value = 0.002
			% difference NMF vs. m-NMF: 37
Rating:			
interview	NOD	yes	N = 17, $\overline{x}$ = 5.35, SD = 1.22
	NOD	no	N = 16, $\overline{x}$ = 2.12, SD = 1.41
			F = 49.6, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 60
Rating:			
questionnaire	NOT-YET	yes	N = 17, $\overline{x}$ = 5.71, SD = 0.47
	NOT-YET	no	N = 7, $\overline{x}$ = 3.00, SD = 2.00
			F = 29.0, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 47
Rating:			
interview	NOT-YET	yes	N = 17, $\overline{x}$ = 5.94, SD = 0.24
	NOT-YET	no	N = 17, $\overline{x}$ = 2.00, SD = 1.00
			F = 249.4, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 66

Task	Stimulus	NMF	Statistical results
Rating:			
questionnaire	PROTECTION	yes	N = 17, $\overline{x}$ = 5.53, SD = 1.07
	PROTECTION	no	N = 16, $\overline{x}$ = 4.00, SD = 1.97
			F = 7.8, p-value = 0.009
			% difference NMF vs. m-NMF: 28
Rating:			
interview	PROTECTION	yes	N = 17, $\overline{x}$ = 5.29, SD = 1.4
	PROTECTION	no	N = 16, $\overline{x}$ = 2.75, SD = 1.39
			F = 27.3, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 48
Rating:			
questionnaire	REVERE	yes	N = 16, $\overline{x}$ = 5.69, SD = 0.48
	REVERE	no	N = 11, $\overline{x}$ = 4.36, SD = 1.75
			F = 8.4, p-value = 0.008
			% difference NMF vs. m-NMF: 23
Rating:			
interview	REVERE	yes	N = 17, $\overline{x}$ = 5.71, SD = 0.77
	REVERE	no	N = 16, $\overline{x}$ = 2.44, SD = 1.59
			F = 57.5, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 57
Rating:			
questionnaire	SEARCH	yes	N = 17, $\overline{x}$ = 5.88, SD = 0.33
	SEARCH	no	N = 3, $\overline{x}$ = 2.67, SD = 1.53
			F = 73.8, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 55
Rating:			
interview	SEARCH	yes	N = 17, $\overline{x}$ = 5.76, SD = 0.56
	SEARCH	no	N = 15, $\overline{x}$ = 2.27, SD = 1.28
			F = 104.5, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 61
Rating:			
questionnaire	SLEEP	yes	N = 17, $\overline{x}$ = 5.18, SD = 0.88
	SLEEP	no	N = 14, $\overline{x}$ = 3.64, SD = 1.86
			F = 9.1, p-value = 0.005
			% difference NMF vs. m-NMF: 30

Task	Stimulus	NMF	Statistical results
Rating:			
interview	SLEEP	yes	N = 17, $\overline{x}$ = 5.35, SD = 1.27
	SLEEP	no	N = 16, $\overline{x}$ = 2.38, SD = 1.63
			F = 34.5, p-value $<$0.001
			% difference NMF vs. m-NMF: 56

4.4.1.3 Age-group comparison

In order to investigate whether lexical nonmanuals are subject to diachronic change and play a different role for younger and older signers, the judgments in the questionnaire and interview were tested with regard to the effect of the participants' age. The following two groups were put in contrast with each other: i) younger signers (between 14 and 31 years; mean age: 23.9), and ii) older signers (between 51 and 61 years; mean age: 54.4). Age group i) is represented by 12 persons and group ii) by 5 persons. To simultaneously incorporate both influencing variables – *age* and *nonmanual manipulation* – a two-way ANOVA was used. This was done by means of setting up a standard regression equation, entailing linear effects for *age* and *nonmanual manipulation* as well as an interaction effect between both (see Field et al. 2012 and Fahrmeir et al. 2013 for further information on regression analysis). The analysis is used to assess the following two hypotheses:

$\mathcal{H}_0$: The ratings of the m-NMF signs by younger signers are the same as the ratings of the m-NMF signs by older signers. The manipulation effect is the same for both age groups.
$\mathcal{H}_1$: The ratings of the m-NMF signs by younger signers are not the same as the ratings of the m-NMF signs by older signers. The manipulation effect is not the same for both age groups.

Until now, to the best of my knowledge, there are no empirical studies concerning the question whether lexical nonmanuals are subject to diachronic change and whether these markings are more essential for the younger or older signer generation. According to this, the baseline hypothesis $\mathcal{H}_0$ implies that the ratings by younger signers and older signers show no significant difference. In contrast, $\mathcal{H}_1$ refers to the alternative hypothesis that participants' age has a significant impact on the ratings of the nonmanually manipulated signs.

The statistical analysis of the impact of age on the ratings is based on all ratings which are controlled for the meaning variable (= meaning category 1) in the questionnaire and the interview (see Table 4.8 and 4.9). The following regression equation was used:

$$rating_i = \beta_0 + \beta_1\ young_i + \beta_2\ nonmanual\ manipulation_i + \beta_3\ young_i \times nonmanual\ manipulation_i + \varepsilon_i$$

$Rating_i$ is the rating given for observation i. The variable $young_i$ is unity if the participant is born after the 31st December 1963 and zero otherwise. The variable $nonmanual\ manipulation_i$ is defined as above. Lastly, $young_i \times nonmanual\ manipulation_i$ denotes the interaction term between the two variables, ε_i denotes the residual.

For the ratings in the questionnaire, Table 4.8 shows the coefficients of the variables and their significance. The average overall ratings are as follows: i) younger signers NMF signs: 5.61, younger signers m-NMF: 3.42, ii) older signers NMF signs: 5.69, older signers m-NMF signs: 5.15. The difference in the ratings by the younger signers for the NMF signs and m-NMF signs amounts to 39% which is significant at all usual levels. For the older signers, the difference between both stimulus groups is only 10% ($p = 0.01$). It is particularly interesting that the ratings by younger and older participants for the m-NMF signs reveal a difference of 34% which is significant at all usual levels.

Tab. 4.8: Statistical analysis of age groups regarding the ratings in the questionnaire

	Estimate	Std. error	t-value	p-value
(Intercept)	5.6897	0.1258	45.21	< 0.001
Young	-0.0727	0.1506	-0.48	0.6294
Nonmanual manip.	-0.5438	0.2110	-2.58	0.0103
Young x nonmanual manip.	-1.6543	0.2513	-6.58	< 0.001

As can be seen from Table 4.9, the nonmanual manipulation effect regarding the ratings in the interview is similar as before: participants responded more positively when faced with no manipulation (see also the corresponding ANOVA in Section 4.4.1.1). This effect is significant at all usual significance levels. The average overall ratings by the two age groups look as follows: i) younger signers NMF signs: 5.74, younger signers m-NMF signs: 2.23, ii) older signers NMF signs: 5.75, older signers m-NMF signs: 2.99. The difference in the ratings by the younger signers for the NMF signs and m-NMF signs amounts to 61% which is significant at all usual levels. For the older signers, the difference between both stimulus groups is smaller and amounts to 48% which is significant at all usual levels as well. The average overall ratings of the NMF signs are almost identical for both age groups. However, the difference between the ratings of the m-NMF signs by the younger and older signers amounts to 26% and is significant at all usual levels (see Table 4.9).

Tab. 4.9: Statistical analysis of age groups regarding the ratings in the interview

	Estimate	Std. Error	t-value	p-value
(Intercept)	5.7500	0.1252	45.94	< 0.001
Young	-0.0105	0.1486	-0.07	0.9439
Nonmanual manip.	-2.7562	0.1808	-15.25	< 0.001
Young x Nonmanual manip.	-0.7574	0.2138	-3.54	< 0.001

In summary, the *lexical judgment task in the questionnaire* and the *lexical judgment task in the interview* reveal a crucial and statistically significant difference between the two age groups with regard to the ratings of the m-NMF signs. Concerning the age effect, it can be observed that the lack of NMFs has a higher effect for younger signers which results in lower ratings. This can be seen as an indicator for a diachronic change with regard to lexical nonmanuals in DGS.[14]

4.4.1.4 Nonmanual sign types

Another step in the analysis concerns the comparison between the condition pairs A/D, B/E, C/F which are based on the three-stage factor *nonmanual sign type* and the two-stage factor *presence of nonmanual features* (see Table 4.1):

- lexical facial expression (condition A and D)
- lexical facial expression and torso/head action (condition B and E)
- lexical torso/head action (condition C and F)

The main point is to test whether torso and head actions are of equal importance on the lexical level as facial expressions. Again, the statistical analysis was conducted exclusively for the ratings regarding the intended meanings of the signs (= meaning category 1) in the questionnaire and interview. The statistical analysis is based on a classical one-way ANOVA. The following two hypotheses were tested:

14 It has to be noted that both age groups are represented by a different amount of signers with deaf parents. Whereas in the group of the older signers only one signer has deaf parents, in the group of the younger signers nine signers have deaf parents.

$\mathcal{H}_0$: The ratings of the m-NMF signs in condition A/B/C are the same as those of the NMF signs in condition D/E/F.
$\mathcal{H}_1$: The ratings of the m-NMF signs in condition A/B/C are not the same as those of the NMF signs in condition D/E/F.

The null hypothesis implies that head/torso actions and facial expressions are no lexical components of signs. The contrary is true for the alternative hypothesis $\mathcal{H}_1$.

When looking at the statistical results for the condition pair C/F in Table 4.10, it becomes clear that actions of the torso/head are essential for lexical markings.

Tab. 4.10: Statistical analysis of nonmanual sign types

Task	Condition	Statistical results
Rating:		
questionnaire	A	N = 96, $\overline{x}$ = 5.62, SD = 0.92
	D	N = 62, $\overline{x}$ = 4.21, SD = 1.72
		F = 45.1, p-value $<$ 0.001
		% difference NMF vs. m-NMF: 25
Rating:		
interview	A	N = 100, $\overline{x}$ = 5.75, SD = 0.82
	D	N = 97, $\overline{x}$ = 2.68, SD = 1.69
		F = 264.7, p-value $<$ 0.001
		% difference NMF vs. m-NMF: 53
Rating:		
questionnaire	B	N = 92, $\overline{x}$ = 5.80, SD = 0.54
	E	N = 38, $\overline{x}$ = 3.95, SD = 1.84
		F = 77.9, p-value $<$ 0.001
		% difference NMF vs. m-NMF: 32
Rating:		
interview	B	N = 101, $\overline{x}$ = 5.91, SD = 0.32
	E	N = 96, $\overline{x}$ = 2.32, SD = 1.43
		F = 605.2, p-value $<$ 0.001
		% difference NMF vs. m-NMF: 61

Task	Condition	Statistical results
Rating:		
questionnaire	C	N = 100, $\overline{x}$ = 5.50, SD = 0.88
	F	N = 65, $\overline{x}$ = 3.63, SD = 1.83
		F = 76.8, p-value $<$ 0.001
		% difference NMF vs. m-NMF: 34
Rating:		
interview	C	N = 102, $\overline{x}$ = 5.57, SD = 1.01
	F	N = 96, $\overline{x}$ = 2.32, SD = 1.38
		F = 359.5, p-value $<$ 0.001
		% difference NMF vs. m-NMF: 58

In the questionnaire, the signs with torso/head actions (= condition C) were rated on average with 5.50 and the signs without these torso/head actions (= condition F) with 3.63. The average rating for condition C in the interview is similar to that in the questionnaire. It amounts to 5.57. In contrast, signs in condition F are rated on average more critically by the participants when the signs in both conditions are shown in direct comparison. The average rating amounts to 2.32 in the interview. The difference between condition C and F lies at 34% in the questionnaire and 58% in the interview. For both elicitation rounds, the results are significant at all usual significance levels. Figure 4.11 illustrates the results. Light red denotes the ratings of nonmanually manipulated signs, blue denotes the ratings of signs without manipulation, and dark red indicates the overlap between both.

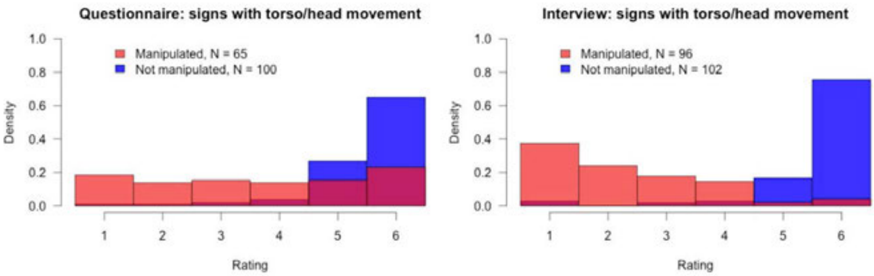

Fig. 4.11: Statistical distribution of the ratings regarding signs with torso/head action

Furthermore, the analysis reveals that the percentage differences between the ratings of NMF signs and m-NMF signs, that means the magnitude of the manipulation effect is very clear and similar for each of the three nonmanual sign types (see Table 4.10). The rating difference between NMF signs and m-NMF signs with regard to the three nonmanual sign types ranges between 25% and 34% in the questionnaire and between 53% and 61% in the interview. The effect of showing the manipulated sign and not manipulated sign of each sign pair successively is similar for each nonmanual sign type.

The results indicate that the three nonmanual sign types – facial expression, facial expression and torso/head action, and torso/head action – play a crucial role on the lexical level. According to the results of this empirical study, the lack of torso/head actions has by no means less impact than the lack of facial expressions.

4.4.1.5 Manual manipulation vs. nonmanual manipulation

In previous research on components of lexical signs, it is a frequent practice to explicitly or implicitly assign more importance to manual components than nonmanual components. It is often assumed that nonmanual markers are not comparable with the manual components of signs (cf. e. g. Becker 2016). In order to obtain first empirical insights into the comparability of manual and nonmanual components on the lexical level, the ratings of all stimulus signs with nonmanual manipulation were compared with the ratings of all filler signs with manual manipulation. The signs with manual manipulation are the filler groups ii) *manually manipulated signs without lexical nonmanuals* and iii) *manually manipulated signs with lexical nonmanuals* (see Table 4.3). For the statistical analysis, a non-parametric bootstrap with 100000 repetitions was used. Due to the fact that different samples that stem from the same individuals were compared, the independence assumption required for classical ANOVA procedures cannot be upheld. Hence, bootstrap was used to draw an inference with regard to differences in the means, which account for the correlation structure (see Efron 1979, Efron & Tibshirani 1993, and Field et al. 2012 for further information on bootstrap). The analysis is based on 165 ratings of the 18 nonmanually manipulated signs that fall into meaning category 1 in the questionnaire and 306 ratings of the 18 manually manipulated signs in the questionnaire. The central question is if manually manipulated signs are differently rated than nonmanually manipulated signs. The following hypotheses are decisive:

$\mathcal{H}_0$: The ratings of nonmanually manipulated signs are the same as the ratings of manually manipulated signs.
$\mathcal{H}_1$: The ratings of nonmanually manipulated signs are not the same as the ratings of manually manipulated signs.

Whereas $\mathcal{H}_0$ assumes that for both manipulation types the ratings are the same, $\mathcal{H}_1$ implies that manually and nonmanually manipulated signs are clearly differently rated on the six-point scale.

The statistical analysis reveals that the rating difference for manually and nonmanually manipulated signs amounts to 28% (see Table 4.11). This difference is significant at all usual significance levels.

Tab. 4.11: Statistical analysis of manually vs. nonmanually manipulated signs

Task	Manipulation	Statistical results
Rating:		
questionnaire	Manual	$N = 306$, $\overline{x} = 2.84$
	Nonmanual	$N = 165$, $\overline{x} = 3.92$
		p-value < 0.001
		% difference manual vs. nonmanual: 28

Figure 4.12 illustrates the statistical distribution of the ratings of both manipulation types. Red denotes the ratings of nonmanually manipulated signs, light green denotes the ratings of manually manipulated signs, and dark green indicates the overlap between both.[15]

It is important to emphasize that for nonmanually as well as manually manipulated signs the ratings spread over the whole six-point scale. Manual as well as nonmanual components obviously have an influence on grammaticality. However, the manual components seem to have a greater impact. It is striking that for the manually manipulated signs more ratings are located at value one and for nonmanually manipulated signs more ratings at value six. But, two issues have to be taken into account: i) The manual components are performed with more conspicuous articulators compared to the nonmanual components and, thus, these manipulations are more visible and can be seen easier. ii) The nonmanually manipulated signs were often perceived as different signs and, thus, in the questionnaire data, some ratings for the intended m-NMF signs are missing. In this respect,

15 In monochrome print, red corresponds to dark grey, light green to light grey, and dark green to medium grey.

it is very interesting that the difference between the average overall ratings of the manually manipulated signs in the questionnaire and the nonmanually manipulated signs in the interview is considerably smaller. When comparing these average ratings the difference amounts to 14% compared to the previous 28%. It is useful to compare the data for the manually manipulated signs in the questionnaire with the data for the nonmanually manipulated signs in the interview because the focus of the judgments in the interview explicitly lies on the more unobtrusive nonmanual features of the intended signs.

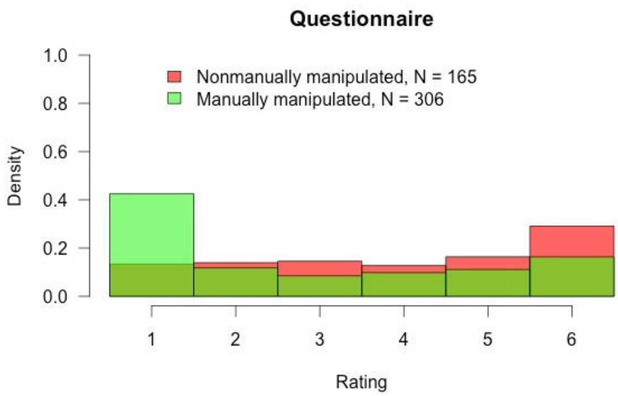

Fig. 4.12: Statistical distribution of the ratings of nonmanually manipulated signs belonging to meaning category 1 and the ratings of manually manipulated signs

4.4.2 Participants' explanatory statements for the judgments (interview)

4.4.2.1 Which role do lexical nonmanuals play?

In order to understand the relevance of lexical nonmanuals, it is revealing to analyze descriptions of the role of these markers by deaf signers. The participants characterized these nonmanuals by using the following terms: *always occur, belonging to it, automatically articulated, sign does not exist without nonmanuals, sign not possible without this marking, with feel, stress*, and *contain much information*. Without the nonmanuals the signers described the signing as *puppet show, calmly signing, exhaustedly signing, bore, funny, strange, robot communication, apathetic, expressionless, frozen*, and *without emotion*. It is interesting that the attribution *without emotion* refers to the m-NMF sign WITHOUT, a sign that does not refer to an emotional state. The missing nonmanual markers consist of lip pucker, lips part, blow, and head shake (AU 18+25+33A+84). Another example that is more related to emotions is the sign FAVORITE. In the NMF condition, it is described as emotional and, in the m-NMF condition, as too neutral.

It has been stated by the participants that certain signs with lacking lexical nonmanuals are not comprehensible (e. g. NOD), have no meaning (e. g. WITHOUT), may be misunderstood (e. g. WITHOUT), can have various meanings (e. g. ALWAYS) or have another meaning (e. g. ARROGANT). Thus, nonmanuals are considered essential for the understanding of signs (see Section 4.4.3).

Furthermore, the descriptions by the participants make clear that individual components used as conventionalized lexical parts of signs can at the same time carry meaning. When seeing the sign WITHOUT in the m-NMF condition, one participant stated that the facial expression and the negation in the form of head shake is missing. Likewise, regarding the sign NOT-YET in the m-NMF condition, participants said that the negation is missing, the head movement must be articulated, and that with respect to negation, head shake always occurs. Thus, even as a lexical component within signs, head shake is clearly associated with negation.

Moreover, it has been noted that similarly to monotonous speaking in spoken language, there are signers who use little facial expressions, but for signers facial expressions are more integral parts. In the interview, the participants precisely named individual missing nonmanual components. For example, concerning the sign REVERE in the m-NMF condition, it has been mentioned that the posture is wrong and that the sign includes a forward movement. For the sign ARROGANT, it has been emphasized that the sign needs a fitting facial expression. For the sign LAZE, it has been explained that the nonmanuals are based on the image how laze looks. Similarly, for the sign WINK, it has been mentioned that the articulation of a wink is needed because it copies the reality. During the discussion of the m-NMF sign WINK, it has been said that signing without the lexical facial expression is typical of hearing people who start to learn sign language. Deaf people do not use the sign in the presented form, but hearing people would use it like this.

4.4.2.2 Nonmanual sign variants

As many dialectal variation regarding manual signs exist in DGS, it can be assumed that dialectal differences regarding nonmanual markings of signs are present as well. To get further insights into this, I analyzed the explanatory statements by the participants concerning different nonmanual sign variants. In particular, the following five signs are interesting in this respect: SLEEP, NOD, REVERE, LAZE, and PROTECTION.

Regarding the sign SLEEP, on the one hand, there is variation between the articulation with one or two hands (see Figure 4.13[16]). On the other hand, there is variation regarding neutral eyes and closed eyes (AU 43E). Whereas the sign SLEEP is signed without AU 43E in the stimulus video and by some of the participants, other participants sign it with AU 43E. It would be interesting to pursue whether the eye closure is a pure dialectal variation or a marker of intensification.[17]

Fig. 4.13: One-handed and two-handed sign SLEEP

Another gripping example is the sign NOD. In the stimulus video, it is signed with one hand movement and one head nod (AU 85). However, many participants described that they know the sign with a reduplicated hand and head movement. Furthermore, it has to be noted that the participants often translated this stimulus with the following terms: *unanimous, agree, affirm,* and *yes* (see Section 4.4.3).

Concerning the sign REVERE, there seem to be at least two different nonmanual sign variants. In the stimulus video, the sign is articulated with head down (AU 54) and mouthing (AU 50) but without a facial expression. In contrast, some participants articulate the sign with head down and tongue show (AU 19, see Figure 4.14). It would be attractive to study further whether the tongue show instead of the mouthing is a dialectal variation, an intensification, another sign with the meaning *desire* or due to other factors.

16 The prominent mouth movement on the left picture is due to mouthing.

17 In future studies, it may be promising to study dialectal variation regarding lexical nonmanuals by using the Hamburg DGS Corpus: http://www.sign-lang.uni-hamburg.de/dgs-korpus/index.php/dgs-korpus.html.

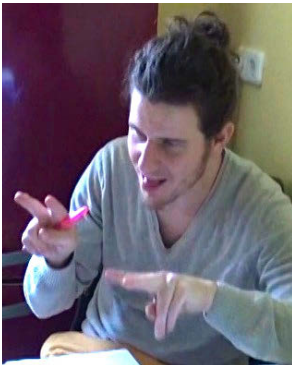

Fig. 4.14: The sign REVERE with head down and tongue show

One participant explained that the sign LAZE exists with two different lexical nonmanual markings. Figure 4.15 shows the lexical marking as it is articulated in the stimulus video as well (left) and a different nonmanual sign variant (right).

Furthermore, it is interesting to study more closely the sign PROTECTION. In the stimulus video, the sign is articulated with a backward torso action (AU 108). However, the participants had different intuitions regarding the torso action. It is described that the sign with a forward action is used for the meaning *protect oneself* and with a backward action for the meaning *protect another person* (see Figure 4.16). Other participants said that they know the sign with a backward action but not with a forward action. For other participants, the backward torso action is a bit exaggerated in the stimulus video. Another person described that the sign PROTECTION with a backward action of the torso is personally related, whereas without this action the sign is more general, neutral, and objective. More investigations are necessary to get deeper insights whether the articulation with a forward torso action, a backward torso action or without a torso action depends on semantic and pragmatic factors, is due to dialectal variation or is based on a combination of both. For this purpose, it would be revealing to design a task by which the participants have to sign PROTECTION in sentences that refer to different semantic contexts.

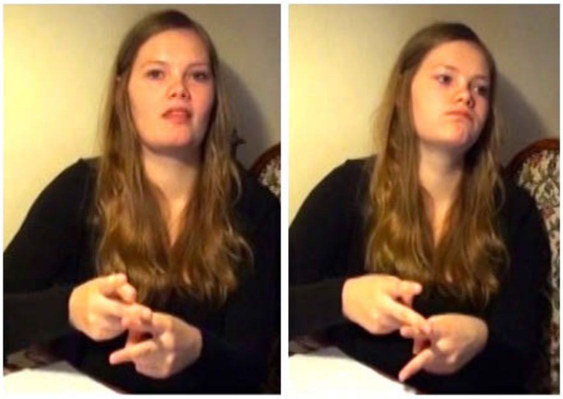

Fig. 4.15: The sign LAZE with two different lexical nonmanual markings

Fig. 4.16: The sign PROTECTION with forward and backward torso action

4.4.2.3 Unilateral lexical nonmanuals

In the following, I pursue the observation that the side of unilateral facial expressions and actions of the head seem to depend on the dominant hand (cf. Pendzich 2013). One example for a unilateral head action is the sign SLEEP with a tilt to the side of the articulating hand. For a unilateral facial expression on the lower face, the sign SUPER is an example. The sign WINK is an example for a unilateral facial expression on the upper face.

As already mentioned in Section 4.2.1.1, in the NMF stimulus WINK, the AU 46 is articulated with the left eyelid, whereas the manual sign is articulated with the right hand. What are the reactions by the participants of the articulation with the non-dominant face half? Many participants stated that the wink occurs on the wrong face half. It is described as strange because the sign WINK is usually articulated with the right hand and right eye or with the left hand and left eye. However, some participants said that the sign needs a wink, but the side of the wink is irrelevant because the facial expression can be fully understood. Overall, it can be stated that the sign WINK with the wink on the dominant face half is best evaluated, followed by the sign with a wink on the non-dominant face half. For the latter, the participants' opinions differ. The sign without a wink is evaluated worse than the sign with a wink on the non-dominant face half. The sign variant with a wink on the non-dominant face half seems to be not completely well-formed. This is confirmed by the statistical analysis of single signs in Section 4.4.1.2. The sign WINK in the NMF condition is the worst judged sign in the questionnaire and the interview. In the interview, the stimulus sign with a wink on the non-dominant face half is judged 11 times with six, two times with five, two times with four, and two times with one. It has to be noted that some participants said that the sign with wink on the non-dominant face half is strange but, nevertheless, they judged the sign with six. The stimulus sign without a wink is never judged with six or five, but, two times with four, six times with three, three times with two, and six times with one.[18]

Besides these deliberate reflections by the participants, it is crucial to consider their signing of WINK. At this, two clear tendencies can be observed: i) the matching between the side of the hand and the face, ii) the use of a bilateral wink (see Figure 4.17). It has to be noted that, in general, the articulation of a wink with only one eyelid is difficult to articulate for some persons. Apart from that, it seems to occur frequently that a unilateral facial expression can optionally be articulated with both face halves. Besides WINK, another example for this observation is the sign SUPER. Figure 4.18 illustrates the articulation of blow as a bilateral action.

18 Two participants stated that they know the sign WINK with an additional short head movement in parallel with the eyelid movement.

Fig. 4.17: The sign WINK with unilateral and bilateral facial expression

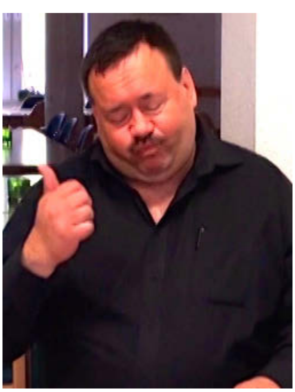

Fig. 4.18: The sign SUPER with a bilateral blow

Figure 4.19 shows the signs SUPER and ALWAYS articulated by a left dominant signer. Again, the matching between the dominant hand and dominant face half is obvious.

Fig. 4.19: Matching between the dominant hand and dominant face half by a left dominant signer within the signs SUPER (left) and ALWAYS (right)

4.4.2.4 Lexical nonmanuals and the interplay with morphological markings and pragmatic factors

For some NMF signs, the participants described the meaning as intensified. For example, the meaning of the NMF sign CONCENTRATE is termed in isolated cases as *strongly concentrate*. Likewise, regarding the sign STRESS in the NMF condition, two participants referred to an increase in the meaning. However, many participants described the missing facial expression of the sign STRESS in the m-NMF condition as an error. Regarding the sign SHOCK, one participant explained the difference between the NMF and m-NMF sign with intensification as well. Two participants said that the NMF sign SHOCK is narrative and the same sign without facial expression and with mouthing is objectively used.

Regarding the sign REVERE one participant rated the NMF sign with six and the m-NMF sign with four and explained this with a difference in the expressivity and the intensity of honor. The data of another participant point in the same direction. He rated the NMF sign a six and the m-NMF sign a four as well and described the m-NMF sign as a generalization of the meaning. Another participant set out that the NMF sign is more narrative and that the nonmanuals are situation-dependent. Similarly, two participants described the m-NMF sign BROKEN as more neutral or rather as a generalization of the meaning. One of these participants explained, furthermore, that the use of the NMFs depends on the content. In contrast, other participants said that the sign BROKEN is not possible without facial expression or described the missing facial expression as an error.

Regarding the sign ARROGANT, especially the comments by five participants are instructive. One participant said that the facial expression depends on the situation. If the situation is extreme, the facial expression of the sign can be used.

For the same sign in the m-NMF condition, the participant judged the sign with three and justified this with context dependency and the issue of the missing facial expression. Another participant stated that ARROGANT can be articulated with mouthing instead of the facial expression, but the head action must occur (see Figure 4.20). Another test person said that ARROGANT can be used objectively, but usually deaf signers use it with negative facial expression. A different participant explained that the sign with the facial expression is a bit more like a swearword. Another test person stated that the m-NMF sign ARROGANT can occur when somebody signs fast.

Fig. 4.20: The sign ARROGANT with mouthing and head up

Another interesting sign with respect to morphological increase and decrease is the sign BLURRY. One participant rated the NMF sign with six and the m-NMF sign with three and explained that the NMF sign means *very blurry* and the m-NMF sign *slightly blurry*.

Furthermore, as mentioned in Section 4.4.2.2, the articulation of the sign SLEEP with closed eyes (AU 43E) and the articulation of the sign REVERE with tongue show (AU 19) could be dialectal variants or signs with additional components as markers for morphological intensification. It would be revealing to elicit more data regarding this question.

In addition to the so far mentioned aspects such as increase, decrease, communication context, and language register, the participants mentioned some more interesting factors regarding the presented nonmanuals. With respect to the sign SUPER, one participant justified her rating of the m-NMF sign with the lowest value one by the missing facial expression to a positive sign. Three participants explained that the m-NMF sign SUPER can be used ironically. Regarding the sign STRESS, one participant said that the m-NMF sign is like a question whether someone is stressed. As discussed in Section 4.4.2.3, the stimulus sign WINK is articulated with a wink on the non-dominant face half. One participant stated that this sign can be misunderstood. It could be interpreted as provocation, annoying or unsettling.

The overview illustrates, on the one hand, the fluid boundary between lexical nonmanuals and the use of nonmanuals for morphological modifications and, on the other hand, the interplay with pragmatic factors (see also Chapter 7).

4.4.3 Translation task (interview)

The translation task shows that signs without nonmanuals and mouthings lead signers to activate different meanings. Often, the participants described that specific m-NMF signs can have various meanings. It is worthwhile to analyze in detail how the relationship between the NMF and m-NMF sign of each sign pair can be described.

Table 4.12 summarizes the meanings attributed to the NMF and m-NMF signs by the participants. The column *meanings* contains the meanings for the NMF and m-NMF signs spontaneously assigned (written down and/or signed) by the participants in the translation task as well as the meanings that the participants specified in the discussions. The frequency of the associated meanings is indicated in brackets. For several meanings attributed to the m-NMF signs, participants said that the respective sign actually needs other nonmanuals and/or mouthing. When a sign has no meaning for the participant, this is indicated by a horizontal line (—). The column *main classification* serves for the main categorization of the relationship between the NMF and m-NMF sign of each sign pair. The following four categories are used:

a) The NMF sign and m-NMF sign are attributed to the same meaning.
b) The m-NMF sign does not have a meaning.
c) The m-NMF sign is ambiguous and leads signers to name different meanings.
d) The m-NMF sign has a different meaning than the NMF sign. Thus, in DGS, nonmanual minimal pairs seem to exist. When systematically looking at these signs with different meanings, it becomes apparent that the m-NMF signs need additional or other nonmanual markers and/or mouthing to get the different meaning(s).

When reading Table 4.12, it sticks out that the intended meanings often occur not only with the NMF signs but also with m-NMF signs. It has to be underlined that these occurrences may be favored in several cases by the fact that due to the Study *Lexical Decision with Reaction Times* which was carried out before (see Chapter 5) the participants know which signs are meant.

Tab. 4.12: Meanings assigned to the stimuli

Sign	NMF	Meanings	Main classification
ALWAYS	yes	immer [11], regelmäßig [5], wie immer [2], zuverlässig [1], oft [1], stetig [1]	
ALWAYS	no	führen/Führung [10], immer [7], leiten/Leitung/Leiter [6], durchführen [4], regelmäßig [3], begleiten [2], immer dabei [1], zuverlässig [1], oft [1], stetig [1], Einleitung [1], Ausführung [1], ausführlich [1], fortwährend [1], ableiten [1], Induktion/Deduktion [1], so mache ich [1]	c), d)
BROKEN	yes	kaputt [13], defekt [3], Faden verloren [2], Nervenzusammenbruch [2], Panne [1]	
BROKEN	no	kaputt [14], defekt [4], Faden verloren [4], Panne [2], Internet kaputt [1], Ablenkung [1], baff [1], elektronisch ausschalten (anschalten) [1]	a), c)
FAVORITE	yes	Liebling(s-) [15], mögen [7], total mögen/sehr mögen [2], lieben [1], gern [1], Steckenpferd [1], Favorit [1]	
FAVORITE	no	Liebling(s-) [14], mögen [10], gern [1]	a)
STRESS	yes	Stress [17]	
STRESS	no	Stress/stressig [11], genervt/nerven [7], Neurologie [5], Nerv [1], Neuron [1], Narbe [1], sorgen [1]	a), c), d)
SUPER	yes	super [16], perfekt [5], toll [4], erstklassig [1], tolle Leistung [1], klasse [1], kann gut [1]	
SUPER	no	super [12], toll [3], ironisch super [2], perfekt [2], – [1], erstklassig [1], klasse [1], genial [1], ironisch toll [1], Trainer (einhändig) [1], modifiziert von Runden laufen [1]	a), c)

Sign	NMF	Meanings	Main classification
WINK	yes	zwinkern [16], – [1], blinken [1]	
WINK	no	zwinkern [11], Osnabrück [8], – [1], im Moment [1], Festival Clin d' Oeil [1]	a), d)
ARROGANT	yes	arrogant/Arroganz [16], hochnäsig [2]	
ARROGANT	no	stolz [15], arrogant [5], eitel/zu eitel [4], eingebildet [3], hochnäsig [2], fein [1], nobel [1]	d)
BLURRY	yes	verschwommen/nicht klar/unklar/schlecht sehen [16], schwindelig/Schwindel [2], verstehe nur Bahnhof/erstmal schwer verstehen [2], Steigerung von Nebel [1], Licht blendet [1], unsicher [1]	
BLURRY	no	Nebel [14], verschwommen/nicht klar/Unklarheit [12], – [1], schwindelig [1], Verschleierung [1]	a), d)
CONCENTRATE	yes	konzentrieren/konzentriert/Konzentration [18], (auf jemanden) fokussieren[2], treu [1], Vertiefung [1]	
CONCENTRATE	no	konzentrieren/konzentriert/Konzentration [15], vertrauen [11], stur [3], treu [2], glauben [2], Fokus/fokussieren[2], konservativ [1]	a), d)
LAZE	yes	faulenzen/faul/rumhängen/strikt passiv [17], ausruhen/entspannen/relaxen/chillen [4], bequem [1], baden [1], Pause [1], passiv [1]	
LAZE	no	Rente/Rentner [10], passiv [9], faulenzen/faul [8], ausruhen/relaxen/chillen [5], Pause [4], Ruhe [3], Recht [2], Rest [2], baden [1]	c), d)
SHOCK	yes	Schock/schockieren [15], erschrocken/erschrecken [8], Erkältung [1]	
SHOCK	no	Erkältung/Grippe [9], Schock [5], –[3], erschrecken [2], angesteckt [1], einschüchtern [1]	b), d)
WITHOUT	yes	ohne/kein/gar nichts/nicht haben/nicht gemacht [17], noch nicht [6]	
WITHOUT	no	ohne/kein/nicht haben [16], noch nicht [3], Homo [1]	a)
NOD	yes	nicken/ja nicken/Kopfnicken [13], ja/Bejahung/bejahen/einstimmig/zustimmen/Einverständnis/bereit sein [11], möglich [1]	
NOD	no	nicken/Kopfnicken [10], ja/bejahen/zustimmen [8], richtig/kann sein/kann [2], – [1], kaltherzig ignorieren [1], schneller besiegen [1]	a)

Sign	NMF	Meanings	Main classification
NOT-YET	yes	noch nicht [17]	
NOT-YET	no	auweia/aua/tut weh/oh weh [14], noch nicht [8], wow [6], Reeperbahn/Reeper [3], – [2], uh [1], ooh [1], puh [1], boah [1], krass [1], schlimm [1], unglaublich [1], knapp [1], ist gewesen [1], Fünfzehn [1]	d)
PROTECTION	yes	Schutz/schützen [17]	
PROTECTION	no	Schutz/schützen/beschützen [17]	a)
REVERE	yes	(ver)ehren/Ehrung/Ehre/-ehr- [16], geehrte [1], vertrauen [1], begehren [1]	
REVERE	no	(ver)ehren/Ehrung [15], Recht [2], Fan [2], geehrte [1], von oben genauer und überprüft bis unten beobachten [1], gehorchen [1], glauben [1]	a), c)
SEARCH	yes	suchen [16], versuchen [4]	
SEARCH	no	oral/Oralismus [16], suchen [5]	d)
SLEEP	yes	schlafen [17]	
SLEEP	no	schlafen [15], oh/uh/oh mein Gott!/Mein Gott! [11], aua [4], – [2], müde [1], Übernachtung [1]	a), d)

Regarding the meaning *passive* mentioned for the NMF sign LAZE, it has to be noted that the participant said that this sign means *passive* in a negative version. The nonmanuals are interpreted as an increase of content by nonmanuals.

Furthermore, the translation task reveals that the sign NOD is a difficult stimulus item. The sign NOD in the NMF condition got many different translations such as *yes, nod, possible, affirm, unanimous, agree, consent*, and *be ready*. The main reason for this seems to be a dialectal variation between one hand and head movement versus a reduplicated hand and head movement (see Section 4.4.2.2). In the stimulus video, the sign model uses one hand and head movement.

As already mentioned in Section 4.4.2.2, the participants had different intuitions regarding the upper body action of the sign PROTECTION. Possible subtle differences in the meaning based on different upper body actions are not listed in Table 4.12.

Evaluating the meanings for the NMF and m-NMF sign BROKEN, it stands out that in contrast to the m-NMF sign the NMF sign got the meaning *nervous breakdown* twice. It would be interesting to pursue whether only the NMF sign can have this meaning and whether the signs BROKEN and NERVOUS-BREAKDOWN are homonyms.

In order to get further insights regarding the relationship between the NMF sign and m-NMF sign of each sign pair, it would be revealing to carry out a follow-up study based on a list with all the meanings for the NMF and m-NMF signs attributed by the participants and summarized in Table 4.12. Several other deaf signers could be asked whether they know the same meanings for the signs. In this way, it would be possible to further analyze nonmanual minimal pairs, homonyms, ambiguous signs, the relevance of mouthings, and the impact of dialectal variation more quantitatively.

In the following, I present the results with respect to potential candidates for nonmanual minimal pairs in DGS. It should be emphasized that the analysis reveals another interesting phenomenon as well: When signers see signs without lexical nonmanuals they often activate other signs with nonmanual or manual differences instead of the intended signs. One example is the activation of the sign RIGHT instead of the sign REVERE. These signs differ nonmanually as REVERE has a lexical head action. Looking at the manual components, both signs have the same handshape, the same movement, the same place of articulation but differ in the hand orientation and the velocity of the movement. As the head action is an inherent part of the sign REVERE, when seeing this sign in the m-NMF condition, two participants activated the manually different sign RIGHT. Another example are the signs NOT-YET and FIFTEEN. These signs nonmanually differ as the latter sign has no nonmanual marking. Manually both signs are articulated with the same handshape, the same place of articulation but differ in the hand orientation and the movement.

Table 4.13 provides an overview of seven possible types of nonmanual minimal pairs. Another productive minimal pair type, in case one assumes that mouthings are considered elements of signs, are signs which differ only in mouthing (e. g. COLOUR – MARMELADE). However, as the focus of the present study is the relevance of lexical nonmanuals and their interplay with mouthings, this type is not listed in Table 4.13. The different types of nonmanual minimal pairs are illustrated with potentially fitting candidates of nonmanual minimal pairs in DGS. These pairs are based on the assessment by the participants, a follow-up discussion with a professional deaf informant, and the use of two DGS dictionaries.[19] In further follow-up studies, these probable nonmanual minimal pairs have to be verified. Furthermore, it is important to take into account that it can be assumed that dialectal variation play a role for nonmanual minimal pairs.

19 Kestner, Karin and Tiemo Hollmann. 2009-2010. *Das große Wörterbuch der Deutschen Gebärdensprache*. Verlag Kestner; Internet dictionary *Spread the Sign*, https://www.spreadthesign.com.

Also, the classifications of the potential nonmanual minimal pairs with respect to the seven types are not meant to be final but preliminary and as a first approach to get deeper empirically based insights into nonmanual minimal pairs in sign languages.

Tab. 4.13: Seven possible types of nonmanual minimal pairs (nMP) including combinations with mouthings

Type of nMP	Sign A	Sign B	Potential candidates in DGS
i)	NMF: + Mouthing: –	NMF: – Mouthing: –	–
ii)	NMF: + Mouthing: –	NMF: – Mouthing: +	ALWAYS – CARRY-OUT ALWAYS – DERIVE ALWAYS – INTRODUCTION ALWAYS – LEAD CONCENTRATE – TRUST LAZE – LEFTOVER LAZE – PASSIVE LAZE – PENSION WINK – FESTIVAL CLIN D'OEIL SHOCK – INFLUENZA WINK – OSNABRÜCK
iii)	NMF: + Mouthing: –	other NMF: + Mouthing: –	CONCENTRATE – CONSERVATIVE
iv)	NMF: + Mouthing: –	other NMF: + Mouthing: +	ANNOYED/PEEVE – STRESS ARROGANT – PROUD ARROGANT – VAIN BLURRY – FOG DESIRE – REVERE OH/POOH/BOAH – NOT-YET SLEEP – OH/OH-MY-GOD/MY-GOD WOW – NOT-YET
v)	NMF: + Mouthing: +	NMF: – Mouthing: –	–
vi)	NMF: + Mouthing: +	NMF: – Mouthing: +	NOT-YET – REEPERBAHN SEARCH – ORAL STRESS – NERVE STRESS – NEUROLOGY

Type of nMP	Sign A	Sign B	Potential candidates in DGS
vii)	NMF: + Mouthing: +	other NMF: + Mouthing: +	NOT-YET – OW

For some of the listed potential nonmanual minimal pairs, further remarks are necessary: Regarding the sign pair SHOCK – INFLUENZA, it has to be mentioned that the classification ii) is based on the verification by nine participants. However, my deaf informant from the follow-up discussion knows another sign for *influenza*. Likewise, in both dictionaries used, this sign is not listed for the meaning *influenza*.

Concerning the pairs ALWAYS – INTRODUCTION and ALWAYS – DERIVE, it has to be noted that the signs INTRODUCTION and DERIVE often seem to be articulated with an arched movement instead of a straight movement as in the sign ALWAYS. However, especially when signing fast, it may be that the arched movement turns into a straight movement. Furthermore, it is possible that in some dialects, the signs may usually be articulated with a straight movement.

With respect to the sign pair CONCENTRATE – TRUST, it can be added that the sign TRUST seems to be used in two manually slightly different forms. On the one hand, it can be articulated with the fingertips oriented to the front of the signer, like the sign CONCENTRATE, and, on the other hand, with the fingertips oriented upwards. The sign CONCENTRATE without nonmanuals and without mouthing seems to be ambiguous: Nine participants translated the m-NMF sign with both options *concentrate* and *trust*.

Regarding the sign pairs LAZE – PASSIVE, LAZE – PENSION, and LAZE – LEFTOVER, it has to be noted that the signs PASSIVE, PENSION, and LEFTOVER can occur with two different handshapes: either the v-handshape as in the sign LAZE or the u-handshape.

The city name OSNABRÜCK as a counterpart to the sign WINK seems to exist in four different manual forms: a) the same manual sign like WINK, b) a variant with triplication of the secondary movement, c) a variant with an additional movement in the form of a pulling back of the hand, and d) a variant with triplication of the secondary movement and the additional movement in the form of a pulling back of the hand. It is possible that with deeper insights, these four variants of the sign name OSNABRÜCK prove to be dialectal variation, which is a quite frequent phenomenon in signs for locations, city names etc. Regarding sign variant c), possibly, the sign is articulated in citation form with this minimal manual difference compared to WINK and can be used colloquially without the additional movement. Concerning sign variants b), c), and d), the sign WINK without lexical nonmanual marking leads to the activation of a sign with a manual difference. The triplication of the movement within the sign OSNABRÜCK in variant b) and d) may be due to the syllable structure of the corresponding German word which has three syllables and is used as mouthing (cf. Pfau & Steinbach 2006b, 158; Pendzich 2016a, 237f.; see Section 3.2).

Regarding the potential nonmanual minimal pairs with the sign STRESS, it has to be mentioned that the sign exists with two slightly different handshapes: either a bent indexfinger or a straight indexfinger. In the stimulus video, the sign model articulates the sign with a bent indexfinger.

The sign pair BLURRY – FOG is listed under nonmanual minimal pair type iv): sign with NMF and without mouthing vs. sign with other NMF and mouthing. The sign BLURRY is performed with brow action, reduced eye aperture, tongue show, and head/torso movement back. For the sign FOG, some participants stated that the sign is articulated with small opened eyes (see Figure 4.21). However, according to the descriptions by other participants the sign FOG is signed without lexical nonmanual marking (see Figure 4.22). This could either be a dialectal variation or the addition of small opened eyes is a morphological increase. The difference between pure lexical nonmanual marking and a morphological nonmanual increase is a very fluent transition in sign languages (see Chapter 7). Moreover, it seems that the sign FOG can be used in two manually slightly different forms: either both hands cross during the articulation, like in the sign BLURRY (see Figure 4.21 and 4.22), or both hands articulate the movement more eccentrically and side by side.

Fig. 4.21: Nonmanual minimal pair BLURRY (left) – FOG (right). The sign FOG is articulated with small opened eyes

Fig. 4.22: Nonmanual minimal pair BLURRY (left) – FOG (right). The sign FOG is articulated without lexical nonmanuals

The sign pair SLEEP – OH/OH-MY-GOD/MY-GOD is listed under type iv): sign with NMF and without mouthing vs. sign with other NMF and mouthing. However, it seems that OH/OH-MY-GOD/MY-GOD may be articulated with a facial expression and/or mouthing.

Regarding the sign pair SEARCH – ORAL, apart from nonmanual differences, the participants often described that the sign ORAL is articulated in front of the mouth, whereas the sign SEARCH is signed further up in front of the face. However, in the stimulus video, the perception that the hand movement in SEARCH is articulated higher is just due to the head down movement.

4.4.4 Mouthing classification task (interview)

In order to get an impression of the relevance of mouthing, I carried out the *mouthing classification task* for the 18 NMF signs. As already mentioned in Section 4.2.1.3, for each NMF sign, the participants had to decide between the following answer options: a) *mouthing has to be there*, b) *mouthing is never used*, c) *mouthing is sometimes used*, and d) *mouthing can be used if…* The participants selected answer category d) only in two cases. Instead, they selected category c) and named precise conditions for the use of mouthing. Thus, it is appropriate to merge category c) and d). Furthermore, the two selections of category d) are cases in which the participants selected answer category c) as well. In total, it happened three times that participants selected not only one but two answer categories. This concerns the sign STRESS with the answer categories a) and c), LAZE with the answer categories c) and d), and REVERE with the answer categories c) and d). In case of the sign STRESS both answer categories were incorporated in the analysis, whereas, for the signs LAZE and REVERE, only category c) is relevant. Concerning the sign WITHOUT, the classification by one participant is not included in the results as he selected answer category a) which is conflicting with his explanations on the relevance of the lexical facial expression.

Table 4.14 summarizes the results of the mouthing classification task. Category a) *obligatory use of mouthing* has 72 selections, category b) *mouthing is never used* has 104 selections, and category c) *variability of mouthing* has 123 selections. With respect to the 123 cases in which the participants attributed a mouthing variability, which means that a mouthing is only sometimes used, it is interesting to examine the individual reasons for this variability in more detail. For some signs, it may have to do with dialectal variation. Possibly, some signs contain specific conditions for the use of a mouthing. Another influencing factor can be the use of mouthing due to the presence of hearing people in natural communication situations. The signs that were overridingly classified for mouthing variability are BROKEN, SUPER, ARROGANT, CONCENTRATE, SHOCK, SLEEP, and REVERE.

Tab. 4.14: Results of the mouthing classification task

Sign	a) Obligatory use of mouthing	b) Mouthing is never used	c) Mouthing variability
ALWAYS	0	10	5
BROKEN	0	6	10
FAVORITE	0	16	1
STRESS	13	0	5
SUPER	1	2	13
WINK	0	10	6
ARROGANT	0	7	10
BLURRY	0	13	4
CONCENTRATE	5	0	12
LAZE	0	13	4
SHOCK	1	2	13
WITHOUT	0	11	5
NOD	1	13	3
NOT-YET	13	0	3
PROTECTION	14	0	3
REVERE	8	0	9
SLEEP	5	1	11
SEARCH	11	0	6

The results show that the classifications of the status of mouthing for the NMF signs are very consistent. Only for five signs, the classification varies between two categories with a percentage difference of less than 50%: BROKEN, WINK, ARROGANT, REVERE, and SEARCH. However, for all signs which have several selections within two categories one of these categories is c). The sign with the lowest percentage difference between two categories is the sign REVERE with a difference of 11% between category a) and c). As mentioned in Section 4.4.2.2, in the stimulus video, the sign is articulated with mouthing, but some participants said that they know the sign with tongue show (AU 19). The fact that the task revealed no occurrence of clear uncertainty between category a) and b) shows that signers have clear intuitions regarding the status of mouthing. Furthermore, the results demonstrate the relevance of mouthing as part of certain signs.

Regarding the five signs STRESS, NOT-YET, PROTECTION, REVERE, and SEARCH, which were presented with mouthing in the stimulus videos, the majority of the participants had the same intuition of the obligatory use of mouthing like the sign model of the stimulus videos. One exception was the sign REVERE.

It is interesting to consider the status of mouthings for signs that have lexical nonmanuals only on the lower face. This applies to the signs ALWAYS, BROKEN, and FAVORITE. For these signs, the presence of a mouthing results in an omission of the facial expression. Regarding the sign FAVORITE, the obligatory status of the facial expression in the lower face is very clear. 16 participants selected the answer category b) for mouthing is never used and only one participant assumed a variability. Also, the sign ALWAYS, by the majority, is articulated with the facial expression in the lower face. Only five signers assigned a mouthing variability, which could be due to dialectal variation. In contrast, regarding the sign BROKEN, most participants ascribed variability between the use of the mouthing and the facial expression. The sign BROKEN might contain specific conditions for the use of the mouthing or facial expression. Moreover, in this context, it is worth mentioning that one participant described that the sign BROKEN1 that is articulated with the indexfinger (as in the stimulus video) is always used with the facial expression in the lower face and the sign BROKEN2 that is articulated with the fist is signed with the mouthing.

The lexical nonmanuals of the signs STRESS, WINK, CONCENTRATE, SHOCK, NOD, NOT-YET, PROTECTION, SEARCH, and SLEEP can be independently combined with mouthing, without a change of the nonmanual markers. Nevertheless, by no means, is mouthing equally important for all of these signs. The signs WINK and NOD show a clear tendency for no use of mouthings. The results for the signs CONCENTRATE, SHOCK, and SLEEP indicate quite a variability in the use of mouthings. In contrast, the signs STRESS, NOT-YET, PROTECTION, and SEARCH point to the obligatory status of mouthings. However, concerning the sign SEARCH, one participant described mouthing variability in terms of a difference between objectivity and narration. He stated that the mouthing is not necessary within narration, then, the sign is articulated with more body movement and mouth gesture. Within objective contexts, the mouthing is said to be required.

Regarding the signs SUPER, ARROGANT, LAZE, WITHOUT, and BLURRY, the use of a mouthing results in a change of certain parts of the lexical nonmanuals, namely the facial expression in the lower face. The signs LAZE, WITHOUT, and BLURRY show a strong tendency for no use of mouthing. The classification for the sign ARROGANT varies between no use of mouthing and variability. One participant explained that the sign with the facial expression is used more as a swearword. If the sign ARROGANT is not used as a swearword, it is better signed with the mouthing. It seems that if the sign is used with the mouthing it is, nevertheless, nonmanually articulated with the head up action and the facial expression in the upper face. The sign SUPER unambiguously reveals a variability between the use of the mouthing or the facial expression in the lower face. Moreover, one participant explained that it is more polite with the mouthing.

4.5 Summary and discussion

The empirical perception study tests the significance of lexical nonmanuals by means of showing signs to deaf participants in the NMF and m-NMF condition. The impact of the nonmanual manipulation is analyzed with respect to acceptability judgments and the meaning of signs. When analyzing lexical nonmanuals, it is important to differentiate between i) inherent nonmanual parts of signs and ii) optional nonmanual markings in the form of individually different facial actions and torso/head actions which are not articulated by every signer with the respective signs.

Regarding the *lexical judgment task in the questionnaire* and the *lexical judgment task in the interview*, the statistical analyses of the overall ratings of the 18 NMF signs and the 18 m-NMF signs as well as the analyses of the single signs and the nonmanual sign types reveal that signers have clear intuitions whether nonmanuals are inherent parts of certain signs. The participants rated signs with and without nonmanual manipulation accordingly on a six-point scale. As m-NMF signs were frequently perceived as other signs than the intended signs, it is important to include the variable of meaning in the statistical analyses. In this way it is possible to get the statistical results based on the judgments for the intended signs.

The first statistical analysis *NMF signs vs. m-NMF signs* (see Section 4.4.1.1) reveals that, in the questionnaire, the 18 NMF signs were rated on average with 5.64 and the 18 m-NMF signs with 3.92. Hence, the nonmanual manipulation leads to ratings that are on average 30% worse than the ratings of signs with lexical nonmanuals. The difference between both average overall ratings of the two stimulus groups is significant at all usual levels: $p < 0.001$. In the interview, the 18 NMF signs were rated on average with 5.74 and the 18 m-NMF signs with 2.44. Again, the difference between the ratings of the two stimulus groups is significant ($p < 0.001$). In this second data elicitation, the m-NMF signs were rated 57% worse than the NMF signs. When comparing the average overall ratings in the *lexical judgment task in the questionnaire* and the *lexical judgment task in the interview*, it is apparent that the m-NMF signs were rated more critically when the participants saw the m-NMF sign and the NMF sign of each sign pair successively. However, as mentioned above, some ratings for the intended signs are missing in the questionnaire as the participants often perceived the m-NMF signs as other signs. Furthermore, the comparison of the results of both judgment tasks shows high consistency and reliability of the participants' judgments as the average overall ratings are almost identical for the NMF signs. The statistical results for the average overall ratings in both lexical judgment tasks clearly reveal the fundamental relevance of certain nonmanuals for lexical entries of specific signs in DGS.

The second statistical analysis of *single signs* (see Section 4.4.1.2) yields that the difference between the NMF sign and the m-NMF sign of the sign pairs is statistically significant for each sign pair with the exception of the sign pairs ALWAYS, CONCENTRATE, and LAZE in the questionnaire. But, the non-significant results for these three signs in acceptability judgments seem to be due to the too small samples as m-NMF signs were often perceived as different signs than the intended signs.[20] Regarding the m-NMF sign ALWAYS, only three ratings by the participants refer to the intended sign. For the m-NMF sign CONCENTRATE, six ratings relate to the intended sign and, regarding the m-NMF sign LAZE, actually no rating refers to the intended sign. In the interview, the difference between the signs in both conditions is significant for all stimulus pairs at all usual significance levels. Here, the rating difference between the NMF sign and the m-NMF sign of each stimulus pair lies between 47% and 71%.

The third statistical analysis *age-group comparison* (see Section 4.4.1.3) shows a crucial and statistically significant difference between younger signers (mean age: 23.9) and older signers (mean age: 54.4) with respect to the ratings of the m-NMF signs. Whereas the ratings by both age groups are very similar for NMF signs, the difference between the ratings of m-NMF signs reveals that younger signers rated these stimuli 34% (in the questionnaire) or rather 26% (in the interview)

20 For the stimulus pairs STRESS, ARROGANT, SHOCK, and SEARCH the samples are similarly small in the questionnaire data, but revealed larger percentage differences between the NMF signs and the m-NMF signs and the differences achieved statistical significance.

worse than the older signers. This is significant at all usual levels and indicates that lexical nonmanuals are more relevant for the ratings of the younger signers. To get deeper insights into this diachronic change, I carried out a follow-up discussion with a deaf informant who has deaf parents. He explained that lexical facial expressions were used in the past as well, but the articulation was very reduced. Today, facial expressions are articulated stronger. The reduced use of facial expressions by older signers seems to be due to the education system and an adaptation to hearing people. Especially in upscale contexts (e. g. a political speech), certain lexical facial expressions are not used. One example is the articulation of the sign DISGUST which clearly has nonmanuals classified as inherent lexical parts of the sign (see Figure 4.23).

Fig. 4.23: The sign DISGUST with lexical nonmanuals (left picture: data elicitation Pendzich 2012)

In exalted contexts, particularly by older signers, this sign would not be articulated with a strong tongue show (AU 19). This seems to derive from the fact that not the signing with the hands but the use of specific facial expressions, regrettably, tends to be perceived negatively by many hearing people. In my view, in this context, it is appropriate to refer to the existence of *display rules*:

> We (Ekman and Friesen 1969b, 1975) proposed the term 'display rules' to describe social norms which specify who can show what emotion to whom, when. Some of these rules are learned so well that they operate automatically, without choice or even awareness. Others are known but not acquired as habits; they are ideals to be followed, but not well practiced. These display rules cover many signs of emotions, not just the face, although facial expression receives attention as a very visible, easily decipherable cue. (Ekman 1979, 179f.; see also Ekman 2004, 45)

As deaf signers use the whole face as a crucial articulator for the expression of a variety of essential linguistic units, the *display rules* for facial expressions of the hearing community cannot apply to the Deaf community as well. This becomes particularly obvious when considering examples of sign languages such as the DGS sign DISGUST in which an emotional facial expression has become an inherent lexical part of the sign. It seems that there are different *display rules* for the communication between deaf people among each other and the communication between deaf and hearing people.

In addition, my deaf informant explained that younger signers are often more self-confident and use much more facial expressions. Differences of style among signers clearly exist, but lexical facial expressions are articulated. Apart from the use of specific intensifications of nonmanuals for morphological increase, the use of a great deal of facial expressions denotes an intensive style. Lexical nonmanuals may be articulated with different intensities.

The fourth statistical analysis (see Section 4.4.1.4) reveals that the three *nonmanual sign types*, i.e., i) facial expression, ii) facial expression and torso/head action, and iii) torso/head action play a crucial role on the lexical level. The magnitude of the manipulation effect is very clear and similar for each nonmanual sign type. The rating difference between NMF signs and m-NMF signs for the three nonmanual sign types ranges from 25% to 34% in the questionnaire and from 53% to 61% in the interview. According to the results of this empirical analysis, torso/head actions have by no means a lesser relevance than facial expressions on the lexical level.

The last statistical analysis of *manual manipulation vs. nonmanual manipulation* (see Section 4.4.1.5) exposes a rating difference of 28% in the questionnaire ($p < 0.001$). Manual and nonmanual manipulations obviously have an impact on lexical judgments, but manual manipulations seem to have a stronger impact. In this regard, it should be noted that manual components are performed with more conspicuous articulators and, therefore, these manipulations are more visible and prominent in the videos. Furthermore, in the present study, the nonmanually manipulated signs were often perceived as different signs. This leads to the fact that there is a lack of some ratings for the intended m-NMF signs in the questionnaire data. In light of this, it is useful to look at the difference between the average overall ratings of the manually manipulated signs in the questionnaire and the nonmanually manipulated signs in the interview. This difference is considerably smaller and amounts to 14% compared to the previous 28%.

With the qualitative analysis of *participants' explanatory statements* deeper insights into the reasons for the given ratings in the *lexical judgment tasks* are gained. In the first qualitative analysis of these statements *Which role do lexical nonmanuals play?* (see Section 4.4.2.1), I examined the descriptions of the role of nonmanual markers by deaf signers. Inter alia, it has been stated that certain signs with lacking lexical nonmanuals are unintelligible, may be misunderstood, have no meaning, can have various meanings or have another meaning. The participants precisely named missing nonmanual components. Moreover, their statements make clear that some individual components used as lexical parts of signs can also carry meaning. In these cases, it is difficult to distinguish between phonemes and morphemes (see Section 7.1 and Section 7.5 for further discussion).

In the second qualitative analysis (see Section 4.4.2.2), I investigated *nonmanual sign variants*. Regarding this, the five signs SLEEP, NOD, REVERE, LAZE, and PROTECTION are particularly interesting. Further empirical studies are necessary to figure out whether the addition of specific nonmanual components to the sign variants shown in the stimulus videos are pure dialectal variants, markers for intensification or due to other semantic factors.

In the third qualitative analysis *unilateral lexical nonmanuals* (see Section 4.4.2.3), I examined the question whether the side of unilateral facial expressions and actions of the head depends on the dominant hand. Two clear tendencies can be observed: On the one hand, a lateral match between the hand and the side of the face or head action, and, on the other hand, the use of bilateral facial expressions instead of unilateral facial expressions. Not infrequently, it seems to occur that a unilateral lexical facial expression can optionally be articulated with both face halves. Finally, it seems to be appropriate not only to use the term *dominant hand* but also the wider definition *dominant half of the upper body*.

In the fourth qualitative analysis, I investigated *lexical nonmanuals and the interplay with morphological markings and pragmatic factors* (see Section 4.4.2.4). Lexical nonmanuals are defined as inherent parts of certain signs. Nevertheless, under specific conditions, these markers can be dropped, reduced or intensified. In sign languages, the boundary between pure lexical nonmanual markings and morphological nonmanual modifications is very fluent. Furthermore, an interesting interplay between lexical nonmanuals and pragmatic factors appears. The following aspects are particularly crucial: morphological increase, morphological decrease, the use of mouthing, communication context, language register, narrative vs. objective, and irony.

The *translation task* (see Section 4.4.3) enables me, on the one hand, to include the variable of meaning in the statistical analyses, and, on the other hand, to analyze the impact of nonmanuals on the meaning of lexical signs. The analysis verified that the relationship between the NMF and m-NMF sign of each sign pair can be adequately described with the four categories which were named in the introduction: a) The m-NMF sign does not have a different meaning than the NMF sign, i.e., both signs are attributed to the same meaning. b) The m-NMF sign does not have a meaning. c) The m-NMF sign is ambiguous and leads signers to name different meanings. d) The NMF sign and the m-NMF sign have different meaning(s). As category d) applies, in DGS, minimal pairs based on nonmanual markers seem to exist. However, as the study reveals no potential nonmanual minimal pair in which one sign of the pair has no lexical nonmanuals and no mouthing, category d) requires the following amendment: The m-NMF sign needs additional or other nonmanual markers and/or mouthing to get the different meaning(s). But, it may well be that further empirically based studies uncover nonmanual minimal pairs for the so far missing two types: 1) sign with NMF and without mouthing vs. sign without NMF and without mouthing, 2) sign with NMF and with mouthing vs. sign without NMF and without mouthing. The *translation task* can be seen as a first approach to get deeper empirically based insights into nonmanual minimal pairs in DGS. When including mouthings as a combinatory factor, there are seven possible types of nonmanual minimal pairs (see Table 4.13). One clear example of a nonmanual minimal pair in DGS is the sign pair ARROGANT – PROUD. Furthermore, the analysis reveals another interesting aspect: When signers see m-NMF signs they often activate other signs that are nonmanually or manually different to the intended signs. This can be seen as an indication for a similar phonological status of nonmanual and manual components as both types of components seem to be similarly important for lexical activation.

The *mouthing classification task* (see Section 4.4.4) is essential to identify the relevance of mouthings for lexical signs. The results yield that signers have clear intuitions regarding the status of mouthing and their classifications are very consistent. Furthermore, the results reveal the relevance of mouthings as an integral part of certain signs. It has been shown that the signs STRESS, NOT-YET, PROTECTION, and SEARCH have a strong tendency towards the use of a mouthing. Regarding the attribution of mouthing variability by the deaf participants, it would be interesting to analyze in more detail the individual reasons for this variability. For some signs, it may have to do with dialectal variation. Three further important factors seem to be language register, communication context, and educational background. When analyzing the interplay between lexical nonmanuals and mouthings, three different relationships have to be distinguished: i) Signs that have a lexical nonmanual marking only on the lower face. In most of these cases, the presence of a mouthing results in an omission of the facial expression.[21] ii) Signs that have a lexical facial expression on the lower face in combination

21 In Pendzich (2012), I provide examples for the fusion of lexical facial expressions in the lower face and mouthings. See Chapter 7.4.2 for an extensive discussion of the interaction between nonmanuals and mouthings.

with a lexical facial expression on the upper face and/or a torso/head action. The use of a mouthing results in a change of a part of the lexical nonmanuals, namely, the facial expression on the lower face. iii) Signs that have lexical nonmanuals but not on the lower face. A mouthing can be combined with the lexical nonmanuals without a change of these markers.

In conclusion, the empirical perception study clearly reveals that nonmanuals play an important role on the lexical level in DGS. Signers have clear intuitions about whether or not and which nonmanuals are inherent parts of certain signs. The findings of the study indicate that nonmanual markers in the form of torso/head actions as well as muscular activities in the upper face for DGS are more decisive on the lexical level than mostly suggested. Previous research often concentrates on lexical mouth actions without closely considering other lexical nonmanuals. However, when investigating lexical nonmanuals, it is important to analyze head/torso actions and muscle contractions in the lower and upper face.

5 Study II: Lexical decision with reaction times

5.1 Research question

The present reaction time study investigates the status of lexical muscle contractions in the lower and upper face as well as torso/head actions in DGS and presents an empirical basis for the discussion of the relevance of these markers for lexical processing. Taking certain nonmanuals as inherent parts of specific signs leads to the assumption that the processing of manipulated signs without these nonmanual markers would be more costly. Thus, the hypothesis of the present reaction study is that nonmanual manipulations in terms of an omission of these markers have to be reflected in a slowing down of reaction times when these markers are relevant for lexical processing. Seeing a sign that includes nonmanual marking in citation form without this marking must lead to an inhibition effect whereby the access to the mental entry of the lexical sign takes more time.[1] The study is based on a video questionnaire with a forced-choice lexical decision task with reaction time measurements, a subsequent translation task, and discussions of the stimulus videos. The stimuli consist, on the one hand, of signs that are assumed to have inherent nonmanual features (NMF) as well as the same signs in manipulated versions without these inherent nonmanual features (m-NMF) and, on the other hand, of two answer words per stimulus video for measuring the reaction time.

The following sections describe the methodology of the study including the precise design (Section 5.2.1) and the metadata of the participants (Section 5.2.2), the elicitated data (Section 5.3), and the analyses and results (Section 5.4).[2] The chapter ends with a summary and discussion (Section 5.5).

1 The idea of conducting a reaction time study with stimuli in the form of signs with and without nonmanual components arose in the course of the study presented in Pendzich (2012, 13).

2 The statistical analyses (Section 5.4.1) were carried out in collaboration with Alexander Silbersdorff, Chair of Statistics, University of Göttingen.

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5.2 Methodology

5.2.1 Study design

5.2.1.1 Stimuli and fillers

The same stimulus videos as in Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4.2.1.1) were used. The substantial difference in Study II: *Lexical Decision with Reaction Times* is that each video is combined with two answer words to measure the reaction time.

For the stimulus signs, which are assumed to include lexical nonmanuals, two factors are relevant: *presence of nonmanual features* (factor I) and *nonmanual sign type* (factor II). Factor I refers to the creation of sign pairs. Each of these pairs consists of one sign with lexical nonmanual features (NMF) and the same sign in a manipulated version (m-NMF). The m-NMF signs are manually exactly the same as the NMF signs but without the lexical nonmanual features. Factor II implies three different *nonmanual sign types*: i) signs with a lexical facial expression, ii) signs with a lexical facial expression and torso/head action, iii) signs with a lexical torso/head action. This results in a six-condition design (see Table 5.1). Each condition pair A/D, B/E, C/F is represented by six different signs commonly used in DGS.

Table 5.2 comprises the selected stimuli within the three nonmanual sign types.[3] In addition to the 36 stimuli, I created 36 filler signs which are evenly composed of four groups: i) correct signs without lexical nonmanuals, ii) manually manipulated signs without lexical nonmanuals, iii) manually manipulated signs with lexical nonmanuals, iv) signs merged from two signs by taking the manual components of one sign and the nonmanuals of another (see Table 5.3). An example for the fillers in group iv) is EVIL <> HAPPY, which is composed of the manual components of EVIL and the nonmanual marking of HAPPY.[4]

3 For further details on the design of the stimulus videos see Chapter 4.2.1.1.

4 For further details on the design of the filler videos see Chapter 4.2.1.1.

Tab. 5.1: Design of the stimuli

Factor I: presence of NMF	**Factor II: nonmanual sign type**	**Condition**	**Items**
yes	i) facial expression with muscular activity in the lower and/or upper face	A	6
yes	ii) facial expression with muscular activity in the lower and/or upper face and torso/head action	B	6
yes	iii) torso/head action	C	6
manipulated	i) facial expression with muscular activity in the lower and/or upper face	D	6
manipulated	ii) facial expression with muscular activity in the lower and/or upper face and torso/head action	E	6
manipulated	iii) torso/head action	F	6
Number of stimuli			= 36

Tab. 5.2: Stimuli

Nonmanual sign type	**Signs**
i) Signs with a lexical facial expression	ALWAYS, BROKEN, FAVORITE, STRESS, SUPER, WINK
ii) Signs with a lexical facial expression and torso/head action	ARROGANT, BLURRY, CONCENTRATE, LAZE, SHOCK, WITHOUT
iii) Signs with a lexical torso/head action	NOD, NOT-YET, PROTECTION, REVERE, SEARCH, SLEEP

To measure if the nonmanual manipulation has an influence on the reaction time, the participants had to choose between two German answer words per each stimulus. One answer word fits the meaning of the sign and the other answer word refers to a totally different sign. For example, the sign ARROGANT is combined with the German words *hell* (= ‘bright’) and *arrogant* (= ‘arrogant’; see Appendix D for all answer words of the stimuli and fillers). As soon as a video has finished, both answer words appeared to the right of the video (see Figure 5.1). To select one of these answer words the participants had to click on one of two possible

Tab. 5.3: Fillers

Filler type	Signs
i) Correct signs without lexical nonmanuals	ASK, BOOK, CAR, CHEAP, DRIVE, EAT, INTERNET, NEW, PARIS
ii) Manually manipulated signs without lexical nonmanuals	CALCULATE, COMPARE, DOCTOR, GET-TO-KNOW, HOUSE, NAME, REASON, SPORT, YOUNG
iii) Manually manipulated signs with lexical nonmanuals	CLUMSY, ENVIOUS, EXPULSION, HURRIED, IGNORE, NO-IDEA, SHY, SQUANDER, WHY
iv) Signs merged from two signs by taking the manual components of one sign and the nonmanuals of another	EVIL <> HAPPY DISGUSTING <> LAUGH GLAD <> SAD HAPPY <> DISGUSTING ILL <> GLAD JOYFUL <> RESISTANCE LAUGH <> EVIL RESISTANCE <> ILL SAD <> JOYFUL

buttons on the keyboard that are marked with an up arrow for the upper answer word and a down arrow for the bottom answer word. In order to exclude times for moving the fingers to the buttons, the participants were instructed to keep their fingers on the keyboard during the whole study.[5] The arrangement of the fitting answer word above or below the non-fitting answer word was randomized. However, I controlled the randomization for the following two influencing factors: i) The arrangement of the answer words was identical for the NMF sign and m-NMF sign of each sign pair. This means for both related stimuli the matching answer word is positioned at the same place. This is crucial for comparing the reaction times as it can be assumed that the selection of the fitting answer word takes a few milliseconds longer when positioned at the bottom and read as the second alternative. Without such a fixed arrangement of the answer words it would be possible that with the NMF sign the fitting word would be positioned at the top and with the m-NMF signs of the same sign pair at the bottom. If then the reaction time for the m-NMF sign would be longer than the reaction time for the NMF sign, it would not be possible to state whether the reaction time is longer because the

5 To achieve highest possible accuracy wthin the measurement of reaction times a better method would be to use a response box.

fitting term was read as the second alternative or because of the missing nonmanual component. ii) The randomization of the answer words was controlled with respect to a balanced positioning of the fitting answer word at the top or bottom. This includes the stimuli as well as the fillers. Hence, the participants had to click equally often on the up arrow and down arrow.

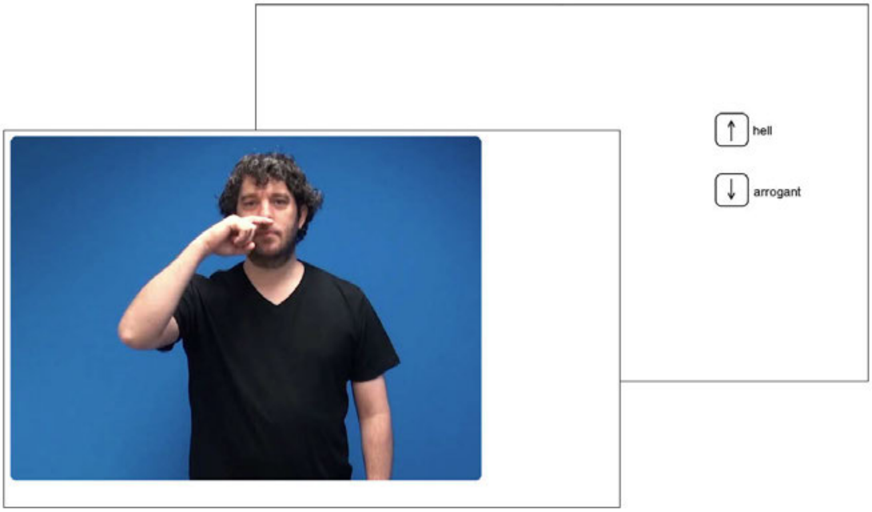

Fig. 5.1: Design of the forced-choice lexical decision task in the questionnaire: initial point of the m-NMF sign ARROGANT and the two German answer words *hell* (= 'bright') and *arrogant* (= 'arrogant')

The two videos in the NMF and m-NMF condition of each stimulus pair were shown with the same two answer words. This is necessary to rule out the possibility that different answer words have an effect on the reaction times (e. g. if between two German words and the corresponding DGS signs a greater similarity exists than for the answer words of the second sign in the same stimulus pair). Since each answer word occurs twice within the stimuli the answer words of the fillers were used twice as well. Here, a positive side effect is that in this way the list of answer words which the participants had to read carefully at the beginning of the study (see Section 5.2.1.2) is minimized (= 72 answer words). The answer words for the filler types i), ii), and iii) are mixed among each other. In type iv) each answer word occured twice within the group. It is not possible to mix the answer words of this filler type with those of the other filler types as within type

iv) the signs are composed of the nonmanual components of one sign and the manual components of another sign. Accordingly, one answer word refers to the nonmanual components and the other to the manual components.

The determination of the two German answer words for each stimulus pair is based on the following six criteria: i) One fitting answer word, one obviously not fitting answer word, ii) orthographical and phonological distance between both answer words, iii) phonological distance between the two signs that correspond to the answer words, iv) semantic unrelatedness between both answer words and corresponding signs, v) both answer words in the same word class, vi) different word classes within the stimulus set. In accordance with criterion ii), orthographically and phonologically similar German words like for instance *Schock* – *Bock* (= 'shock' – 'buck') were not used. Furthermore, I did not select answer words with the same initial letter. As mentioned in criterion iii), I did not combine answer words that refer to phonologically similar signs. For example, this would be the case for the signs REVERE – RIGHT, which have the same handshape, movement as well as place of articulation and differ in the hand orientation, velocity of the movement and lexical nonmanuals. I selected answer words that refer to signs that are no minimal pairs and differ in preferably many parameters. According to criterion iv), both answer words and corresponding signs for each stimulus show no semantical relation as would be the case for words like *schlafen* – *müde* (= 'sleep' – 'tired'). In accordance with criterion v), both answer words for each stimulus video belong to the same part of speech. Thus, answer pairs such as *schlafen* – *kochen* (= 'sleep' – 'cook') were used.[6] As indicated in criterion vi), the German answer word pairs belong to different word classes: adjective, noun, verb, preposition, adverb, and interrogative pronoun. The lexicon of spoken languages in the oral modality as well as the lexicon of sign languages in the visual modality is composed of different lexeme types which refer to events, entities, properties etc. However, so far there are only few comprehensive studies on word classes in sign languages and very few studies set up general criteria for the determination of word classes in view of the entire lexicon of a sign language. One important characteristic of sign languages is that signs are often multifunctional. Mostly, the sign form shows no indicator for the word class (cf. Meir 2012).[7]

6 In six fillers, the combination with answer words in the same word class was not possible. The sign NO-IDEA is combined with the answer words *no-idea* – *why*, CLUMSY with *clumsy* – *no-idea*, WHY with *why* – *new*, JOYFUL with *joyful* – *resistance*, LAUGH with *laugh* – *evil*, and RESISTANCE with *resistance* – *ill*.

7 Nevertheless, various studies on different sign languages reveal that subtle differences in the movements of specific signs may signal the word class distinction between nouns and verbs. See Meir (2012) for an overview.

As just described in detail, the current study combines materials of two different modalities: on the one hand, recorded signs and, on the other hand, written German answer words. It is not unusual to combine materials of different modalities within an empirical study. One other example is the study by Dahan et al. (2001) for spoken language. They investigate with two eye tracking experiments "the time course of frequency effects during spoken-word recognition in continuous speech" (Dahan et al. 2001, 353) and combine spoken material with pictures in each trial. Within the task the participants had to click on and move specific pictures according to the spoken instructions. In contrast to the study by Dahan et al. (2001), it was not convenient to use pictures for the current study. The meaning of the stimuli could not be unambiguously illustrated by pictures. For example, there are no clear pictorial representations for the semantic concepts *favorite* and *search*.

Another common method which could be used for measuring reaction times is the choice between two buttons for the categories *sign* vs. *nonsign* (see e. g. the study by Corina & Hildebrandt 2002; for further information on reaction time studies in sign languages, see Tyrone 2015). However, as the results of Study I: *Lexical Judgments and the Meaning of Signs* (see Chapter 4) indicate, this method seems to be inappropriate for the present reaction time study. Study I reveals that several m-NMF signs were perceived as different signs with a different meaning than the corresponding NMF signs. When the participants had to choose between the categories *sign* vs. *nonsign* there would be a great chance that they selected the category *sign* for certain m-NMF signs. These would presumably be those m-NMF signs which were perceived as different signs than the corresponding NMF signs. It may be that the choice for m-NMF signs is made with the same speed as the choice for the corresponding NMF signs. In contrast, the advantage of using the answer words is that the presented answer words for the m-NMF signs do not perfectly fit if the nonmanuals clearly belong to the signs. Seeing a m-NMF sign may lead to the activation of one or more other signs than the intended sign or may lead to an irritation due to the nonmanual manipulation. Consequently, the reaction times by selecting an answer word for the m-NMF signs should be longer than those for the NMF signs if the nonmanuals are inherent parts.

5.2.1.2 Design of the questionnaire

I conducted a reaction time study based on a forced-choice lexical decision task. The instructive videos were signed in DGS by one female deaf signer. The stimulus videos were signed by one male deaf signer. The questionnaire was created with the programming language BlitzBasic and was divided into twelve parts:

1. Welcome video
2. Metadata questionnaire: information about the name, gender, age of birth, place of birth, place of residence, age of deafness, hearing status of the parents, preferred language, age of DGS acquisition, and school
3. Instruction video: explanation of the task
4. Practice: list with answer words for the practice
5. Practice: instruction video with the option to see the answer words again or to start with the practice videos
6. Practice: four videos
7. Instruction video: option to go back to the first instruction video (part 3-5), to do the practice session again (part 6) or to start with the actual task (part 8)
8. Task: instruction video with information on spending enough time reading the list of answer words
9. Task: list with answer words
10. Task: instruction video with the option to see the answer words again or to start with the stimulus videos
11. Task: 72 videos
12. Video of thanks

Before starting with the forced-choice lexical decision task, the participants saw a list with all answer words occurring in the practice (part 4) and the actual task (part 9) with the instruction to spend enough time reading these words. The practice included eight answer words. The actual task contained 36 answer words for the stimuli and 36 answer words for the fillers. Each answer word occurred twice in the study (see Section 5.2.1.1). The practice included four videos combined in each case with two answer words constructed in the same way as the stimuli and fillers. In this way, participants were familarized with the task and, prior to the start of the actual experiment, got to know why they had to read the list with answer words.

As soon as a video had finished, the two answer words appeared on the right side of the video (see Section 5.2.1.1). The reaction time is defined as the time span between the appearance of the answer words and the selection of one answer word. After the selection of an answer word the next stimulus video displayed automatically. As stated explicitly in the instruction video, each stimulus video could only be viewed once.

The participants saw the randomized 36 stimuli and 36 fillers one after the other. To ensure that the position of the stimuli has no influence on the reaction times the data elicitations were carried out in balanced ratio with two different lists (= randomization lists A) and B)). Randomization list B) had the reversed order of list A). Furthermore, the arrangement of the answer words for each stimulus was reversed in list A) and B). This means all answer words that were positioned at the top in list A) occurred at the bottom in list B). The participants saw each stimulus video twice, once with and once without the lexical nonmanuals (see pictures of all stimuli in Appendix A). To ensure that the participants saw a sufficient number of other signs between the two signs of each stimulus pair the randomization had been manually revised. Between the NMF and m-NMF sign of each stimulus pair at least eight other signs were placed. A further manual revision concerns the first and last sign in the randomization lists. Since the last sign in randomization list A) was the first sign in list B), I selected for both positions filler signs. This is due to the fact that after the practice session short instructive videos were played. After this short break, for acclimatization reasons, it is better to begin with a filler sign than with a critical item.

The communication between the participants and me as the instructor took place in DGS. For the time when participants did the reaction time questionnaire they worked alone at the laptop and the instructor sat apart. After the participation in the study *Lexical Decision with Reaction Times* the test persons participated in the study *Lexical Judgment and the Meaning of Signs* (see Chapter 4). That study included the lexical judgment questionnaire and the interview with the translation task, the lexical judgment task in direct comparison of NMF and m-NMF signs with participants' explanatory statements, and the mouthing classification task. The translation task and participants' explanatory statements are also relevant for the study *Lexical Decision with Reaction Times*. The results of these two tasks enable to identify outliers in the reaction times (see Section 5.3).

5.2.2 Participants

The study is based on the participation of 17 test subjects: nine women and eight men. All test persons were between 14 and 61 years old (mean age: 32.4). Apart from one participant, these are the same signers as in the study *Lexical Judgment and the Meaning of Signs* (see Chapter 4). Ten participants are native signers and seven are near-native signers, which is defined as DGS acquisition before the age of seven. DGS is the preferred language of all participants. Table 5.4 summarizes the relevant anonymized metadata of the participants, listing a fictive name abbreviation (A, B, C, ...), gender, age at the data elicitation, age of deafness, age of DGS acquisition, hearing status of the parents, and the signer's preferred language. Due to privacy reasons, the cities or regions the participants came from and/or lived in are not listed in Table 5.4.

Originally, the study was carried out with 21 participants. Although, during the acquisition of participants it was stated explicitly that only deaf persons with early sign language acquisition can participate, at two meetings it became clear that the person did not fulfill the metadata criteria. These two persons were not deaf, had no deaf parents, and started to learn DGS after the age of 17. Another older person had to be excluded from the evaluation as she was not able to do the task on the computer alone and jointly worked on it with a hearing friend. A fourth participant had to be excluded due to the fact that she selected the wrong answer word in nine cases and pressed both buttons simultaneously in eleven cases which resulted in the selection of both answer words.

The study was carried out in the SignLab of the Georg-August-University Göttingen, in the Deaf center in Braunschweig, in public areas in a library of the Humboldt-University Berlin, and at participants' residences in Berlin as well as in Hamburg.

Tab. 5.4: Metadata of the participants

Signer	Gender	Age	Deaf at age	DGS at age	Deaf parents	Preferred language
A	m	61	0	6	no	DGS
B	f	51	1.5	6	no	DGS
C	m	53	2	6	no	DGS
D	m	14	5[a]	0	yes	DGS
E	f	31	0[a]	0	yes[b]	DGS
F	f	29	0	3	no	DGS
G	f	28	0	2	no	DGS
H	m	25	0	0	yes	DGS
I	m	28	0	0	yes	DGS
J[c]	f	25	0	6	yes	DGS
K	f	44	0	2.5	no	DGS
L	m	26	0	0	no	DGS
M	m	55	0	0	yes	DGS
N	f	20	0	0	yes	DGS
O	f	20	0	0	yes	DGS
P[d]	f	24	0	0	yes	DGS
Q[d]	m	17	0	0	yes	DGS

[a] hard of hearing
[b] mother: deaf, father: hard of hearing
[c] first native language: Polish Sign Language (PJM)
[d] father from Turkey

5.3 Data

The study yields 612 reaction times for the stimuli: 306 for NMF signs and 306 for m-NMF signs. Prior to the statistical analysis with R (cf. R Core Team 2015), the evaluation table with all reaction times for the stimuli was checked with respect to the following four types of outliers: i) I reviewed if the participants had selected non-fitting answer words. ii) In the data elicitation, two participants mentioned that they have missed videos. According to that, I excluded three reaction times. iii) If the participants saw a NMF sign video after the m-NMF sign of the same stimulus pair and the reaction time for the NMF sign is nevertheless markedly longer (250ms or more) the statements in the subsequent interview were checked to be sure that there are no distracting factors that have an influence on the reaction times. Thereby, two distracting factors were found: different translation and different manual articulation. Due to the fact that we have to deal with high dialectal variation in DGS, this evaluation step is important. Firstly, I excluded four striking and inconclusive reaction times belonging to stimuli for which participants selected meanings in the translation task (see Section 4.4.3) which were not included in the two listed answer words. Secondly, I removed two reaction times for one stimulus pair based on the circumstance that the participant knows the sign with a reduplicated manual movement instead of a single movement shown in the video. This became clear in the subsequent interview. Furthermore, in this individual case, the reaction time of 2151ms for the NMF sign matches the following type of outliers as well. iv) If the reaction time for a NMF sign video takes more than 2000ms (average reaction time for NMF signs amounts to 746ms) the statements in the subsequent interview were checked for distracting factors that have an influence on the reaction time. This revealed that one participant had difficulties with two stimulus pairs because he uses the signs rarely. Moreover, one of these signs is problematic for the participant as he knows the sign with an additional nonmanual marking not shown in the NMF sign video. This is probably due to dialectal variation. Using the mentioned criteria i) to iv) to check the 612 reaction times for outliers, 19 reaction times were excluded from the statistical evaluation. Hence, the following statistical analyses of the stimuli are based on 593 reaction times. In Section 5.4.1.5, additional 306 reaction times for manually manipulated signs in filler type ii) and iii) are used.

5.4 Results

5.4.1 Statistical analyses of the reaction times

5.4.1.1 Single signs

To get an impression of the average reaction times for each individual sign pair composed of the NMF and m-NMF conditions the statistical analyses were carried out in terms of a classical one-way analysis of variance (ANOVA) for separate sign pairs based on the following hypotheses:

$\mathcal{H}_0$: The reaction time for the m-NMF sign is the same as the reaction time for the NMF sign of the same sign pair.
$\mathcal{H}_1$: The reaction time for the m-NMF sign is not the same as the reaction time for the NMF sign of the same sign pair.

The results of the ANOVA are summarized in Table 5.5. Checking the p-values for the individual sign pair analyses, it becomes apparent that only the differences in the reaction times of the NMF sign and m-NMF sign of the stimulus pairs ALWAYS, SEARCH, and NOT-YET are statistically significant. ALWAYS as well as SEARCH are marginally significant at the 10% level and NOT-YET is significant at all usual significance levels. But, it is important to keep in mind that the sample size is very small when focussing on individual sign pairs. Therefore, it is to be expected that for each individual sign pair lower levels of statistical significance are observed than for the whole dataset. Nevertheless, the results show clear differences between the reaction times for NMF signs and m-NMF signs.

Tab. 5.5: Statistical analysis of individual sign pairs

Stimulus	Condition	NMF	Statistical results
ALWAYS	A	yes	N = 16, $\overline{x}$ = 763.19, SD = 200.03
ALWAYS	D	no	N = 17, $\overline{x}$ = 1143.06, SD = 841.34
			F = 3.1, p-value = 0.089
			% difference NMF vs. m-NMF: 33
BROKEN	A	yes	N = 15, $\overline{x}$ = 937.20, SD = 283.15
BROKEN	D	no	N = 17, $\overline{x}$ = 888.47, SD = 376.71
			F = 0.2, p-value = 0.685
			% difference NMF vs. m-NMF: 5

Stimulus	Condition	NMF	Statistical results
FAVORITE	A	yes	N = 17, $\overline{x}$ = 793.06, SD = 211.95
FAVORITE	D	no	N = 17, $\overline{x}$ = 825.88, SD = 256.52
			F = 0.2, p-value = 0.687
			% difference NMF vs. m-NMF: 4
STRESS	A	yes	N = 17, $\overline{x}$ = 653.53, SD = 164.21
STRESS	D	no	N = 16, $\overline{x}$ = 657.56, SD = 159.54
			F = 0.0, p-value = 0.943
			% difference NMF vs. m-NMF: 1
SUPER	A	yes	N = 17, $\overline{x}$ = 846.76, SD = 320.68
SUPER	D	no	N = 17, $\overline{x}$ = 901.88, SD = 326.06
			F = 0.2, p-value = 0.623
			% difference NMF vs. m-NMF: 6
WINK	A	yes	N = 17, $\overline{x}$ = 673.65, SD = 242.93
WINK	D	no	N = 17, $\overline{x}$ = 711.88, SD = 226.56
			F = 0.2, p-value = 0.638
			% difference NMF vs. m-NMF: 5
ARROGANT	B	yes	N = 15, $\overline{x}$ = 773.60, SD = 358.66
ARROGANT	E	no	N = 15, $\overline{x}$ = 939.00, SD = 779.67
			F = 0.6, p-value = 0.462
			% difference NMF vs. m-NMF: 18
BLURRY	B	yes	N = 17, $\overline{x}$ = 741.35, SD = 329.24
BLURRY	E	no	N = 17, $\overline{x}$ = 657.18, SD = 207.02
			F = 0.8, p-value = 0.379
			% difference NMF vs. m-NMF: 11
CONCENTRATE	B	yes	N = 17, $\overline{x}$ = 707.65, SD = 232.78
CONCENTRATE	E	no	N = 17, $\overline{x}$ = 695.24, SD = 265.69
			F = 0.0, p-value = 0.886
			% difference NMF vs. m-NMF: 2
LAZE	B	yes	N = 17, $\overline{x}$ = 829.41, SD = 232.51
LAZE	E	no	N = 14, $\overline{x}$ = 838.07, SD = 210.69
			F = 0.0, p-value = 0.915
			% difference NMF vs. m-NMF: 1
SHOCK	B	yes	N = 17, $\overline{x}$ = 684.41, SD = 165.24
SHOCK	E	no	N = 17, $\overline{x}$ = 730.88, SD = 280.71
			F = 0.3, p-value = 0.561
			% difference NMF vs. m-NMF: 6

Stimulus	Condition	NMF	Statistical results
WITHOUT	B	yes	N = 15, $\overline{x}$ = 782.93, SD = 232.13
WITHOUT	E	no	N = 16, $\overline{x}$ = 870.25, SD = 215.98
			F = 1.2, p-value = 0.287
			% difference NMF vs. m-NMF: 10
NOD	C	yes	N = 16, $\overline{x}$ = 813.25, SD = 345.83
NOD	F	no	N = 17, $\overline{x}$ = 861.71, SD = 273.43
			F = 0.2, p-value = 0.657
			% difference NMF vs. m-NMF: 6
NOT-YET	C	yes	N = 16, $\overline{x}$ = 679.81, SD = 218.56
NOT-YET	F	no	N = 16, $\overline{x}$ = 1268.50, SD = 555.79
			F = 15.5, p-value $<$ 0.001
			% difference NMF vs. m-NMF: 46
PROTECTION	C	yes	N = 17, $\overline{x}$ = 646.06, SD = 169.01
PROTECTION	F	no	N = 17, $\overline{x}$ = 675.82, SD = 208.08
			F = 0.2, p-value = 0.650
			% difference NMF vs. m-NMF: 4
REVERE	C	yes	N = 16, $\overline{x}$ = 749.19, SD = 184.56
REVERE	F	no	N = 16, $\overline{x}$ = 799.31, SD = 308.79
			F = 0.3, p-value = 0.581
			% difference NMF vs. m-NMF: 6
SEARCH	C	yes	N = 17, $\overline{x}$ = 678.35, SD = 232.27
SEARCH	F	no	N = 17, $\overline{x}$ = 851.24, SD = 327.25
			F = 3.2, p-value = 0.085
			% difference NMF vs. m-NMF: 20
SLEEP	C	yes	N = 17, $\overline{x}$ = 696.65, SD = 220.62
SLEEP	F	no	N = 17, $\overline{x}$ = 713.59, SD = 213.88
			F = 0.1, p-value = 0.822
			% difference NMF vs. m-NMF: 2

The highest reaction time differences between the NMF sign and the m-NMF sign achieve the sign pairs NOT-YET with 46%, ALWAYS with 33%, and SEARCH with 20%. The signs NOT-YET and SEARCH were shown with a slight mouthing in the NMF condition. In Section 5.4.1.2, it is tested whether mouthing has a significant influence on the reaction times. In contrast, the sign ALWAYS unequivocally does not include a mouthing as the sign has the AUs 17+R25+R33 as inherent parts. The average reaction time for the m-NMF version of NOT-YET differs greatly from those of the other m-NMF stimuli. The average reaction time for this stimulus is 1269ms and the difference between the NMF and m-NMF version of NOT-YET is highly significant with $p < 0.001$ (see Table 5.5). Figure 5.2 illustrates the distribution of the reaction times for NOT-YET. For all histograms in this chapter, light red denotes the reaction times for nonmanually manipulated signs, blue denotes the reaction times for signs without manipulation, and dark red indicates the overlap between both.[8] It is not clear if the high reaction time difference between the NMF and m-NMF version of NOT-YET is based exclusively on the nonmanual manipulation in the form of a missing head action (AU 84) as this stimulus is shown in the NMF version with a slight mouthing. However, the striking reaction time of the stimulus pair NOT-YET is not the NMF sign, which is shown with a slight mouthing, but the m-NMF sign belonging to the condition in which all stimuli are shown without mouthing.

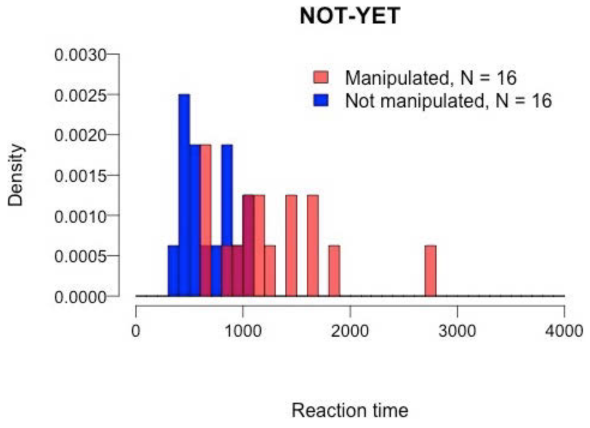

Fig. 5.2: Statistical distribution of the reaction times for NOT-YET

The second highest difference between the reaction times for the NMF and m-NMF sign of a sign pair is obtained with ALWAYS and amounts to 33%. Whereas the mean reaction time for the NMF sign ALWAYS is 763ms, the mean reaction time for the m-NMF sign amounts to 1143ms. Hence, the mental processing of ALWAYS without the lexical AUs 17+R25+R33 takes clearly more time. Figure 5.3 visualizes the distribution of these reaction times.

The lowest differences between the reaction times for the NMF and m-NMF sign of a sign pair show STRESS and LAZE. The difference between the two conditions is 1% for both sign pairs. Comparing the distributions of the reaction times

8 In monochrome print, light red corresponds to light grey, blue to dark grey, and dark red to medium grey.

for both signs in Figure 5.4, it is conspicuous that for the sign LAZE the NMF sign leads to the fastest reaction times. In contrast, regarding the sign STRESS, it sticks out that the fastest reaction times are achieved by the m-NMF sign and the lowest reaction times by the NMF sign, which is the reverse of what was expected.

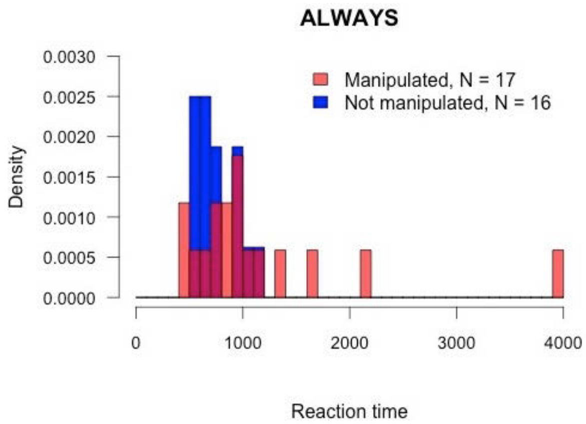

Fig. 5.3: Statistical distribution of the reaction times for ALWAYS

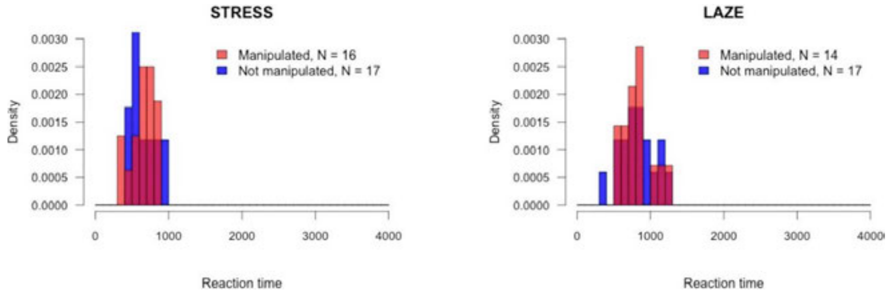

Fig. 5.4: Statistical distribution of the reaction times for STRESS and LAZE

An example that shows the relevance of lexical facial expressions in the form of muscular contractions in the upper face is the sign WINK. The NMF condition yields an average reaction time of 674ms compared to 712ms in the m-NMF condition. The difference in these reaction times amounts to 5% (see Table 5.5 and Figure 5.5).

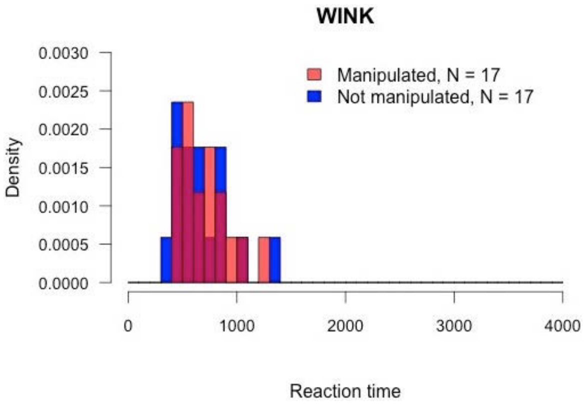

Fig. 5.5: Statistical distribution of the reaction times for WINK

In case of three stimulus pairs, the nonmanual manipulation does not reveal the expected effect of a slower average reaction time for the m-NMF signs. This concerns the signs BROKEN (= nonmanual sign type *lexical facial expression*), BLURRY (= nonmanual sign type *lexical facial expression and torso/head action*), and CONCENTRATE (= nonmanual sign type *lexical facial expression and torso/head action*). These signs show faster average reaction times in the m-NMF condition. Why do these signs demonstrate the reverse effect in the reaction times? These signs were stimuli in Study I: *Lexical Judgment and the Meaning of Signs* as well and reveal clear differences between the NMF and m-NMF condition in the ratings by the participants (see Section 4.4.1.2). Furthermore, the translation task (see Section 4.4.3) shows that most of the participants translated the sign BROKEN with the German word *kaputt* and the sign CONCENTRATE with the German words *konzentrieren, konzentriert*, and *Konzentration* coinciding with the answer words in the lexical decision task. However, the German translations of the sign BLURRY varied more largely: *verschwommen, nicht klar, unklar, schlecht sehen* etc. Hence, in this case longer reaction times in the NMF condition, for some participants, can be due to an inhibition effect resulting from an unexpected answer word. Moreover, the translation task reveals that, at least in some dialects, the NMF stimuli BROKEN and BLURRY have homonyms. This could explain the longer reaction times when participants at first activate the meaning that is not listed as an answer word. The meaning *nervous-breakdown* was given only in the NMF condition of the stimulus BROKEN. The stimulus BLURRY only in the NMF condition also was translated with *light-blinded* and *it's-as-clear-as-mud*. In order to get further insights, I counted how many participants showed longer reaction times for the NMF signs BLURRY, BROKEN and CONCENTRATE and I checked whether this occurs with the first or second sign seen of a stimulus pair. Table 5.6 shows that all possible cases regarding a faster or slower reaction time for the NMF signs are present in the data. The stimulus BLURRY for five participants yields the expected faster reaction times for the NMF signs, the stimulus BROKEN for six participants and CONCENTRATE for seven participants. Particularly unexpected is the case *NMF sign slower, seen second*, which occurs five times with BLURRY, four times with BROKEN, and three times with CONCENTRATE. In some cases, this might just be due to inattentiveness. For each of the three stimulus pairs, in most cases the reaction times for the NMF sign are longer than for the m-NMF sign when occurring as first sign of the stimulus pair. Hence, the order effect seems to play a role. The statistical analysis of the overall order effect follows in Section 5.4.1.3.

Tab. 5.6: Overview of faster and slower reaction times in the NMF condition compared to the m-NMF condition of BLURRY, BROKEN, and CONCENTRATE

Stimulus	Case	Occurrences
BLURRY	NMF sign faster, seen first	1
	NMF sign faster, seen second	4
	NMF sign slower, seen first	7
	NMF sign slower, seen second	5
BROKEN	NMF sign faster, seen first	3
	NMF sign faster, seen second	3
	NMF sign slower, seen first	6
	NMF sign slower, seen second	4
CONCENTRATE	NMF sign faster, seen first	1
	NMF sign faster, seen second	6
	NMF sign slower, seen first	7
	NMF sign slower, seen second	3

Furthermore, it is interesting to pursue the average reaction times for the three nonmanual sign types: i) lexical facial expression, ii) lexical facial expression and torso/head action, iii) lexical torso/head action (see Table 5.1 and Table 5.2). As can be gathered from Table 5.5 the percentage differences between NMF and m-NMF signs are similar for the nonmanual sign types i) and ii). Type iii) shows the biggest percentage difference. On average, the percentage differences are as follows: i) signs with a lexical facial expression (= condition A and D) 9% or 10% without the sign BROKEN, ii) signs with a lexical facial expression and torso/head action (= condition B and E) 8% or 9% without the signs BLURRY and CONCENTRATE, iii) signs with a torso/head action (= condition C and F) 14%.

In short, the statistical analysis of all individual sign pairs indicates that lexical nonmanuals to a variable extent play a role for the processing of specific signs: For most of the investigated signs, the omission of the nonmanuals resulted in 4% to 6% longer reaction times. Some signs only showed a difference of 1% to 2%. Moreover, the signs ALWAYS, ARROGANT, NOT-YET, SEARCH, and WITHOUT revealed differences between 10% and 46%. Due to the too small sample size when analyzing individual sign pairs, the difference in the reaction times of NMF signs and m-NMF signs only for three sign pairs is statistically significant: ALWAYS, NOT-YET, and SEARCH.

5.4.1.2 NMF signs without mouthing vs. NMF signs with mouthing

As already discussed in Section 4.2.1.1, the stimuli include five signs with slight mouthing in the NMF condition: NOT-YET, PROTECTION, REVERE, SEARCH, and STRESS. In the following, it is tested whether these NMF signs with slight mouthing yield different reaction times than the NMF signs without mouthing. The mean values are compared by means of a classical one-way ANOVA with the following two underlying hypotheses:

$\mathcal{H}_0$: Reaction times for NMF signs with mouthing are the same as those for NMF signs without mouthing.
$\mathcal{H}_1$: Reaction times for NMF signs with mouthing are not the same as those for NMF signs without mouthing.

On the 5% level, the analysis reveals a significant difference in the average reaction time for the five NMF signs with mouthing compared to the average reaction time for the 13 NMF signs without mouthing (see Table 5.7). The average reaction time for the NMF signs with mouthing amounts to 681ms and the average reaction time for the NMF signs without mouthing 773ms (p = 0.021). It can be assumed that this difference of 12% results from the occurrence of the slight mouthings. This would mean that already very slight lip movements referring to a German word lead to a faster selection of the proper written word. However, in order to make sure that the difference in the reaction times of both NMF sign groups is exclusively due to mouthing the same signs with and without mouthing (without another difference in the sign form) have to be compared. So far, it cannot be ruled out that the faster reaction times of these signs are due to other undetected factors. For the purpose of checking the influence of mouthings in detail a follow-up study could be conducted with signs in the following four stimulus variants: i) sign with mouthing and with lexical nonmanuals, ii) sign with mouthing and with lacking lexical nonmanuals, iii) sign with lacking mouthing and with lexical nonmanuals, iv) sign with lacking mouthing and with lacking lexical nonmanuals.

Tab. 5.7: Statistical analysis of NMF signs with mouthing vs. NMF signs without mouthing

Mouthing	Statistical results
Yes	N = 5, $\overline{x}$ = 681.39, SD = 40.72
No	N = 13, $\overline{x}$ = 772.55, SD = 74.51
	F = 6.6, p-value = 0.021
	% difference NMF vs. m-NMF: 12

5.4.1.3 NMF signs vs. m-NMF signs

The statistical analyses of the overall reaction times for NMF signs versus m-NMF signs are again based on classical one-way ANOVAs with the following two underlying hypotheses:

$\mathcal{H}_0$: Reaction times for m-NMF signs are the same as those for NMF signs.
$\mathcal{H}_1$: Reaction times for m-NMF signs are not the same as those for NMF signs.

All stimulus pairs

In the first step, an ANOVA with regard to the reaction times for all stimuli is carried out. The results are summarized in Table 5.8 and Figure 5.6.[9] This analysis step shows a significant effect of a 11% faster lexical decision for NMF signs compared to m-NMF signs, which is significant with $p = 0.002$.

9 For all histograms in this chapter, light red denotes the reaction times for nonmanually manipulated signs, blue denotes the reaction times for signs without manipulation, and dark red indicates the overlap between both. In monochrome print, light red corresponds to light grey, blue to dark grey, and dark red to medium grey.

Tab. 5.8: Statistical analysis of the reaction times for all stimuli

NMF	Statistical results
Yes	N = 296, $\overline{x}$ = 745.47, SD = 251.85
No	N = 297, $\overline{x}$ = 833.38, SD = 403.85
	F = 10.1, p-value = 0.002
	% difference NMF vs. m-NMF: 11

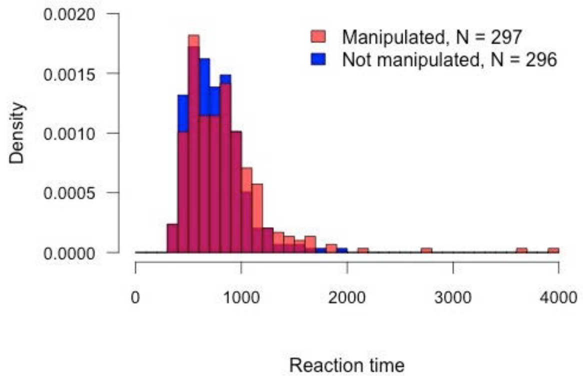

Fig. 5.6: Statistical distribution of the reaction times for all stimuli

As in a balanced manner two randomizations of the stimuli that are back-to-front were used, the influence of seeing the NMF sign or m-NMF sign of each stimulus pair first should be counterbalanced within the statistical overall results. Nevertheless, the effect of order is additionally tested. To capture the interdependencies between the two variables *order 2nd* and *nonmanual manipulation*, a two-way ANOVA is used rather than the one-way ANOVA used before. To estimate the two variables as well as their interaction effect, the following regression equation is determined:

$$reaction\ time_i = \beta_0 + \beta_1\ order\ 2nd_i + \beta_2\ nonmanual\ manipulation_i + \beta_3\ nonmanual\ manipulation_i \times order\ 2nd_i + \varepsilon_i$$

$Reaction\ time_i$ is the reaction time for observation i. The variable $order\ 2nd_i$ is unity if a sign of one stimulus pair occurred after the other sign of the same stimulus pair and zero otherwise. The $nonmanual\ manipulation_i$ variable is defined as above. Lastly, $nonmanual\ manipulation_i \times order\ 2nd_i$ denotes the interaction term between the two variables, ε_i denotes the residual (see Field et al. 2012 and Fahrmeir et al. 2013 for further information on regression analysis).

As can be seen from Table 5.9, the average reaction times with the included order effect are as follows: i) NMF signs seen before the corresponding m-NMF signs: 793ms, NMF signs seen after the corresponding m-NMF signs: 700ms, ii) m-NMF signs seen before the corresponding NMF signs: 873ms, m-NMF signs seen after the corresponding NMF sign: 793ms. In this context, it is useful to compare, on the one hand, the average reaction time for the NMF signs that occur first with the average reaction time for the m-NMF signs that occur first, and, on the other hand, the average reaction time for the NMF signs that occur second with the average reaction time for the m-NMF signs that occur second. Regarding the videos seen first, the analysis reveals 9% slower reaction times for the m-NMF signs (p = 0.039). Regarding the videos seen second, the analysis reveals 12% slower reaction times for the m-NMF signs (p = 0.017). These percentage differences clearly show that the difference in the reaction times for NMF signs versus m-NMF signs exists for the signs of the stimulus pairs seen first as well as for the signs of the stimulus pairs seen second. However, the average reaction times show that for the NMF signs as well as for the m-NMF signs the decision is faster when the participants see the second video of a stimulus pair. This regularity of the reaction times is an indicator that the design of the study worked. Concerning the impact of the order, an effect of -93ms for the NMF signs (p = 0.017) and -80ms (p = 0.039) for the m-NMF signs is found. The difference between the reaction times for the NMF signs occurring first or second amount to 12%. The difference between the reaction times for the m-NMF signs occurring first or second amount to 9%.

Tab. 5.9: Statistical analysis of the order effect based on all stimuli

	Estimate	Std. error	t-value	p-value
(Intercept)	792.6644	27.68	28.64	< 0.001
Nonmanual manip.	80.1369	38.81	2.06	0.039
Order 2nd	-93.1377	38.88	-2.40	0.017
Nonmanual manip. x order 2nd	12.9460	54.9365	0.24	0.814

Stimulus pairs without mouthing

In the next analysis step, an ANOVA is carried out for all stimuli apart from the stimulus pairs which are signed with mouthing in the NMF condition: NOT-YET, PROTECTION, REVERE, SEARCH, and STRESS. Both signs of these stimulus pairs are excluded, the NMF signs with slight mouthing and the m-NMF signs without mouthing. The statistical results in Table 5.10 show that without these ten stimuli the effect of the nonmanual manipulation is smaller and amounts to 7% slower reaction times. This difference between the reaction times for NMF and m-NMF signs is marginally statistically significant at the 10% level (p = 0.088). Figure 5.7 illustrates the distribution of the reaction times for all stimulus pairs without slight mouthing.

Tab. 5.10: Statistical analysis of the reaction times for all stimulus pairs without slight mouthing

NMF	Statistical results
Yes	N = 213, $\overline{x}$ = 770.75, SD = 267.22
No	N = 215, $\overline{x}$ = 827.67, SD = 406.99
	F = 2.9, p-value = 0.088
	% difference NMF vs. m-NMF: 7

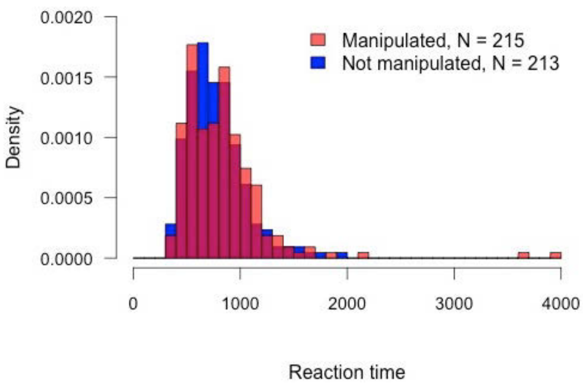

Fig. 5.7: Statistical distribution of the reaction times for all stimulus pairs without slight mouthing

The statistical significance in the analysis without the stimulus pairs with mouthing is lower than in the previous analysis of all stimulus signs. However, it is possible that this difference in the statistical significance is just due to a too small sample size as ten signs (i.e., 165 reaction times) were ruled out. Both distributions, illustrated in Figure 5.6 and Figure 5.7, show that the mass for the manipulated and not manipulated stimuli is distributed differently and that some participants need much more time for some stimuli caused by an inhibition effect due to the nonmanual manipulation.

Finally, it should be noted that it cannot be assumed with certainty that the difference of 4% in the percentage difference of NMF versus m-NMF signs without the five stimulus pairs with mouthing compared to the percentage difference of NMF versus m-NMF signs with all stimuli predominantly depends on the slight mouthings (see Section 5.4.1.2).

Stimulus pairs without the NMF signs with mouthing

In addition to the previous analysis, another ANOVA is carried out for which only the NMF signs of the stimulus pairs with mouthing (as the m-NMF signs have no mouthing) were excluded: NOT-YET, PROTECTION, REVERE, SEARCH, and STRESS. The statistical analysis reveals a difference of 8% in the reaction times of the NMF and m-NMF signs (see Table 5.11). The average reaction time for the NMF signs amounts to 771ms and for the m-NMF signs to 833ms. The results are significant at the 5% level (p = 0.049). The distribution of the reaction times is illustrated in Figure 5.8.

Tab. 5.11: Statistical analysis of the reaction times for all stimulus pairs without the NMF signs with mouthing

NMF	Statistical results
Yes	N = 213, $\overline{x}$ = 770.75, SD = 267.22
No	N = 297, $\overline{x}$ = 833.38, SD = 403.85
	F = 3.9, p-value = 0.049
	% difference NMF vs. m-NMF: 8

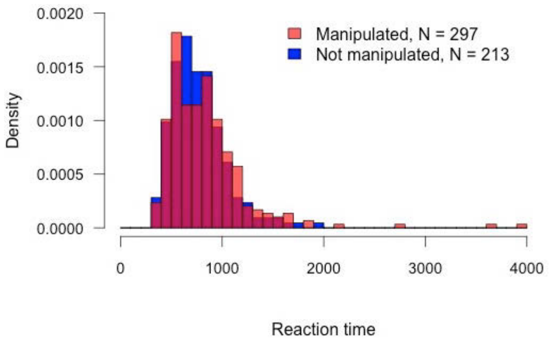

Fig. 5.8: Statistical distribution of the reaction times for all stimulus pairs without the NMF signs with mouthing

As in the analysis of the overall reaction times regarding all stimuli (see the first analysis in Section 5.4.1.3), a two-way ANOVA specified as before in a regression framework with the following regression equation is used:

$$\textit{reaction time}_i = \beta_0 + \beta_1 \textit{ order } 2nd_i + \beta_2 \textit{ nonmanual manipulation}_i + \beta_3 \textit{ nonmanual manipulation}_i \times \textit{order } 2nd_i + \varepsilon_i$$

Reaction time$_i$ is the reaction time for observation i. The variable *order* $2nd_i$ is unity if a sign of one stimulus pair occurred after the other sign of the same stimulus pair and zero otherwise. The *nonmanual manipulation*$_i$ variable is defined as above. Lastly, *nonmanual manipulation*$_i \times$ *order* $2nd_i$ denotes the interaction term between the two variables, ε_i denotes the residual.

As can be seen in Table 5.12, the average reaction times with the included order effect are as follows: i) NMF signs seen before the corresponding m-NMF signs: 838ms, NMF signs seen after the corresponding m-NMF signs: 704ms, ii) m-NMF signs seen before the corresponding NMF signs: 873ms, m-NMF signs seen after the corresponding NMF sign: 793ms. For the videos seen first, the analysis reveals 4% slower reaction times for the m-NMF signs which is insignificant though (p = 0.429). For the videos seen second, the analysis reveals 11% slower reaction times for the m-NMF signs which is significant at the 5% level (p = 0.048). Thus, these results show that a difference in the reaction times for NMF signs versus m-NMF signs could be proven only for the signs of the stimulus pairs seen second. This can be seen as an indicator that the reading speed carries weight. When participants see the first sign of a stimulus pair they have not read the particular answer word combination before (they only saw the preparatory list with all answer words in a random order prior to the beginning of the task (see Section 5.2.1.2)). It seems that, on average, the participants spent more time with reading the answer words of the sign seen first than of the sign seen second of each stimulus pair. It can be assumed that this diluted the percentage difference in the reaction times between the NMF and m-NMF signs seen first. Concerning the order effect, the data reveal that the decision is statistically significantly faster when participants see the second sign of a stimulus pair: The effect of the order is -133ms for the NMF signs (16%, p = 0.006) and -80ms for the m-NMF signs (9%, p = 0.049).

Tab. 5.12: Statistical analysis of the order effect without the NMF signs with mouthing

	Estimate	Std. error	t-value	p-value
(Intercept)	837.6792	34.00	24.64	< 0.001
Nonmanual manip.	35.1221	44.35	0.79	0.429
Order 2nd	-133.2400	47.97	-2.78	0.006
Nonmanual manip. x order 2nd	53.0483	62.86	0.84	0.399

Stimulus pairs without BROKEN, BLURRY, and CONCENTRATE

Because the single sign analysis (see Section 5.4.1.1) reveals three stimulus pairs for which the nonmanual manipulation did not show the expected impact of slower reaction times, in this section, the statistical analysis of the overall reaction times for all stimuli except the stimulus pairs BROKEN, BLURRY, and CONCENTRATE is presented. Again, an one-way ANOVA is used.

The results show a percentage difference of 13% between the reaction times of the NMF and m-NMF signs. The average reaction time for the NMF signs is 737ms and for the m-NMF signs 851ms. The difference between the reaction times is significant with $p < 0.001$. Table 5.13 and Figure 5.9 summarize the results.

Tab. 5.13: Statistical analysis of the reaction times for all stimulus pairs without BROKEN, BLURRY, and CONCENTRATE

NMF	Statistical results
Yes	N = 247, $\overline{x}$ = 736.71, SD = 241.88
No	N = 246, $\overline{x}$ = 851.30, SD = 419.95
	F = 13.8, p-value < 0.001
	% difference NMF vs. m-NMF: 13

5.4.1.4 Age-group comparison

In the next step, the reaction times are tested regarding the effect of the participants' age. Therefore, two groups were contrasted with each other: i) younger signers (between 14 and 31 years; mean age: 23.9), ii) older signers (between 44 and 61 years; mean age: 52.8). Age group i) is represented by 12 persons and group ii) by 5 persons. To simultaneously incorporate both influencing variables – *age* and *nonmanual manipulation* – a two-way ANOVA is used. This is done by means of setting up a standard regression equation, entailing linear effects for *age* and *nonmanual manipulation* as well as an interaction effect between both (see Field

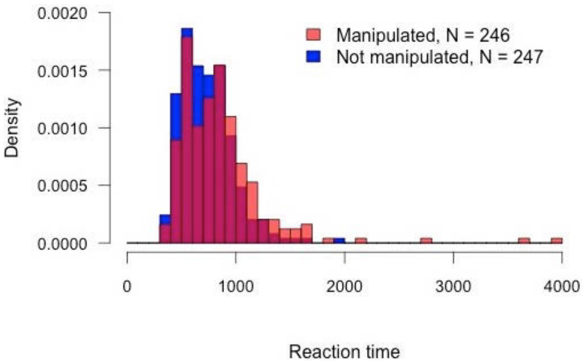

Fig. 5.9: Statistical distribution of the reaction times for all stimulus pairs without BROKEN, BLURRY, and CONCENTRATE

et al. 2012 and Fahrmeir et al. 2013 for further information on regression analysis). The analysis is used to assess the following two hypotheses:

$\mathcal{H}_0$: The difference between reaction times for NMF and m-NMF signs by younger signers is the same as the difference between reaction times for NMF and m-NMF signs by older signers.
$\mathcal{H}_1$: The difference between reaction times for NMF and m-NMF signs by younger signers is not the same as the difference between reaction times for NMF and m-NMF signs by older signers.

The used regression equation is as follows:

$$reaction\ time_i = \beta_0 + \beta_1\, young_i + \beta_2\, nonmanual\ manipulation_i + \beta_3\, young_i \times nonmanual\ manipulation_i + \varepsilon_i$$

Reaction time$_i$ is the reaction time for observation i. The variable $young_i$ is unity if the participant is born after the 31st December 1970 and zero otherwise. The *nonmanual manipulation*$_i$ variable is defined as above. Lastly, $young_i \times nonmanual\ manipulation_i$ denotes the interaction term between the two variables, ε_i denotes the residual. Table 5.14 shows the coefficients of the variables and their significance.

The average reaction times are as follows: i) younger signers NMF signs: 700ms, younger signers m-NMF signs: 789ms, ii) older signers NMF signs: 852ms, older signers m-NMF signs: 937ms. Thus, the effect of the nonmanual manipulation is +89ms for the younger signers (13%, p = 0.01) and +85ms for the older

Tab. 5.14: Statistical analysis of age groups

	Estimate	Std. error	t-value	p-value
(Intercept)	851.8427	34.9887	24.35	< 0.001
Young	-152.1132	41.8396	-3.64	< 0.001
Nonmanual manip.	85.4494	49.4814	1.73	0.0847
Young x nonmanual manip.	3.7394	59.1488	0.06	0.9496

signers (10%, $p = 0.08$). Younger and older signers need marginally significantly (1% level and 10% level) more time to process the m-NMF signs compared to the NMF signs. The difference between the reaction times for the NMF signs of the younger and older signers amounts to 18% ($p < 0.001$), the difference between the reaction times for the m-NMF signs of the younger and older signers is slightly lower and amounts to 16% ($p < 0.001$). Despite the general faster processing by younger signers, the nonmanual manipulation seems to have greater impact for the younger people than for the older people. But, this difference is rather small within the present data set (+89ms vs. +85ms). Nevertheless, these results are in line with the result of Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4) that lexical nonmanuals seem to be more important for younger signers.[10]

5.4.1.5 Manual manipulation vs. nonmanual manipulation

Lexical manual components of signs are much more often object of research than lexical nonmanual components. It is often assumed that nonmanual markers are not comparable with the manual components of signs (see Section 3.1). In order to obtain empirical insights into the comparability of manual and nonmanual components on the lexical level, the reaction times for manually manipulated filler signs are compared with the reaction times for nonmanually manipulated stimulus signs. For this, not all reaction times for the nonmanually manipulated signs are used but rather only the reaction times for m-NMF signs that occurred before the corresponding NMF sign of the same stimulus pair. Excluding the order effect is necessary to ensure the same experimental framework for manually and nonmanually manipulated signs as the manually manipulated signs did not occur in two conditions. The signs with manual manipulation are the filler signs in the type ii) *manually manipulated signs without lexical nonmanuals* and iii) *manu-*

10 It has to be noted that both age groups are represented by a different amount of signers with deaf parents. Whereas in the group of the older signers only one signer has deaf parents, in the group of the younger signers nine signers have deaf parents.

ally manipulated signs with lexical nonmanuals (see Table 5.3). A non-parametric bootstrap with 100000 repetitions is used. Due to the fact that different samples that stem from the same individuals are compared, independence assumptions required for classical ANOVA procedures cannot be upheld. Hence, bootstrap is used to draw inferences with regard to differences in the means, which account for the correlation structure (see Efron 1979, Efron & Tibshirani 1993 and Field et al. 2012 for further information on bootstrap). The analysis is based on 151 reaction times for the 18 nonmanually manipulated signs and 306 reaction times for the 18 manually manipulated signs. The underlying question is if the reaction times for manually manipulated signs are much longer than the reaction times for nonmanually manipulated signs. The basis for the statistical evaluation are the following hypotheses:

$\mathcal{H}_0$: Reaction times for manually manipulated signs are the same as reaction times for nonmanually manipulated signs.
$\mathcal{H}_1$: Reaction times for manually manipulated signs are not the same as reaction times for nonmanually manipulated signs.

Whereas $\mathcal{H}_0$ assumes that the reaction times are nearly the same, $\mathcal{H}_1$ implies that manual manipulations have a greater impact and the lexical decision takes more time.

The statistical analysis reveals that the decisions for manually manipulated signs take on average 1020ms and for nonmanually manipulated signs 873ms. According to this, the reaction times for nonmanually manipulated signs are 14% faster, but this is not statistically significant (see Table 5.15).

Tab. 5.15: Statistical analysis of manual vs. nonmanual manipulation

Manipulation	Statistical results
Manual	N = 306, $\overline{x}$ = 1020
Nonmanual	N = 151, $\overline{x}$ = 873
	p-value = 0.666
	% difference manual vs. nonmanual: 14

The analysis reveals no statistically significant structural difference between the reaction times for manually and nonmanually manipulated signs. This may well be due to the small sample size. Nevertheless, the results indicate that manual and nonmanual components seem to be not fundamentally different for the processing of signs. Manual components can be seen easier than nonmanual components due to more prominent articulators and this articulatory caused perception difference could be reflected in the reaction times. Figure 5.10 shows the statistical distribution of the reaction times for both manipulation types. Red denotes the reaction times for nonmanually manipulated signs, light green denotes the reaction times for manually manipulated signs, and dark green indicates the overlap between both.[11]

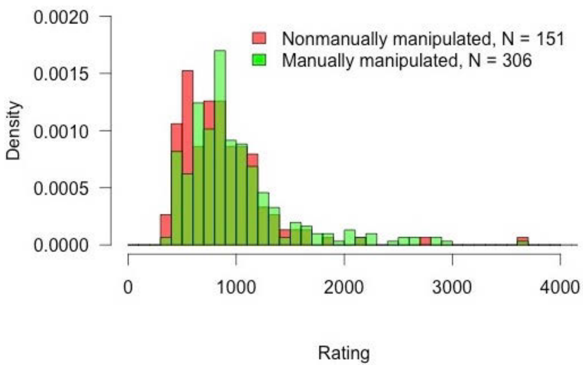

Fig. 5.10: Statistical distribution of the reaction times for nonmanually and manually manipulated signs

5.4.2 Manual meaning vs. nonmanual meaning

As described in Section 5.2.1.1, the nine fillers belonging to type iv) are manipulated signs which mix two different signs manually and nonmanually: EVIL <> HAPPY, DISGUSTING <> LAUGH, GLADLY <> SAD, HAPPY <> DISGUSTING, ILL <> GLADLY, JOYFUL <> RESISTANCE, LAUGH <> EVIL, RESISTANCE <> ILL, and SAD <> JOYFUL. For each of these filler signs, the sign mentioned first stands for the manual components and the sign mentioned second for the nonmanual components. Each filler combines two completely different meanings. Furthermore, the manual and nonmanual components of both signs are articulatory very different. The answer words are in each case the corresponding German words for the two mixed signs. To obtain more insights into the status of manual and nonmanual compo-

11 In monochrome print, red corresponds to dark grey, light green to light grey, and dark green to medium grey.

nents, it is gripping to analyze whether the participants selected the answer word belonging to the manual or nonmanual components. The results are summarized in Table 5.16.

The numerical proportion of 129 selections of the manual meaning to 24 selections of the nonmanual meaning shows that the participants tended predominantly to choose the meaning of the manual components. However, it is quite explicit that for three signs the overall meaning is less clear. These are the signs EVIL <> HAPPY, DISGUSTING <> LAUGH, and HAPPY <> DISGUSTING (see Figure 5.11). In particular for these three signs, the nonmanual components, for some signers, have a stronger influence on the overall meaning of the signs than the manual components. The sign HAPPY <> DISGUSTING yields the smallest difference within the selection of the manual or nonmanual meaning. It amounts to three selections.

Tab. 5.16: Selection of the manual or nonmanual meaning for fillers in type iv)

Sign	Manual meaning	Nonmanual meaning
EVIL <> HAPPY	12	5
DISGUSTING <> LAUGH	11	6
GLADLY <> SAD	17	0
HAPPY <> DISGUSTING	10	7
ILL <> GLADLY	17	0
JOYFUL <> RESISTANCE	17	0
LAUGH <> EVIL	16	1
RESISTANCE <> ILL	16	1
SAD <> JOYFUL	13	4

Fig. 5.11: Signs merged from two signs by taking the manual components of one sign and the nonmanuals of another: EVIL <> HAPPY, DISGUSTING <> LAUGH, and HAPPY <> DISGUSTING

5.5 Summary and discussion

Assuming that certain nonmanual elements are lexical, the underlying hypothesis of the current study is that nonmanual manipulations in terms of an omission of these markers have to be reflected in a slowing down of reaction times during lexical processing. In order to test this hypothesis, a reaction time study based on a forced-choice lexical decision task was conducted. As described in detail in Section 5.4.1, several steps for the statistical analysis of the data (in the form of 593 reaction times for the stimuli) were carried out. In accordance with the hypothesis, the analyses reveal an increased processing workload for m-NMF signs, which indicates the relevance of nonmanuals for lexical processing. This further supports the assumption that specific nonmanuals inherently belong to the lexical entries of certain signs in the mental lexicon. As part of Study I: *Lexical Judgment and the Meaning of Signs*, I discussed, inter alia, the relevance of nonmanual minimal pairs (see Section 4.4.3) which underlines that the difference in the reaction times between NMF and m-NMF signs is not just due to a facilitation of the lexical processing by gestural nonmanuals. The results of Study II: *Lexical Decision with Reaction Times* match with and complement the results of Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4).

The analysis of the overall reaction times for all stimulus pairs (see Section 5.4.1.3) reveals that the nonmanual manipulation causes longer reaction times. The lexical decision for NMF signs compared to m-NMF signs is 11% faster, which is significant with $p = 0.002$. Subsequently, some additional analysis steps excluding some stimuli were carried out. To sum up these different analyses, it can be stated that the nonmanual manipulation results in 7% to 13% slower reaction times. Depending on the exclusion of different signs from the analysis, the levels of the statistical significance are different, but all analyses of the overall reaction times are at least at the 10% level statistically significant.

The statistical analysis for all individual sign pairs (see Section 5.4.1.1) indicates that lexical nonmanuals to various degrees play a role for the processing of certain signs: For most of the investigated signs, the omission of the nonmanuals resulted in 4% to 6% longer reaction times. Some signs only showed a difference of 1% to 2%. Moreover, the signs ALWAYS, ARROGANT, NOT-YET, SEARCH, and WITHOUT revealed differences between 10% and 46%. Due to a too small sample size when analyzing individual sign pairs, the differences in the reaction times for NMF signs and m-NMF signs are statistically significant only for three sign pairs: ALWAYS, NOT-YET, and SEARCH. Nevertheless, the analysis reveals clear differences between the reaction times for NMF signs and m-NMF signs.

One important point concerns the relevance of lexical facial expressions not only in the form of muscle contractions in the lower face but also in the form of muscle contractions in the upper face. An example for this type of lexical nonmanuals is the sign WINK with a facial expression in the upper face only (see Figure 5.12). The single sign analysis shows a difference of 5% between the average reaction times for the NMF and m-NMF version of WINK (see Section 5.4.1.1). One further example is the sign SHOCK, which has muscle contractions in the lower and upper face as well as a torso/head action. SHOCK reveals a difference of 6% between the average reaction times for the NMF and m-NMF sign (see Section 5.4.1.1).

Fig. 5.12: The sign WINK with lexical muscle contraction in the upper face

Regarding different lexical nonmanual sign types, the analysis shows that nonmanuals for all three types clearly belong to signs and have an impact on processing, facilitating comprehension (see Section 5.4.1.1). Comparing the results for the different nonmanual sign types, it is particularly interesting that the signs with a torso/head action reveal the biggest difference between the reaction times for NMF and m-NMF signs. On average, the percentage differences are as follows: i) signs with lexical facial expression (= condition A and D) 9%, ii) signs with lexical facial expression and torso/head action (= condition B and E) 8%, and iii) signs with torso/head action (= condition C and F) 14%.

The statistical comparison of the reaction times for NMF signs without mouthing versus NMF signs with mouthing (see Section 5.4.1.2) shows a 12% faster lexical decision for signs with mouthings, which is statistically significant at the 5% level. This indicates that already very slight lip movements referring to a German word lead to a faster selection of the fitting written word. However, in order to make sure that the difference in the reaction times between both NMF sign groups is exclusively due to the mouthings the same signs with and without mouthing (without another difference in the sign form) have to be contrasted. Based on the present results, it cannot be ruled out that the faster reaction times of the signs with slight mouthing are due to other undetected factors. For the purpose of checking the influence of mouthings in more detail, it would be worthwhile to conduct a follow-up study with signs in the following four conditions: i) sign with mouthing and with lexical nonmanuals, ii) sign with mouthing and with lacking lexical nonmanuals, iii) sign with lacking mouthing and with lexical nonmanuals, iv) sign with lacking mouthing and with lacking lexical nonmanuals.

The comparison of two age groups (see Section 5.4.1.4) reveals longer reaction times for older signers (mean age: 52.8) compared to younger signers (mean age: 23.9). The analysis shows marginal statistical significant differences between NMF and m-NMF signs for younger as well as older signers. The nonmanual manipulation has a slightly larger impact for the younger signers: 13% ($p = 0.01$) compared to 10% for the older signers ($p = 0.08$).

The analysis of the overall reaction times for manually versus nonmanually manipulated signs (see Section 5.4.1.5) reveals no statistically significant structural difference. Manual and nonmanual components seem to be not fundamentally different for the processing of signs. However, it has to be noted that manual components are signed with visually more prominent articulators than nonmanual components. Furthermore, the DGS lexicon consists of many signs without lexical nonmanual markings whereas there are very few signs, if any, that have only nonmanual components (for the discussion of nonmanual signs in sign languages, see Section 3.1.3).

Finally, the analysis of the manipulated filler signs, which mix two different signs manually and nonmanually, indicates that manual components seem to be more crucial for the lexical meaning of signs (see Section 5.4.2). Nevertheless, it has been shown that in particular for three stimuli the deaf participants often tend to select the meaning of the nonmanual components as the overall meaning of the signs. This underlines that manual as well as nonmanual components play an important role on the lexical level and their relevance is comparable. In this context, it is important to note that usually manual signs may be combined with different adverbial or adjectival facial expressions (see Section 2.2.2). Hence, signers are used to process nonmanual modifications of lexical manual signs. In contrast, manual components are not used to modify the meaning of nonmanuals. This may explain the fact that signers tend to more often select the meaning of the manual components as the overall meaning of the mixed signs.

Lastly, it has to be mentioned that this reaction time study is just a first step along this path. For further investigations in this direction, to achieve highest possible accuracy within the measurements of reaction times it is recommended to use a response box. Nevertheless, the structural clarity within the statistical results shows that the chosen technique for the measurement of reaction times is usable. For instance, regarding the effect of order, reaction times revealed that for the NMF signs as well as for the m-NMF signs the decision is faster when the participants see the second video of a stimulus pair. This regularity of the reaction times is an indicator that the design of the study worked.

6 Study III: Meaning attribution to isolated facial expressions

6.1 Research question

Research on sign languages has long focused on providing evidence for the grammatical status of manual signs and nonmanual elements. Since this has become an undeniable fact, the gestural origin of manual and nonmanual features and the gesturing of signers now are more and more taken into account (cf. Wilcox 2004; Özyürek 2012). In the visual modality and in the auditory modality, nonmanuals may express emotions, attitudes, and reactions. However, a striking contrast between signers and speakers is that the former mainly use the face to nonmanually gesture and the latter also apply acoustic gestures, the voice quality, and intonation to express affective information in the broadest sense (cf. Emmorey 1999; Liddell 1980). As only signers also use nonmanuals for lexical and grammatical functions, it is interesting to investigate whether this has a general effect on the perception of facial expressions. Another important point is the fact that single gestural elements can be used without an accompanying signed or spoken word. It is possible, for instance, to communicate on the gestural level just by a smile. Grammatical and lexical nonmanuals, in contrast, usually need to have a manual host that they align with. Despite clear criteria differentiating between, on the one hand, lexical and grammatical nonmanuals and, on the other hand, emotional and gestural nonmanuals (see Section 2.2.3), blurred cases appear due to the facts that i) the same nonmanual feature is typically used in gestural and affective functions as well as in linguistic functions, and ii) we deal with a grammaticalization continuum between nonmanual gestures and nonmanual linguistic markers (cf. Herrmann & Pendzich 2014). Head shake, for example, is a gestural negative marker in many spoken languages (cf. Harrison 2014) and has become an essential grammatical marker of negation in basically all sign languages examined so far (cf. Zeshan 2004a; van Loon et al. 2014; Pfau 2015).

In this chapter, I present an empirical perception and meaning attribution study on lexical and grammatical facial expressions in DGS, conducted in collaboration with Annika Herrmann. The study aims at getting deeper insights into nonmanual actions at the interface between gesture, emotion, and sign. The meaning of muscular actions in the lower and upper face is investigated by presenting stimulus videos with different facial expressions articulated by one male deaf signer. The following three issues are decisive:

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1. Which meaning attributions do grammatical and lexical facial expressions get when observed separately from manual signs? Are they different for hearing and deaf subjects? Are the meaning attributions of deaf signers more consistent and is there a clear connection to the linguistic system of these facial expressions?
2. Do deaf signers and hearing speakers have the same inventory of facial gestures?
3. Do meaning attributions to isolated facial expressions support compositional accounts (cf. Nespor & Sandler 1999; Dachkovsky 2008; Herrmann 2012; Dachkovsky et al. 2013; Cavicchio & Sandler 2015), which attribute meaning to certain nonmanual components?

In the following, I start with the description of the methodology of the study. I clarify the precise design (Section 6.2.1) and the metadata of the participants (Section 6.2.2). Afterwards, I provide an overview of the elicited data set and explain the categorization of the data (Section 6.3). Subsequently, I present the results of the study (Section 6.4). In the last section, I summarize and discuss the results (Section 6.5).

6.2 Methodology

6.2.1 Study design

6.2.1.1 Stimuli and fillers

The study is based on 24 stimulus videos that show in each case a facial expression which is used as a grammatical and/or lexical marker in DGS. For comparison, we added one video with neutral facial expression. The videos are restricted to the face, the neck, and a small part of the shoulders. Ten stimuli include muscular actions in the lower face only, nine stimuli show muscular actions in the upper face only, and five stimuli present muscular actions in both face halves. Six stimuli show an individual AU. The other stimuli present combinations of two to nine AUs. The stimuli were articulated by a deaf signer and recorded with a Sony HDR-CX550VE full-HD camera. Subsequently, the videos were cut with the video editing software application Adobe Premiere Pro.[1] All facial expressions were coded

1 As described, the present study use naturally articulated stimulus videos. An alternative approach would be to use realistic synthetic 3D stimuli, which could be produced with the tool FACSGen (cf. Roesch et al. 2010). With this tool, it is possible to create realistic constant or dynamic facial expressions based on the AUs of FACS (cf. Ekman et al. 2002b).

with FACS (cf. Ekman et al. 2002b). Table 6.1 gives an overview of all stimuli listing the articulated AUs as well as an example for a grammatical or lexical function of each facial expression (see Appendix E for illustrations of each stimulus video).

Tab. 6.1: Action Units (AUs) within the stimuli

Stimulus	Face	AUs	Example for grammatical or lexical function
	Lower		
a)		17+R19+R25+26	sign RECENTLY
b)		19+25+26	sign LAZE
c)		17+R25+R33	sign ALWAYS
d)		18	sign FAVORITE
e)		22+25+33A	sign OWN
f)		17	sign AGREE
g)		18+25+33A	sign WITHOUT
h)		17+25+33	sign EFFORT
i)		19+25+26+33	sign SQUANDER
j)		17+25+33A	sign DISAPPEAR
	Upper		
k)		4	wh-interrogatives
l)		1+2	conditionals
m)		5	sign AMAZE
n)		7+43	sign FOG
o)		7	low accessibility
p)		43E	sign TIRED
q)		45	prosodic boundary marker
r)		1+2+5+7	yes/no-interrogative with low accessibility
s)		4+7	wh-interrogative with low accessibility
	Lower and upper		
t)		6+7+9+12+19+20+25+26+58	sign DISGUST
u)		4+5+7+9+17+24+38	sign ANGER
v)		6+7+9+12+25+33A	sign STRANGE
w)		5+10+25+33A	sign SUDDEN
x)		6+7+9+12+19+25+26	sign ANNOY

Regarding stimulus r), it has to be noted that the tightening of the lids (AU 7) starts later than the other AUs. Thus, in the analysis, it has to be taken into account that possibly some participants overlooked AU 7 and labeled only the eye brow movements (AU 1+2) and the upper lid raise (AU 5). Stimulus t) is the only video that shows a head action which belongs to the linguistic facial expression. This stimulus refers to the sign DISGUST which includes a lexical facial expression and head back action (AU 58). With respect to the given example for stimulus f), it has to be mentioned that the sign AGREE is usually signed with head nod (AU 85) in addition to the facial expression. As already explained for the stimuli with lexical nonmanuals in Chapter 4, due to high dialectal variation in DGS, it can be assumed that phonetic variabilities and nonmanual sign variants exist for the given examples of signs with lexical nonmanuals in Table 6.1. Hence, the indication of examples does not mean that these signs generally only occur with exactly the same AUs. One example for phonetic variation seems to be the sign ANNOY which may be articulated with an upper lip raiser (AU 10) instead of the nose wrinkle (AU 9) used in the stimulus video.

Instructive examples that illustrate, on the one hand, the important role of the duration of facial expressions on the lexical level, and, on the other hand, the relevance of intensity differences of AU 33 are the stimuli h) and j). Whereas stimulus j) is coded as AU 17+25+33A, stimulus h) is coded with the same AUs but differs with regard to expanded cheeks. Besides the difference between AU 33 and 33A, the main difference between both facial actions is the duration of the blow. In stimulus j), which shows the facial expression of the sign DISAPPEAR, the blow is very quick. In contrast, in stimulus h), the blow has a considerably longer duration and higher intensity. This facial expression refers, for example, to the sign EFFORT. Generally, the duration of a lexical facial expression and the duration of a manual sign correlate. The sign DISAPPEAR has one path movement with a secondary movement in the form of a closing of the hand form. The mouth pattern is aligned with these manual movements. The sign EFFORT is articulated with a path movement without a secondary movement and the mouth pattern accompanies the manual sign without a change in the muscular contraction.

Examples for unilateral versus bilateral facial actions are the stimuli c) and h). Both facial expressions are articulated with the same AUs but differ with respect to unilateralism. Whereas all AUs are articulated bilaterally in stimulus h), two AUs are unilateral in stimulus c): 17+R25+R33.

As illustrated in Figure 6.1, stimulus videos start with a largely neutral face followed by an increasing facial expression, and end with the individual apex of the articulated facial expression. Exceptions are those videos which show very rapid actions such as an eye blink. These videos return to a neutral face in order to be fully understood. This concerns solely the stimuli j) and q).

Fig. 6.1: Example of the structure of the stimulus videos

The following criteria are decisive for the stimulus videos: i) eye gaze directed to the camera, ii) no unintended eye blinks, iii) facial expression which reaches relatively quickly the individual apex, iv) largely the same onset of different AUs, and v) largely neutral head position (apart from stimulus t)).

All of the stimulus videos have a duration of one to two seconds. Whereas facial expressions corresponding to lexical signs have in neutral signing approximately the same duration as in the stimulus videos, usually, facial expressions used for the named grammatical functions have in signed sentences a longer duration than in the stimulus videos (except for the prosodic blink). However, as all videos with the exception of stimuli j) and q) end with the individual apex of the articulated facial expression which remains as still image, the facial expressions are present longer than the videos last.

As input for the recording of the stimuli, the deaf informant saw German words for signs which are assumed to have an inherent lexical facial expression, German sentences for the translation into DGS, and instructions for the articulation of specific facial expressions in a PowerPoint presentation. Furthermore, I gave him instructions in DGS.

As fillers eight stimuli of a related study are used. Each of these videos show an emotional facial expression. The selection of these facial expressions followed Ekman 1979, Ekman & Friesen 2003, and Ekman 2010. It has to be mentioned that overlaps occur between the emotional, grammatical, and lexical facial expressions. On the one hand, some of the grammatical and lexical facial expressions can be used emotionally as well, for example upper lid raise (AU 5). On the other hand, there are overlaps between grammatical and lexical facial markers. For example, eyebrow raise (AU 1+2) is used as an interrogative marker in many sign languages (see Section 2.2.2) and, on the lexical level, e. g. as part of the sign SHOCK in DGS. Table 6.2 gives an overview of the numerical proportion of the stimuli and fillers subdivided into muscle contractions in the lower face, the upper face, and the combination of both.

Tab. 6.2: Amount of stimuli and fillers in relation to the used face halves

Function	Total	Lower face	Upper face	Lower and upper face
Stimuli				
Grammatical and/or lexical	24	10	9	5
Comparison				
Neutral	1	–	–	–
Fillers				
Emotional	8	1	4	3

6.2.1.2 Design of the questionnaire

The perception study on the meaning of facial expressions is based on two online video questionnaires: one for deaf participants and one for hearing participants. The instructive videos for deaf participants were signed in DGS by one female deaf signer. Hearing participants got written instructions in German. The stimulus videos were signed by one male deaf signer. The questionnaire is created with the sofware OnExp (Onea/Syring).[2] The data elicitation procedure consisted of the following six steps:

1. Welcome video for deaf participants or welcome text for hearing participants
2. Metadata questionnaire: information about the name, age of birth, place of birth, gender, place of residence, e-mail address, hearing status, age since current hearing status, hearing status of the parents, mainly used language, preferred language, age of DGS acquisition, school/university, and profession
3. Instruction video for deaf participants or instruction text for hearing participants
4. Practice session
5. Task
6. Video expression of thanks for deaf participants or written expression of thanks for hearing participants

In step 3, the participants received the explanation of the task which is to label the meaning of each face video. As illustrated in Figure 6.2, per each stimulus the participants saw a single video and below an input field for labeling the meaning. On the left side below the video, a button is positioned for repeating the current video. Each video could be seen several times.

As mentioned in Section 6.2.1.1, stimulus videos end with the individual apex of the articulated facial expression. To end with the maximum of the facial expres-

2 For further information on OnExp, see https://onexp.textstrukturen.uni-goettingen.de.

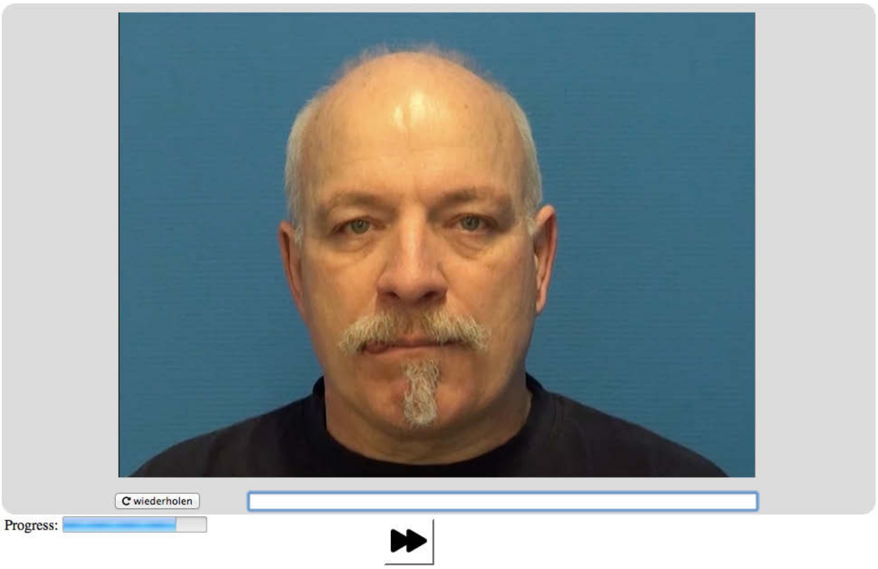

Fig. 6.2: Design of the meaning attribution task in the questionnaire

sion has the advantage that the participants saw the facial expression they had to label at the end of the video. This facial expression remained as a still image during the entering of the meaning attribution by the participants.

The practice session consists of four practice videos designed in the same way as the stimuli and fillers. Hereby, the participants were familiarized with the task. For each data elicitation, a spontaneously randomized list of the stimuli and fillers was used. In this way, potential effects regarding the order of the videos could be eliminated.

With respect to facial expressions of emotions, Rosenberg & Ekman (1995) did studies based on similar tasks with hearing subjects. The participants were "either providing labels of their own choice to describe the stimuli (free-choice condition), choosing a label from a list of emotion words, or choosing a story from a list of emotion stories (fixed-choice conditions)" (Rosenberg & Ekman 1995, 111). When comparing these studies with the study at hand, the following six main differences of the *Meaning Attribution Study* have to be underlined: The study i) is carried out with hearing and deaf subjects, ii) uses linguistic facial expressions of DGS as stimuli, iii) focuses on the investigation of the interface between linguistic facial expressions and affective/gestural facial expressions, iv) uses videos instead of still images, v) is based on spontaneously randomized orders of the stimuli for each subject instead of one randomized order for all participants, and vi) is not performed as group participation. Regarding the last point, it has to be mentioned that Rosenberg & Ekman (1995) did the tasks with groups of participants. This leads to the procedure that each slide is presented for a fixed time: 30 seconds for viewing and judging the stimulus (cf. Rosenberg & Ekman 1995, 117). In contrast, in the present study, the participants decided by themselves how much time they spent with each stimulus.

Another example for a perception study on emotional facial expressions is the online emotion recognition test (ERT) by Merten (2001, http://www.gnosisfacialis.de/infoERT.html). This test contains 28 still photographs with facial expressions of seven different emotions: happiness, fear, disgust, surprise, anger, sadness, and contempt. Participants can decide how much time they spend with each picture. When they are ready for the judgment, they have to click on a button on the right of the picture. Then, on the next side, a list with seven emotion terms appears for selecting the best fitting one. Hence, during the classification of each emotion shown, the photograph is not present. At the end of the task, each participant gets the results of the ERT.[3]

It should be noted that many studies on universals in emotional facial expressions are based on a fixed-choice paradigm and photographs or slides as stimuli (cf. Rosenberg & Ekman 1995, 112). However, in particular with respect to lexical facial expressions of sign languages, there is a difference in perceiving them in the form of still images or facial actions in videos. Many lexical facial expressions as, for instance, that of the DGS sign SUDDEN, can hardly be fully understood by viewing one still photograph. Furthermore, the viewing of facial expressions as videos better corresponds to the natural perception of facial expressions in social interactions. Therefore, we decided to use videos.

6.2.2 Participants

The study is based on the participation of i) 22 deaf or hard of hearing signers[4] (15 women, 7 men) aged between 20 and 51 (mean age: 32.1) and ii) 22 hearing

3 Stokoe & Battison (1975) observed that a particular video-taped facial expression was interpreted positively by deaf signers and negatively by hearing signers (cf. Baker 1977, 231). Unfortunately, I had no access to the paper by Stokoe & Battison (1975) which was presented at the Michael Reese Medical Center Workshop, Toward Understanding the Mental Health Needs of Deaf Adults, Chicago, III. Therefore, I do not know whether Stokoe & Battison (1975) carried out a complete perception study on facial expressions by hearing and deaf subjects or whether the given observation is an isolated case.

4 In the following, I will use the term *deaf* for the deaf and hard of hearing subjects. The two hard of hearing participants acquired DGS as their native language.

speakers (13 women, 9 men) aged between 19 and 33 without DGS competence (mean age: 27.2).[5] Table 6.3 summarizes the relevant anonymized metadata of the deaf participants and Table 6.4 of the hearing participants. Both tables list a fictive name abbreviation (A, B, C, ...), gender, age at participation, age since current hearing status, age of DGS acquisition, hearing status of the parents, and the preferred language. Because of privacy reasons, the places of birth and the cities the participants live in are not listed in the tables.

All hearing participants have hearing parents, their preferred language is German, and they have no DGS competence. 14 of the deaf participants have deaf parents or one deaf parent and acquired sign language as native language. The other deaf participants acquired DGS before the age of six. Only participant P acquired DGS since he was seven years old, but he has deaf parents and his first native language is Russian Sign Language (RSL). The preferred language of all deaf participants is DGS. Only one participant mentioned DGS as well as German as preferred languages. Participant O has deaf parents but, nevertheless, stated that she learned DGS since she was six years old. It can be assumed that this specification refers to the acquisition of DGS at school. Besides many advantages of online questionnaire studies (e. g. time saving and people can participate in their familiar environment), one disadvantage is that unclear points regarding the metadata cannot be directly discussed. However, important questions can be clarified via e-mail.

Tab. 6.3: Metadata of deaf participants

Signer	Gender	Age	Deaf at age	DGS at age	Deaf parents	Preferred language
A	m	33	0	0	yes	DGS, German
B	f	29	0	1	no	DGS
C	f	22	0	0	yes	DGS
D	m	24	0	0	yes	DGS
E	f	21	0	0	yes	DGS
F	f	20	0	0	yes	DGS

5 Furthermore, so far five hearing subjects with DGS competence participated in the study. As it can be assumed that sign language competence may have an influence on the perceiving of facial expressions, these participants have to be treated as separate group. In further investigations, it would be interesting to analyze the impact of sign language competence on the meaning attributions by hearing participants.

Signer	Gender	Age	Deaf at age	DGS at age	Deaf parents	Preferred language
G	f	27	0	1	no	DGS
H	f	38	0	0	yes	DGS
I	f	44	0	3	no	DGS
J	m	29	0	0	yes	DGS
K	f	28	0	2	no	DGS
L	f	27	0[a]	0	yes[b]	DGS
M	f	32	0[a]	0	yes[b]	DGS
N	f	21	3	0	yes	DGS
O	f	51	0	6	yes	DGS
P[c]	m	29	0	7	yes	DGS
Q	m	51	0	0	yes	DGS
R	m	31	0	4	yes[b]	DGS
S	m	51	0	5	no	DGS
T	f	25	0	0	no[d]	DGS
U	f	25	0	2	no[d]	DGS
V	f	48	1	5	no	DGS

[a] hard of hearing
[b] mother: deaf, father: hard of hearing
[c] first native language: Russian Sign Language (RSL)
[d] mother: hard of hearing, father: hearing

Regarding the deaf participants, the study was initially carried out with one more signer. This signer had to be excluded from the analysis due to the fact that he comes from Bulgaria and learned DGS not until the age of 33. Regarding the hearing participants, the data of 10 female signers are not included in the analysis in order to have the same number of hearing and deaf participants. The circumstance that the data elicitation was carried out with more hearing participants than required is based on the issue to get a sufficient number of male participants. As the study was carried out via the Internet, it was not possible to control the participants with respect to gender. Furthermore, another subject of the hearing group had to be excluded because of being hard of hearing. Hard of hearing people without DGS competence form a separate participant group. It can be assumed that they have a different perception of facial expressions than the following three other participant groups: i) hearing people without DGS competence, ii) hearing people with DGS competence, and iii) deaf people with DGS competence.

Tab. 6.4: Metadata of hearing participants

Speaker	Gender	Age	Hearing at age	DGS	Hearing parents	Preferred language
A	m	27	0	no	yes	German
B	m	22	0	no	yes	German
C	f	29	0	no	yes	German
D	f	30	0	no	yes	German
E	m	32	0	no	yes	German
F	f	22	0	no	yes	German
G	m	24	0	no	yes	German
H	f	23	0	no	yes	German
I	f	33	0	no	yes	German
J	f	21	0	no	yes	German
K	m	33	0	no	yes	German
L	f	29	0	no	yes	German
M	f	30	0	no	yes	German
N	f	19	0	no	yes	German
O	f	23	0	no	yes	German
P	m	24	0	no	yes	German
Q	m	32	0	no	yes	German
R	m	29	0	no	yes	German
S	m	31	0	no	yes	German
T	f	24	0	no	yes	German
U	f	32	0	no	yes	German
V	f	30	0	no	yes	German

6.3 Data and categorization

As explained in Section 6.2.1, each participant got the task to label the meaning of 24 stimuli, the neutral video, and the fillers. In this way, data in the form of meaning descriptions for muscle activations in the lower face, upper face, and in both were elicited. For the stimuli and the neutral video, this results in 1085 meaning descriptions subdivided into 538 by deaf subjects and 547 by hearing subjects. The participants could use their own descriptions for the facial expressions without strict specifications. The meaning descriptions often consist of more than one meaning attribution (MeaAtt). In 15 cases, a stimulus was not labeled (deaf subjects: 12, hearing subjects: 3).

The subsequent categorization of the MeaAtts was carried out by two professional hearing linguists who fluently sign DGS. One of them (the author) is a certified FACS-coder by Paul Ekman, Wallace V. Friesen, and Joseph C. Hager. Based on the empirical data, a classification of the elicited MeaAtts was developed with 66 MeaAtt categories (e. g. *happiness, dislike*, *interrogative*) and four main categories to which the individual MeaAtt categories belong: *grammatical, lexical, gestural*, and *affective* (see the list of all MeaAtt categories in Appendix F). Hence, each MeaAtt given by the participants is categorized in two ways: i) selection of one or more fitting MeaAtt categories, and ii) classification of each MeaAtt category in one of the four main categories.

The main category *grammatical* is represented by the following four MeaAtt categories: *interrogative (wh-interrogative, yes/no-interrogative or interrogative), continuation, emphasis*, and *low accessibility*. These grammatical MeaAtt categories were set based on the elicited data. The main category *lexical* is represented by the MeaAtt category *sign*, which is in each case combined with precise English glosses that refer to the specific signs in DGS. The classification of certain MeaAtts as link to lexical signs was initially based on the DGS competence of the two mentioned linguists, DGS dictionaries, and previous empirical data elicitations with deaf subjects. Afterwards, based on the stimulus videos and the MeaAtts by the participants, the lexical classifications were discussed with a deaf native informant. In accordance with his judgments, the classifications were revised. An answer is classified as lexical activation when the given MeaAtt refers to a sign that has the presented facial expression as a lexical component. A further indicator for the lexical group is when a given answer corresponds to the sign that the sign model used while articulating the facial expression shown in the stimulus video. Another indication is that some answers by deaf subjects were completely different from answers by hearing subjects. Of course, there are some uncertain cases within the data but clear cases of doubt were not categorized as lexical. Possibly, there are some more links to lexical signs in the data. To be as objective as possible, *grammatical* and *lexical* MeaAtt categorizations were classified with a *gestural* or *affective* MeaAtt category as well.[6] Besides, many MeaAtts only belong to the main categories *gestural* and/or *affective*. With respect to the main category *affective*, 26 MeaAtt categories are relevant. The main category *gestural*

6 The MeaAtt category *sign: life-partner* is one exception as it is a very specific lexical meaning that has no *gestural* or *affective* analogue.

is represented by 40 MeaAtt categories.[7] Furthermore, the following three special categories were used: *no response*, *description*, and *neutral*. The categories *no response* and *description* are used to differentiate between real meaning labels and cases without an answer and instances where the facial expression is described articulatory and not semantically (e. g. *protruding tongue*). The category *neutral* is applied when participants described a facial expression as *neutral*. A few MeaAtt categories are used within two main categories. One example is the MeaAtt category *dislike* which can either occur in the main category *gestural* or in the main category *affective*. The assignment depends on the shown facial expression and the type of description by the participants.

It has to be mentioned that the distinction between the main categories *gestural* and *affective* is difficult in some cases. Likewise, Ekman (1979, 193) states that "the distinction between emotional and conversational social signals is not always clear cut". Basically, a MeaAtt is classified as *affective* when the participants' meaning label describes an emotion such as anger, happiness, and sadness. "[E]motional expressions are involuntary signals which provide important information to others" (Ekman 2004, 44). In contrast, a MeaAtt is graded as *gestural* when it rather describes a gestural use of the respective facial expression like warning, lack of knowledge or questioning. This means a facial expression is perceived as more consciously and intentionally used. However, the occurrence of gestural signals is more complex as voluntary actions may become habits and may be used automatically. One example for spoken language is that "[u]sing the eyebrows to mark emphasis during speech can be done voluntarily, but usually it is done with little awareness or seeming choice" (Ekman 1979, 179). All MeaAtts that do not express an affective state were classified as gestural. Here, it is important to pay attention to those specific cases in which a MeaAtt belongs to the *gestural* category although it refers to an affective state. These are MeaAtts such as *simulating to be surprised*. This MeaAtt is categorized as *fake* and is counted as *gestural*.

The categorization of MeaAtts can be illustrated with the following example: stimulus e) *lip funneler / blow* (AU 22+25+33A; see Figure 6.3).[8] Table 6.5 in the

7 Related common research terms for non-emotional facial expressions besides the term *gestural* are *conversational actions* or *conversational signals* (cf. Ekman 1979; Ricci Bitti 2014). I decided to use the term *gestural* in order to analyze facial expressions without assumptions regarding a different status of these markers compared to manual gestures.

8 For each discussed stimulus, I use a simplified label (e. g. *lip funneler / blow*) that describes the facial expression. These labels are based on the terminology of FACS, but do not include the description of all AUs. These labels are used to give the reader a quick impression of the external left column summarizes typical MeaAtts given by ten deaf participants. The other four columns show the categorization of each MeaAtt.

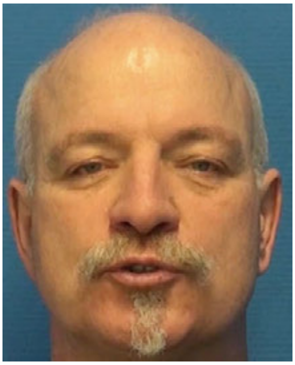

Fig. 6.3: Stimulus e) *lip funneler / blow* (AU 22+25+33A)

As illustrated in Table 6.5, each answer is categorized, on the one hand, with regard to the 66 MeaAtt categories and, on the other hand, regarding the four main categories. For example, we classified the answer "Do you have? (SCH)" as MeaAtt category *yes/no-interrogative* which belongs to the main category *grammatical* as the facial expression is interpreted as a question. As equivalent to this grammatical classification the MeaAtt category *questioning* is added under the main category *gestural*. Because the activation of a specific lexical sign by seeing this facial expression is obvious, the MeaAtt belongs to the main category *lexical* as well. In DGS, the sign OWN has as inherent part the facial expression shown in the stimulus (for further discussions of this stimulus, see Section 6.4.2 and Section 6.4.5).

6.4 Results

6.4.1 Meaning attributions (MeaAtts) by deaf and hearing subjects

Figure 6.4 provides an overview of the distribution of the MeaAtts within the four main groups *gestural, affective, grammatical*, and *lexical*. As already explained in Section 6.3, it should be noted that the participants often used more than one MeaAtt for the description of the meaning of a stimulus. The general distribution

appearance of the facial expressions. For the detailed muscular description, the AUs are listed in brackets. Furthermore, all stimulus videos are illustrated with pictures in Appendix E.

Tab. 6.5: Examples of the categorization of MeaAtts based on the stimulus *lip funneler / blow*

Participants' answers	Grammatical	Lexical	Gestural	Affective
darling, life partner	–	sign: LIFE-PARTNER	–	–
concentrated, lost in thought	–	–	concentration	–
psst!	–	sign: QUIET	be quiet	–
As if he says beautiful	–	–	*description*	–
Do you have? (SCH)	yes/no-interrogative	sign: OWN	questioning	–
agreeing	–	–	consent	–
pscht	–	sign: QUIET	be quiet	–
quiet	–	sign: QUIET	be quiet	–
sch	–	sign: SCH (life partner, own)	–	–
sch... do you have...	yes/no-interrogative	sign: OWN	questioning	–

of affective and gestural MeaAtts is the same for deaf and hearing subjects. Deaf and hearing subjects used 34% more gestural MeaAtts than affective MeaAtts (affective MeaAtts by deaf subjects: 210, gestural MeaAtts by deaf subjects: 319, affective MeaAtts by hearing subjects: 245, gestural MeaAtts by hearing subjects: 370).

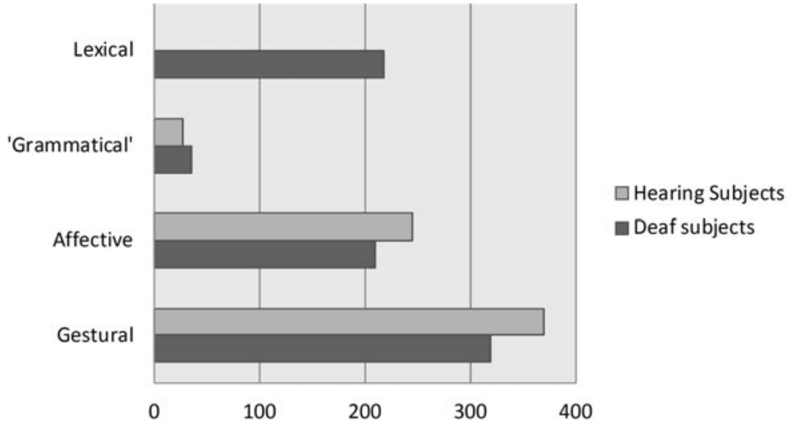

Fig. 6.4: Distribution of the MeaAtts within the four main categories by deaf and hearing subjects

As the same classification criteria were used for hearing and deaf subjects, also, answers by hearing participants were categorized as grammatical MeaAtts. MeaAtt categories that belong to the grammatical classification are *interrogatives (wh-interrogatives, yes/no-interrogatives, unspecified interrogatives), emphasis, continuation*, and *low accessibility*. These grammatical MeaAtt categories were set based on the empirical data we got. As facial expressions are no grammaticalized markings in spoken languages, the classification term 'grammatical' is put in single quotation marks in Figure 6.4. For deaf subjects, we found 35 grammatical MeaAtts and, for hearing subjects, 27. It is interesting that, despite the grammatical status of specific facial markers in DGS, the amount of grammatical MeaAtts is only 23% higher for deaf participants compared to hearing participants. This can be seen as an indicator for the gestural origin of grammatical markings in sign languages. As a reason for the overall low amount of grammatical MeaAtts by deaf subjects one can state that grammatical facial markings usually occur for a longer duration in natural signing than shown in the stimulus videos. Furthermore, the spread of grammatical facial features aligns with the manually articulated sentence structure. In contrast, the stimuli do not include manual signs.

The main difference within the MeaAtts by both participant groups is the impact of lexical MeaAtts by signers. The data reveals that MeaAtts by deaf signers very often depend on lexical facial expressions. Based on the MeaAtts by deaf participants, the categorization, and the follow-up discussion with our deaf informant, we counted 218 MeaAtts that show a link to a lexical sign in DGS.

In the following sections, firstly, I focus on lexical and grammatical MeaAtts and, secondly, I discuss differences and commonalities in the MeaAtts by deaf and hearing subjects. In this way, MeaAtts for several stimuli will be discussed in detail.

6.4.2 Lexical MeaAtts

With respect to lexical MeaAtts the following fifteen stimuli are especially interesting: a), b), c), e), g), h), i), j), k) p), s), t), v), w), and x). Certain stimuli lead, on the one hand, to the activation of signs that have exactly the same lexical facial expression as shown in the respective stimulus and, on the other hand, to the activation of signs that have a similar lexical facial expression. In the following, I will discuss five stimuli for the lexical activation in detail.

Table 6.6 summarizes the elicited MeaAtts for the stimulus a) *lateral tongue show* (AU 17+R19+R25+26). It is very interesting that the data by deaf participants reveal clear links to the lexical signs NEARLY, LITTLE, CHEAT, ANNOY, and TASTY. Only CHEAT and ANNOY which fall in the gestural category *mockery* show a relation to the MeaAtts by hearing participants. It can be assumed that for these signs the lexicalized tongue show originates from the gesture *sticking-out-the-tongue*. It has to be mentioned that the lexical tongue show of the sign ANNOY is centered in citation form (AU 19) and not lateral (AU C19). Regarding the sign TASTY, it has to be noted that this sign is usually articulated with a movement of the tongue. The corresponding gestural category for the sign TASTY is *tasty*, for the signs NEARLY and LITTLE it is *closeness*. No MeaAtts for this stimulus by hearing participants belong to these two categories. Apart from the MeaAtt category *mockery*, the most frequent categories by hearing participants (*irrelevance*, *reflection*, and *amusement*) are not used by deaf participants. The signs NEARLY and LITTLE fit to the assumption that the tongue is a marker for closeness in DGS. Steinbach (2007, 149) mentions that signs which express temporal or spatial proximity are articulated with the tip of the tongue in the mouth angle.

Tab. 6.6: MeaAtts for stimulus a) *lateral tongue show*

Category of MeaAtt	Deaf	Hearing
'Grammatical':		
	0	0
Lexical:		
NEARLY	2	0
LITTLE	2	0
CHEAT	1	0
ANNOY	2	0
TASTY	3	0
Gestural:		
effort	1	0
innocence	1	0
emphasis	1	0
closeness	4	0
questioning	1	0
mockery	7	3
tasty	3	0
irrelevance	0	3
irony	0	1
reflection	0	4
amusement	0	3
direction	0	1
stupidity	0	1
concentration	0	1
contradiction	0	1

Category of MeaAtt	Deaf	Hearing
Affective:		
despair	1	0
dislike	0	1
emotionless	0	1
amusement	0	1
happiness	0	2
Neutral:	0	0
Description:	2	2
No response:	3	1

Another illustrative example for lexical activation is stimulus c) *unilateral blow* (AU 17+R25+R33). Table 6.7 gives an overview of the MeaAtts. For deaf subjects, the facial expression eleven times led to the activation of the lexical sign EFFORT which may be articulated with a unilateral or a bilateral blow in DGS. When looking at the gestural MeaAtts, it becomes clear that, in contrast to deaf subjects, this meaning is not often attributed by hearing subjects. They used corresponding meaning labels only twice and predominantly attributed the meanings *dislike, boredom*, *irrelevance*, and *indecision*.

Tab. 6.7: MeaAtts for stimulus c) *unilateral blow*

Category of MeaAtt	Deaf	Hearing
'Grammatical':		
	0	0
Lexical:		
FATIGUE	1	0
EFFORT	11	0
Gestural:		
irrelevance	2	4
contradiction	1	0
effort	13	2
relief	1	0
dislike	3	6
lack of knowledge	1	2
ignorance	1	0
indecision	0	3
reflection	0	1
disinterest	0	1
expectation	0	1

Category of MeaAtt	Deaf	Hearing
Affective:		
effort	1	0
tiredness	1	1
boredom	2	6
disappointment	0	1
contempt	0	1
Neutral:	0	0
Description:	1	0
No response:	1	0

Regarding stimulus e) *lip funneler / blow* (AU 22+25+33A), it is very interesting that, for deaf signers, the facial expression triggers the explicit links to the lexical signs OWN and LIFE-PARTNER which are obligatorily articulated with the shown SCH mouth pattern in DGS.[9] The explicit activation of the sign LIFE-PARTNER occurred once, the activation of the sign OWN thrice, and in three cases participants only wrote down the common label for the specific mouth pattern (SCH) that both signs have as inherent part. Thus, it is not explicitly clear to which sign these answers refer. However, some responses by deaf subjects such as "sch… Do you have?" unequivocally show that writing down the letter string SCH refers to a sign. Similar answers did not occur by hearing participants. With respect to the sign OWN, it should be noted that this sign is usually articulated with an eyebrow action as interrogative marker in addition to the facial expression in the lower face. A further lexical link in the MeaAtts by deaf subjects refers to the sign QUIET which is named within nine answers. This MeaAtt category illustrates the fluent boundary between gestures and signs. In exactly the same number of cases hearing participants labeled this facial expression as *quiet* or *psst*.[10] In the German hearing community the facial expression *lip funneler / blow* is often used in combination with a manual gesture in the form of a movement with the index finger in front of the lips. Such conventionalized gestures are called *emblems*. The be-quiet emblem has an illocutionary effect as it "may invite the interlocutor to act in a certain way in the communicative interaction" (Özyürek 2012, 628). In DGS, this manual and nonmanual gesture has been lexicalized. This example illustrates that signers systematically integrate manual and nonmanual gestures into their language system

9 Because of space reasons, for the following discussed examples the evaluation tables with the complete numerical distribution of the MeaAtts are not shown. The relevant numerical proportions are named in the text.

10 See Section 6.4.4 for further information on interjections such as *psst*.

(for further information on the incorporation of gestures into sign languages, see Wilcox 2004 and Pfau & Steinbach 2006a) and makes clear that, regarding conventionalized and lexicalized gestures, hearing and deaf subjects used the same MeaAtts (see also Section 6.4.5).

With respect to MeaAtts for facial expressions that are articulated solely with the upper face, it is often more difficult to supply evidence for the unambiguous lexical activation. This is due to the fact that these lexical facial expressions mostly belong to the semantic categories *lexicalized affective nonmanuals* (see Section 7.3.3) and *lexical nonmanual imitation of action* (see Section 7.3.1). As these lexicalized facial markers are based on natural affects or everyday activities of deaf as well as hearing people, hearing subjects often labeled the respective stimuli in a similar manner as deaf subjects. Examples are the signs TIRED and FALL-ASLEEP (see Figure 6.5). In DGS, these signs are articulated with small opened eyes or with eye closure (see Chapter 7 for morphological increase and decrease of lexical facial expressions). For stimulus p) *closing the eyes* (AU 43E), deaf subjects in six cases linked the sign TIRED and ten times the sign FALL-ASLEEP. But, with fifteen answers, i.e. almost the same number, the MeaAtts by hearing subjects fall into the corresponding affective MeaAtt category *tiredness*.

Fig. 6.5: The sign FALL-ASLEEP with lexical facial expression in the upper face

An interesting example with a facial expression in the upper and lower face is stimulus w) *upper lid raise / upper lip raise / blow* (AU 5+10+25+33A). In DGS, this facial expression is a lexical part of the signs SUDDEN and BE-FLABBERGASTED. The MeaAtts by deaf participants in 14 cases reveal a clear link to the sign BE-FLABBERGASTED (see Figure 6.6). In addition, one answer consists of solely giving the typical description of the mouth pattern with the letter string PFF. In two of the 14 cases with a clear link to the sign, this letter string is combined with an explicit reference to the sign BE-FLABBERGASTED (*pf (erstaunt)* and *pffff na-*

sowas). Regarding another answer, the letter string *pff* is combined with the German word *komisch* which can be related to the sign BE-FLABBERGASTED or to the sign STRANGE which includes a similar lexical facial expression (see stimulus v)). In addition, one further answer can be related to the sign BE-FLABBERGASTED or to the sign STRANGE. Hence, when including these three less specified MeaAtts, the group of the lexical sign BE-FLABBERGASTED would even count 17 MeaAtts. The corresponding affective MeaAtt categories to this sign reference are *surprise* and *scepticism*. It is striking that the MeaAtts by hearing participants only once belong to the category *scepticism* and never to the category *surprise*. Furthermore, the gestural category *interest* belongs to the sign BE-FLABBERGASTED. Whereas two MeaAtts by deaf participants fall into this category, no MeaAtt by hearing subjects refers to this category. This clear numerical difference between deaf and hearing subjects within the affective and gestural MeaAtt categories that correspond to the sign can be seen as evidence for the impact of the sign BE-FLABBERGASTED on the MeaAtts by deaf participants. In contrast, the most frequent MeaAtt categories by hearing subjects are *contradiction, warning, fake*, and *anger*. All of these categories got no MeaAtt by deaf participants. In particular, the category *anger* strongly contrasts with the MeaAtts by deaf subjects.

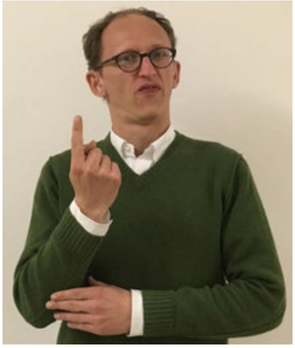

Fig. 6.6: The sign BE-FLABBERGASTED with lexical facial expression in the upper and lower face

The given examples such as, for instance, the MeaAtts referring to the sign OWN illustrate that, isolated from manual components, specific facial muscle contractions activate lexical entries of signs with a corresponding lexical facial expression. This indicates that certain facial expressions are inherent parts of lexical entries of signs in the mental lexicon of deaf signers.

6.4.3 Grammatical MeaAtts

It is interesting to analyze whether facial muscular contractions that serve as markers for different grammatical functions out of context and without manual signs are associated with these functions. The following eight stimuli are in particular central for grammatical MeaAtts: e), k), l), m), n), o), r), and s).

When focusing on the component eyebrows as interrogative marker it has to be distinguished between brow lowerer and brow raise. Regarding stimulus k) *brow lowerer* (AU 4), two MeaAtts by deaf participants and two MeaAtts by hearing participants are connected to the meaning category *interrogative (wh* and *yes/no)*. The most frequent MeaAtt within deaf and hearing subjects is *scepticism* which is in almost the same frequency attributed by both subject groups (deaf subjects (DS): 14, hearing subjects (HS): 16). The affective and gestural MeaAtts for stimulus k) reveal little systematic differences between deaf and hearing subjects. In general, it is known that AU 4 is used in many negative emotions such as sadness, anger, and fear (Ekman 1979, 201). Regarding the elicited data, it is interesting that hearing subjects show a stronger connection to the MeaAtt categories *anger* (DS: 1, HS: 4) and *contradiction* (DS: 1, HS: 5) than deaf subjects. The lower frequency of these more negative MeaAtts by deaf subjects may be due to the grammatical use of brow lowerer as an interrogative marker in DGS. The most frequent MeaAtt category *scepticism* is close to interrogatives such as (4) *What is the connection between both topics?* (see Figure 6.7) and (5) *Why do you do it like this?* (see Figure 6.8). Both examples are articulated with AU 4 as grammatical marker for these wh-interrogatives in DGS.

(4) br-l
TOPIC TOPIC BOTH CONNECTION WHAT [DGS]
'What is the connection between both topics?'

Fig. 6.7: Wh-interrogative 'What is the connection between both topics?' with the grammatical marker brow lowerer in DGS

(5) $\overline{\text{WHY IX}_2 \text{ DO LIKE-THIS}}^{\text{br-l}}$ [DGS]

‘Why do you do it like this?’

Fig. 6.8: Wh-interrogative ‘Why do you do it like this?’ with the grammatical marker brow lowerer in DGS

Brow raise (AU 1+2) as shown in stimulus l) functions as a syntactic marker of various constructions in many sign languages, such as topics, yes/no-interrogatives, conditionals, and relative clauses (see Section 2.2.2). Analyzing the MeaAtts for stimulus l), it becomes clear that deaf as well as hearing participants understand this facial action as an interrogative marker. Four MeaAtts by deaf participants and five MeaAtts by hearing participants are connected to the meaning category *interrogative (wh, yes/no, unspecified)*. Apart from this commonality, three differences between deaf and hearing subjects stick out: i) only deaf subjects connected the meaning *interest* with stimulus l) (DS: 5, HS: 0), ii) for hearing subjects, the stimulus shows a stronger relation to *scepticism* (DS: 4, HS: 10), and iii) for deaf subjects, the stimulus has a closer connection to the affective state *surprise* (DS: 7, HS: 4).

The almost identical number of occurrences of the MeaAtt category *interrogative* by deaf and hearing subjects for the stimuli *brow lowerer* and *brow raise* can be seen as evidence for the gestural origin of these grammatical markers.

With respect to interrogative marking two further stimuli are relevant: stimulus r) *brow raise / upper lid raise / lids tight* (AU 1+2+5+7) and stimulus s) *brow lowerer / lids tight* (AU 4+7). Moreover, both stimuli are interesting with respect to another grammatical function. In sign languages such as ISL, ASL, and DGS, squint functions as a marker for low accessibility (Dachkovsky et al. 2013) or rather reference to common knowledge (Herrmann 2012). One example by Herrmann (2012, 372) which illustrates the interaction of the markings for wh-interrogatives and reference to common knowledge is the elicited DGS interrogative *What’s the name* *of your dog again?* As the signer of this interrogative asks for the dog's name that he has known before, the interrogative is combined with squint.

The facial expression shown in stimulus r) is used in a yes/no-interrogative with low accessibility. Beyond, raised brows are articulated as grammatical marker for other constructions such as continuation. Six MeaAtts by deaf subjects refer to the three grammatical functions *interrogative (yes/no, unspecified*; DS: 2, HS: 1), *continuation* (DS: 2, HS: 1), and *low accessibility* (DS: 2, HS: 0). Two MeaAtts by hearing subjects are related to *continuation* and *yes/no-interrogative*. The most frequent MeaAtt category within hearing subjects is *surprise* with fifteen occurrences compared to eight MeaAtts by deaf subjects. Also, the MeaAtt category *scepticism* is found more often for hearing subjects than deaf subjects (DS: 2, HS: 10). Apart from *surprise*, the most frequent MeaAtt categories for deaf subjects are *interest* (DS: 3, HS: 0) and *consent* (DS: 4, HS: 0) which do not occur in the data of hearing participants.[11]

The facial action in stimulus s) is the grammatical marking for a wh-interrogative with low accessibility. The MeaAtts by the participants show one link to wh-interrogative (DS: 1, HS: 0), three connections to yes/no-interrogatives (DS: 2, HS: 1), and six links to low accessibility (DS: 3, HS: 3).

Regarding squint as marker for low accessibility in sign languages, in particular, stimulus o) *lids tight* (AU 7) is relevant. The elicited data yield eight answers that can be linked to this grammatical function (DS: 5, HS: 3). In detail, the MeaAtts by deaf subjects look as follows: *durchdringend* ('pervading'), *auf die Dinge konzentrieren* ('concentrate on the things'), *überlegen* ('consider'), *nachdenken* ('think about'), and *konzentriert* ('concentrated'). The MeaAtts by hearing subjects are the following: *das überlege ich genau* ('I consider this precisely'), *genauer wissen wollen* ('want to know more precisely'), and *konzentriert* ('concentrated').

With respect to the grammaticalization of *lids tight* (AU 7) as a marker for low accessibility, it is informative to study commonalities in the gestural and affective MeaAtt categories between deaf and hearing subjects for different stimuli in which the facial muscle contraction AU 7 is prominent. In particular, the three facial expressions in stimulus n) *lids tight / small opened eyes* (AU 7+43), stimulus o) *lids tight* (AU 7), and stimulus s) *brow lowerer / lids tight* (AU 4+7) are relevant. It is striking that for all three stimuli the MeaAtt category *anger* often occurs within both participant groups (*lids tight / small opened eyes* DS: 4, HS: 3; *lids*

11 As already mentioned in Section 6.2.1.1, in the stimulus video, the tightening of the lids (AU 7) starts later than the other AUs. Thus, it is possible that some participants overlooked AU 7 and labeled only AU 1+2+5.

tight DS: 8, HS: 5; *brow lowerer / lids tight* DS: 7, HS: 7). Furthermore, for the two facial expressions *lids tight* and *brow lowerer / lids tight* the meaning *scepticism* is often assigned (*lids tight* DS: 4, HS: 7; *brow lowerer / lids tight* DS: 10, HS: 10). As stimulus n) is articulated with low intensity of AU 7 and is combined with AU 43, for both subject groups the most frequent MeaAtt category is *tiredness* (DS: 7, HS: 9). Besides, the MeaAtt category *concentration* which occurs for all the three stimuli (*lids tight* DS: 3, HS: 3; *brow lowerer / lids tight* DS: 1, HS: 5; *lids tight / small opened eyes* DS: 1, HS: 1) and the MeaAtt category *reflection* which is attributed to stimulus *lids tight* (DS: 2, HS: 3) and stimulus *brow lowerer / lids tight* (DS: 2, HS: 0) reveal a connection to the grammatical marking of low accessibility in sign languages (see Section 6.5 for discussion of the grammaticalization of tight lids in sign languages).

Stimulus m) *upper lid raise* (AU 5) shows five connections to the grammatical system of DGS but these are isolated occurrences. Three MeaAtts by deaf subjects are related to the following three categories: *emphasis*, *yes/no-interrogative*, and *continuation*. Two MeaAtts by hearing participants fall in the MeaAtt category *interrogative* (*wh* and *yes/no*). The gestural and affective categories reveal one striking difference between both groups of participants and one prominent commonality: i) For hearing participants *upper lid raise* has the gestural meaning *consent* (DS: 1, HS: 6). ii) The most frequent MeaAtt category for deaf and hearing subjects is *surprise* (DS: 10, HS: 12).

With regard to grammatical MeaAtts, there are four especially interesting findings: i) The analysis of four stimuli that are related to interrogative marking (wh and yes/no) reveal eleven grammatical MeaAtts in the category *interrogative* by deaf subjects and nine congruent MeaAtts by hearing subjects. This can be seen as indicator for the affective and gestural origin of the grammatical markers for interrogatives in DGS. ii) When analyzing the gestural and affective MeaAtts for *brow raise* within stimulus l) and r), on the one hand, it sticks out that only deaf subjects attributed the meaning *interest*, on the other hand, it is prominent that hearing subjects more often connected the meaning *scepticism*. The clear linking with the meaning *interest* by deaf subjects fits with the grammatical marker for interrogatives, as the asking of questions is, in general, based on the desire to get to know more. iii) The analysis of the stimuli which are relevant with respect to squint as marker for low accessibility reveals corresponding MeaAtts by deaf and hearing subjects. Furthermore, it is conspicuous that the MeaAtt categories *anger* and *scepticism* occur with high frequency within both groups of participants. iv) MeaAtts for facial actions which are isolated from the context and manual signs show a connection to the grammatical system of DGS. However, the data reveal fewer links to the grammatical system by deaf subjects than initially expected.

6.4.4 Differences within the MeaAtts by deaf and hearing subjects

The comparison of the MeaAtts by deaf and hearing subjects reveals differences in the perception of isolated facial actions that are no conventionalized gestures. Whereas hearing subjects used "free" gestural and affective interpretations, for deaf subjects, the interpretations are influenced by the interface between i) gestures as well as emotions and ii) sign language. In the following, I discuss six examples.

The analysis of the MeaAtts for stimulus f) *chin raiser* (AU 17) shows that deaf participants much more often used the interjection *hm* as MeaAtt than hearing subjects (DS: 7, HS: 1). This is in particular interesting as "there is a close link between gestures or body movements and interjections" (Stange & Nübling 2014, 1985). "Interjections are relatively conventionalised vocal gestures (or more generally, linguistic gestures) which express a speaker's mental state, action or attitude or reaction to a situation" (Ameka 1992, 106).[12] Ameka (1992, 113f.) classifies interjections with the following three categories: expressive, conative, and phatic. Expressive interjections such as *Wow!* and *Aha!* are indications of the speaker's mental state. Conative interjections are related to the speaker's wishes and directed at a listener, e. g. *Psst!* and *Eh?* Phatic interjections such as *mhm* and *yeah* focus on the establishment and maintaining of contact.[13] The interjection *hm* which is frequently used by deaf participants as MeaAtt for the stimulus *chin raiser* seems to belongs to the third category: phatic interjections. Deaf participants combined this interjection only twice with a more exact description: *hm stimmt* ('that's right') and *hm, weiss nicht so genau* ('don't know exactly'). As the other five occurrences of the interjection *hm* are not precisely specified, the three common meanings of this interjection were counted in the evaluation in order to be as objective as possible: *indecision, dislike,* and *consent*. Overall, for the stimulus *chin raiser*, most MeaAtts by deaf signers fall into the meaning category *consent* (DS: 11). Out of these, six MeaAtts unambiguously belong to this category. As already mentioned, the other instances are to some extent ambiguous as the participants used the in-

12 In this respect, it is striking that, also regarding the whole data, deaf participants used much more interjections within the MeaAtts than hearing participants (DS: 57, HS: 24).

13 "It must be stressed however that a particular item may have multiple functions and hence multiple categorisation. For instance, it is possible to think that the backchanneling interjections could be cognitive since they signal the current state of the utterer with respect to their comprehension and mental involvement in the on-going communication. Similarly, the expressive interjections have an associated conative element. Although they are not directed at an addressee, their emission could evoke a response in a by-stander. The classification is based on what is perceived to be the predominant function of the item in question with respect to its semantics" (Ameka 1992, 114).

terjection *hm* without further explanation. In contrast, hearing subjects did not assign the MeaAtt category *consent* at all. The MeaAtt category with the second most occurrences within the deaf group is *indecision* which is also used by hearing subjects (DS: 9, HS: 5). The most frequent MeaAtt category by hearing subjects is *reflection* (DS: 2, HS: 6), followed by the already mentioned category *indecision* and the category *contradiction* (DS: 1, HS: 5). Furthermore, hearing participants used four times MeaAtts that belong to the category *irrelevance* which did not occur within the deaf group. It is a really interesting finding that, for deaf subjects, *chin raiser* predominantly has the meaning *consent* which is not attributed by hearing subjects. In contrast, hearing subjects predominantly assigned opposite meanings like *contradiction*, *irrelevance*, *indecision*, and *reflection*.

Moreover, the MeaAtts for stimulus g) *lip pucker / blow* (AU 18+25+33A) show striking differences between hearing and deaf subjects. Whereas deaf subjects mainly assigned the MeaAtt category *effort* (DS: 9, HS: 0) and *relief* (DS: 6, HS: 2), for hearing subjects, the meaning *calming* predominates (DS: 0, HS: 5). The MeaAtts by deaf participants seem to be influenced by the lexical signs EFFORT and RELIEF which include lexical facial expressions with blow. It is interesting to note that stimulus c) *unilateral blow* (AU 17+R25+R33) and stimulus h) *bilateral blow* (AU 17+25+33) reveal the strong connection to the meaning *effort* and the relation to the meaning *relief* for deaf subjects as well. Regarding stimulus c), by far the most frequent MeaAtt category is *effort* (DS: 14, HS: 2). In contrast, for hearing subjects the prevalent MeaAtt categories are *dislike* (DS: 3, HS: 6) and *boredom* (DS: 2, HS: 6). The MeaAtt category *relief* only occurs within the deaf group (DS: 1, HS: 0). The analysis of the MeaAtts for stimulus h) shows the predominant MeaAtt category *effort* for deaf subjects (DS: 9, HS: 4) as well. In contrast, for hearing subjects, *bilateral blow* predominantly has the meaning *lack of knowledge* which is not assigned by deaf subjects (DS: 0, HS: 8). Again, the MeaAtt category *relief* only occurs within the deaf group (DS: 4, HS: 0).

A further example for differences between both subject groups is stimulus j) *quick blow* (AU 17+25+33A). Within the data by deaf subjects as well as by hearing subjects there are some typical MeaAtts that do not occur in the other group or only occur once. For deaf subjects, the following MeaAtt categories have to be mentioned: *mockery* (DS: 5, HS: 0), *surprise* (DS: 5, HS: 1), and *arrogance* (DS: 2, HS: 0). On the contrary, for hearing subjects, the following MeaAtt categories stick out: *lack of knowledge* (DS: 0, HS: 2), *contradiction* (DS: 0, HS: 2), *disinterest* (DS: 0, HS: 2), and *contempt* (DS: 0, HS: 3).

Stimulus q) *blink* (AU 45) is another interesting example for differences in the MeaAtts by deaf and hearing subjects. For hearing subjects, *blink* has by the majority the meaning *consent* (DS: 1, HS: 8) and *awareness* (DS: 2, HS: 6). In contrast, deaf participants predominantly described this facial expression as *neutral* (DS: 9, HS: 2). This can be explained with the fact that *blink* in DGS has no specific meaning as it is no lexical or grammatical feature but a marker for prosodic breaks. Such breaks are naturally necessary during spoken or signed language (see Herrmann 2012 for the analysis of blinks as nonmanual marker for prosodic boundaries in DGS).

The stimuli of the present study include five facial expressions with *tongue show* (AU 19): stimuli a), b), i), t), and x). When comparing all affective and gestural MeaAtt categories within deaf and hearing subjects for these stimuli an interesting picture emerges which is summarized in Table 6.8.

Tab. 6.8: MeaAtt categories for stimuli with tongue show: a), b), i), t), and x)

Category of MeaAtt	Deaf	Hearing
affection	1	2
anger	1	0
amusement	7	16
boredom	2	9
closeness	5	1
concentration	0	1
consent	0	1
contempt	2	0
contradiction	1	8
despair	1	0
disgust	5	12
direction	0	1
disinterest	1	1
dislike	21	18
ease	0	1
effort	13	7
emotionless	0	1
emphasis	1	0
envy	0	1
expectation	0	2
fake	0	5
happiness	3	7
innocence	1	0
interest	2	2
irony	2	1

Category of MeaAtt	Deaf	Hearing
irrelevance	2	4
mockery	36	18
lack of knowledge	0	1
provoking	2	5
questioning	1	3
reflection	0	7
scepticism	2	3
stupidity	0	2
surprise	3	2
tasty	4	0
tiredness	0	2

In particular, eleven MeaAtt categories are interesting with respect to differences between both subject groups: *amusement, boredom, closeness, contradiction, disgust, fake, irrelevance, mockery, provoking, reflection*, and *tasty*.[14] The comparison of the occurrences of these MeaAtt categories by deaf and hearing subjects reveals that deaf subjects stronger connect the meanings *closeness, mockery*, and *tasty* with tongue show. This imbalance between both subject groups seems to be due to the impact of lexical facial expressions for deaf subjects. Signs associated with *closeness* such as LITTLE and NEARLY have AU 19 as lexical component. Also, the MeaAtt category *tasty* for tongue show has a counterpart in a lexical facial expression, namely the sign TASTY. Likewise, AU 19 is part of some signs that belong to the meaning category *mockery*, e. g. CHEAT and ANNOY. It has to be noted that the number of 18 MeaAtts in the category *mockery* by hearing participants underlines the gestural origin of this component. Focusing on meanings that are more often attributed by hearing subjects compared to deaf subjects, brings out the following eight MeaAtt categories: *amusement, boredom, contradiction, disgust, fake, irrelevance, provoking*, and *reflection*. At this, three aspects are conspicuous: i) Whereas the data by hearing subjects reveal a strong connection between the meaning *reflection* and *lateral tongue show* (stimulus a) as well as *centered tongue show* (stimulus b), deaf subjects did not assign this meaning (DS: 0, HS: 7). ii) Out of the eight mentioned MeaAtt categories which are more often assigned by hearing subjects four have a negative connotation: *boredom, contradiction, disgust*, and *provoking*. iii) The category *fake* seems to be typical for hearing subjects (DS: 0, HS: 5).

14 When looking at commonalities, the following MeaAtt categories are relevant: *dislike, interest, scepticism*, and *surprise*.

It is interesting to pursue the relevance of the MeaAtt category *fake* for hearing and deaf subjects within the whole data in more detail. This reveals that the MeaAtts by hearing subjects more often belong to the category *fake* than those by deaf subjects (DS: 2, HS: 16). Typical examples for the MeaAtt category *fake* by hearing subjects are *gespielte Ärgernis* ('simulated annoyance'), *gespielt erstaunt* ('simulated amazed'), *tut so, als wäre er überrsacht* ('simulated surprised'), and *gespielte Heiterkeit* ('simulated amusement'). The high number of the category *fake* illustrates that hearing subjects had some difficulties in finding adequate meaning labels for some linguistic facial expressions of DGS. The category *fake* occurs for the stimuli d), e), l), r), t), u), v), and w). As these facial expressions are no expressions of felt emotions, but rather grammatical and lexical markings in DGS in some cases hearing participants found no fitting meaning and, thus, interpreted them as simulated expressions.

To sum up, deaf and hearing subjects show clear differences in the MeaAtts for facial actions. Two types of differences can be distinguished: i) The data reveal typical MeaAtts for individual facial actions that are used only by deaf or hearing subjects. ii) Although the MeaAtts by both subject groups include overlaps, there are often sharp distinctions in the frequency of the MeaAtt categories that occur in both groups. An example for type i) is the MeaAtt category *consent* by deaf participants for the facial expression *chin raiser* (AU 17). Another example is that *lateral tongue show* (AU 17+R19+R25+26) and *centered tongue show* (AU 19+25+26) are connected with the meaning *reflection* only by hearing subjects. As example for type ii) the facial action *blink* (AU 45) can be mentioned. Hearing subjects mainly assigned the meanings *consent* and *awareness* which are rarely attributed by deaf subjects. The detected two types of differences within the MeaAtts by deaf and hearing participants seem to be due to the fact that the MeaAtts by deaf subjects are steered by the interplay between, on the one hand, affective as well as gestural meanings and, on the other hand, linguistic functions of facial muscles contractions. This becomes very clear when analyzing, for instance, the MeaAtts for the stimuli *lip pucker / blow* (AU 18+25+33A), *unilateral blow* (AU 17+R25+R33), and *bilateral blow* (AU 17+25+33). For these stimuli, in contrast to hearing subjects, deaf subjects predominantly assigned the MeaAtt category *effort*. This seems to be triggered by the impact of a lexical facial expression as the sign EFFORT is commonly used in DGS and AU 33 is an inherent lexical part of this sign.

6.4.5 Commonalities within the MeaAtts by deaf and hearing subjects

Some commonalities in the MeaAtts by both participant groups have already been discussed with respect to grammatical MeaAtts (see Section 6.4.3). In the following, I discuss striking commonalities with regard to gestural and affective MeaAtts.

With respect to conventionalized gestures three stimuli are particularly interesting: e), d), and x). Stimulus e) *lip funneler / blow* (AU 22+25+33A) which is already discussed in Section 6.4.2 clearly illustrates the fluent boundary between gesture and sign. In exactly the same number of cases hearing and deaf subjects connected this facial expression with the MeaAtt category *be-quiet* (DS: 9, HS: 9). Whereas this facial gesture together with the associated manual gesture has become the lexical sign QUIET in DGS, by hearing people it is used as emblem (see Section 7.3.4 for lexicalized gestural nonmanuals). Another vivid example for conventionalized gestures is stimulus d) *lip pucker* (AU 18). This facial muscle contraction is labeled as *kiss* in almost the same number of cases by both participant groups (DS: 15, HS: 14). In DGS, lip pucker is a lexicalized component of the signs KISS, CUDDLE, PLEASE, and FAVORITE. The MeaAtts by deaf participants reveal the link to the signs KISS (DS: 15), CUDDLY (DS: 1), and PLEASE (DS: 1). As lip pucker is a non-conventionalized gesture for *cuddly* and also the meaning *please* for lip pucker is not conventionalized in the same degree as *kiss*, hearing participants used no equivalent MeaAtts. Stimulus x) *small opened eyes / nose wrinkle / tongue show* (AU 6+7+9+12+19+25+26) presents the lexical facial expression of the sign ANNOY. On the one hand, the occurrences of the MeaAtt category *mockery* by deaf and hearing subjects highlights the gestural origin of this lexical facial expression (DS: 16, HS: 9). On the other hand, the fact that the data of deaf subjects reveal more occurrences of this MeaAtt category seems to be triggered by the impact of the lexical sign belonging to this lexical facial expression.

With respect to the MeaAtt category *awareness*, it is striking that three stimuli are typically connected with this meaning in almost the same frequency by both participants groups: stimulus l) *brow raise* (AU 1+2; DS: 2, HS: 3), stimulus m) *upper lid raise* (AU 5; DS: 6, HS: 5), and stimulus r) *brow raise / upper lid raise / lids tight* (AU 1+2+5+7; DS: 2, HS: 2).

Moreover, it is interesting to analyze commonalities with regard to affective states. One clear example is stimulus m) *upper lid raise* (AU 5) for which deaf and hearing subjects predominantly attributed the meaning *surprise* (DS: 10, HS: 12). The MeaAtt category *scepticism* is related to this facial expression by both groups as well, however, with less frequency (DS: 3, HS: 2). Another example for affective MeaAtts is stimulus t) *small opened eyes / nose wrinkle / tongue show / lip stretch / head back* (AU 6+7+9+12+19+20+25+26+58). In this stimulus, the sign model articulates the lexical nonmanual marking of the sign DISGUST in DGS. As this nonmanual marking belongs to the semantic category *lexicalized affective nonmanuals* (see Section 7.3.3) MeaAtts of the affective category *disgust* are used by both participant groups (DS: 3, HS: 3). For stimulus g) *lip pucker / blow* (AU

18+25+33A), the MeaAtt category *boredom* occurs nearly equally often within deaf and hearing subjects (DS: 2, HS: 3).

To sum up, in addition to the differences within the MeaAtts between deaf and hearing subjects which were discussed with respect to lexical facial expressions in Section 6.4.2 and more generally in Section 6.4.4 there are interesting commonalities as well. Examples such as the facial expression *lip funneler / blow* which is assigned equally often to the MeaAtt category *be-quiet* by both participant groups make clear that, regarding conventionalized gestures or rather lexicalized gestures in DGS, hearing and deaf people connect the same meanings. Furthermore, the study reveals commonalities in terms of MeaAtts related to affective states. One vivid example is that deaf and hearing subjects predominantly attributed the meaning *surprise* to the facial expression *upper lid raise*.

6.5 Summary and discussion

The starting point of the current empirical perception and meaning attribution study was the fact that deaf and hearing people use the face to nonmanually gesture and express emotions, but only signers use facial expressions for lexical and grammatical functions as well. By investigating the meaning of muscular contraction in the lower and upper face, the study aims to get deeper insights into nonmanual actions at the interface between gesture, emotion, and sign language. Whereas there are already studies in particular with hearing participants focusing on the meaning of emotional facial expressions, the current study is the first that addresses meaning attributions for lexical and grammatical facial expressions presented as videos and analyzes differences and commonalities between deaf and hearing subjects. As intensity and tempo of facial features may have an impact on the meanings and it is more natural to see facial actions than still pictures of facial expressions it is worth to work with videos instead of pictures.

The study reveals data in the form of 1085 meaning descriptions for muscle contractions in the lower face, upper face, and in both (DS: 538, HS: 547). Meaning descriptions often consist of more than one MeaAtt.

In the first step, we analyzed the overall distribution of MeaAtts in the four main categories *gestural, affective, grammatical*, and *lexical* (see Section 6.4.1). As explained, it has to be noted that the distinction between the main categories *affective* and *gestural* is difficult in some cases. Nevertheless, it is interesting that the general distribution of affective and gestural MeaAtts is the same for deaf and hearing participants. Both groups used 34% more gestural MeaAtts than affective MeaAtts. Regarding 'grammatical' MeaAtts, it is striking that the amount of these MeaAtts is only 23% higher for deaf subjects compared to hearing subjects. This result can be seen as indicator for the gestural origin of grammatical markings in sign languages. The overall relatively low amount of grammatical MeaAtts by deaf subjects can be explained with the facts that, in natural signing, i) grammatical facial markings usually occur for a longer duration than shown in the stimulus videos and ii) the spread of linguistic facial features is aligned with the manually expressed sentence structure which is not present in the stimuli. The main difference between deaf and hearing subjects is the strong impact of lexical facial expressions on the MeaAtts by deaf signers.

The detailed analysis of lexical MeaAtts by deaf subjects (see Section 6.4.2) yields that isolated from manual components and the communication context specific facial actions trigger the access to mental entries of i) signs that have exactly the same lexical facial expression as presented in the respective stimulus and ii) signs that have a similar lexical facial expression. This indicates that specific facial expressions are an inherent part of the mental lexical entry of certain signs. Regarding facial expressions solely in the lower face, one impressive example is stimulus e) *lip funneler / blow* (AU 22+25+33A) which for deaf subjects triggers the activation of the lexical signs OWN and LIFE-PARTNER. With regard to MeaAtts for facial expressions solely in the upper face, it is often more difficult to supply evidence for the unambiguous activation of lexical signs because these lexical facial expressions mostly belong to the semantic categories *lexical nonmanual imitation of action* (see Section 7.3.1) and *lexicalized affective nonmanuals* (see Section 7.3.3). Due to this, hearing subjects often labeled the respective stimuli in a similar manner as deaf subjects. With respect to facial actions in the lower and upper face, the facial expression in stimulus w) *upper lid raise / upper lip raise / blow* (AU 5+10+25+33A), which is a lexical part of the signs SUDDEN and BE-FLABBERGASTED in DGS, is an interesting example. The MeaAtts by deaf subjects yield a clear link to the sign BE-FLABBERGASTED 14 times. The corresponding affective and gestural MeaAtt categories to this sign reference are *scepticism*, *surprise*, and *interest*. It is striking that the MeaAtts by hearing subjects only once belong to the category *scepticism* and zero times to the categories *surprise* and *interest*. This clear difference in the MeaAtts by deaf and hearing subjects can be seen as evidence for the impact of the sign BE-FLABBERGASTED on the MeaAtts by deaf participants.

Besides, it is revealing to investigate whether facial expressions which serve as markings for different grammatical functions out of context and without manual signs are associated with these functions (see Section 6.4.3). In particular, three aspects are interesting: i) The analysis of four stimuli which show interrogative marking (wh and yes/no) yields almost the same frequency of grammatical MeaAtts in the category *interrogative* by deaf and hearing subjects with slightly higher amount by deaf participants (stimulus k) *brow lower* (AU 4), l) *brow raise*

(AU 1+2), r) *brow raise / upper lid raise / lids tight* (AU 1+2+5+7), s) *brow lowerer / lids tight* (AU 4+7)). This can be seen as indicator for the gestural origin of the grammatical markers for interrogatives in DGS. Regarding brow raise, it supports the idea that this facial muscle contraction has been grammaticalized from an affective and gestural marker via interrogative marking in sign languages towards a more functional marker of other syntactic constructions (see Janzen 1999; see Section 2.2.2). The latter are marked by raised brows, but are not explicitly semantically associated when labeling the meaning of isolated brow raise. ii) When analyzing the gestural and affective MeaAtts for the two stimuli l) and r) which include *brow raise*, on the one hand, it sticks out that only deaf participants assigned the meaning *interest*, on the other hand, it is striking that hearing participants more often connected the meaning *scepticism*. The clear linking with the meaning *interest* by deaf participants fits with the grammatical marking of interrogatives as asking of questions is generally based on the interest to get to know more. Hence, this MeaAtt is closely related to interrogatives. iii) The analysis of stimuli which are relevant with regard to squint as marker for low accessibility (especially stimulus o) *lids tight* (AU 7) and s) *brow lowerer / lids tight* (AU 4+7)) shows the gestural MeaAtt categories *concentration* and *reflection* by deaf participants as well as by hearing participants. Both MeaAtt categories are related to the marking of low accessibility. Moreover, it is conspicuous that the MeaAtt categories *anger* and *scepticism* occur with high frequency within both groups of participants.

The individual findings for different stimuli lead to the main result that MeaAtts for facial actions which are isolated from the context and manual signs have a connection to the grammatical system of DGS. However, the data reveal fewer links to the grammatical system by deaf participants than initially expected.

In addition to the specific analyses of lexical and grammatical MeaAtts, two general evaluations of differences (see Section 6.4.4) and commonalities (see Section 6.4.5) in the interpretations of isolated facial actions by deaf and hearing subjects were carried out. This reveals clear differences regarding MeaAtts for facial actions that are no conventionalized gestures (see Section 6.4.4). Within these differences, two main types can be distinguished: i) The data show typical MeaAtts for individual facial actions that are used only by deaf or hearing participants. ii) Although the MeaAtts by both subject groups include overlaps, there are often sharp distinctions in the frequency of the MeaAtt categories that occur in both groups. An example for type i) is that *lateral tongue show* (AU 17+R19+R25+26) and *centered tongue show* (AU 19+25+26) are connected only by hearing subjects with the meaning *reflection*. As example for type ii) the facial action *blink* (AU 45) can be mentioned. Hearing subjects mainly assigned the meanings *consent* and *awareness* which are rarely attributed by deaf subjects. The two detected main types of differences within the MeaAtts by deaf and hearing participants seem to be due to the fact that the MeaAtts by deaf subjects are influenced by the interplay between, on the one hand, affective as well as gestural meanings and, on the other hand, linguistic functions of facial muscles contractions in DGS.

Furthermore, it is interesting to analyze gestural realizations of specific meanings such as *consent*. This meaning is associated with different facial actions by deaf and hearing subjects (see Section 6.4.4). Whereas for hearing participants *upper lid raise* (AU 5; DS: 1, HS: 6) and *blink* (AU 45; DS: 1, HS: 8) have the gestural meaning *consent*, for deaf subjects *chin raiser* predominantly has the meaning *consent* (DS: 6 or even 11 when including the ambiguous cases, HS: 0).

Moreover, differences in the MeaAtts by deaf and hearing subjects can be analyzed by focusing on specific AUs that occur in different stimuli (see Section 6.4.4). With respect to *tongue show* (AU 19) this reveals that deaf participants stronger connect the meanings *closeness, mockery*, and *tasty* with this facial action. This imbalance between both groups of participants seems to be due to the impact of lexical facial expressions for deaf signers. But, it has to be noted that the category *mockery* is also frequently used by hearing subjects which underlines the gestural origin of this lexical component. Focusing on meanings that are more often attributed to AU 19 by hearing subjects compared to deaf subjects, two aspects have to be emphasized: i) Whereas the data by hearing subjects reveal a strong connection between the meaning *reflection* and *lateral tongue show* (stimulus a), AU 17+R19+R25+26) as well as *centered tongue show* (stimulus b), AU 19+25+26), deaf subjects did not assign this meaning (DS: 0, HS: 7). ii) Out of eight MeaAtt categories that are more often assigned by hearing subjects four have a negative connotation: *boredom, contradiction, disgust*, and *provoking*.

Another interesting aspect that could be deepened in further studies is the empirical finding that deaf subjects used much more interjections within the MeaAtts than hearing subjects (DS: 57, HS: 24; see Section 6.4.4). This is absorbing as “there is a close link between gestures or body movements and interjections” (Stange & Nübling 2014, 1985).

Besides clear differences within the MeaAtts by deaf and hearing subjects, the study reveals commonalities as well (see Section 6.4.5). Examples such as stimulus e) *lip funneler / blow* (AU 22+25+33A), which is attributed in the same frequency by both participant groups to the MeaAtt category *be-quiet*, and stimulus d) *lip pucker* (AU 18), which is labeled as *kiss* in almost the same number of cases by both groups, make clear that, regarding conventionalized gestures or rather lexicalized gestures in DGS, deaf and hearing persons made the same MeaAtts. The use of MeaAtts such as *be-quiet* suggest that specific facial actions are perceived in a similar manner to manual gestures. Hence, it seems to be appropriate to use the terms *nonmanual gestures* and *manual gestures*. Moreover, the examples *be-quiet* and *kiss* illustrate the fluent boundary between gestures and signs. Furthermore, the analysis shows commonalities in terms of MeaAtts related to affective states. One illustrative example is that deaf and hearing subjects predominantly assigned the meaning *surprise* to the facial expression *upper lid raise* (AU 5; DS: 10, HS: 12). In addition, this stimulus reveals an interesting commonality between deaf and hearing subjects regarding gestural MeaAtts as both groups often connected the meaning *awareness* (DS: 6, HS: 5).

In the following, I discuss, on the one hand, by the example of AU 7 how the results of the current study are relevant for the understanding of grammaticalization, and, on the other hand, the connection of the results to compositional accounts.

Focusing on the grammaticalization of specific facial actions in sign languages, AU 7 as marker for low accessibility is an interesting example. The study shows that the MeaAtt categories *concentration* and *reflection*, which reveal a relation to the grammatical function of low accessibility, occurred with lower frequency than the affective MeaAtt categories *anger* and *scepticism*. The high frequency of both affective MeaAtt categories for facial expressions with tight lids underlines that squint as grammatical marker for low accessibility in sign languages has passed a complex grammaticalization process from an affective marker for *anger* and *secpticism* and a gestural marker for *concentration*, *reflection*, *awareness*, and *warning* to a grammatical marker for low accessibility in sign languages. In this process, different pronounced meanings of AU 7 have been delimited for the grammatical use. This grammaticalization is described as complex due to the fact that AU 7, especially on the affective level, is associated with completely different meanings than on the grammatical level. The emotions *anger* and *scepticism* and the gestures *awareness* and *warning* are not directly related to low accessibility. In contrast, for instance, head shake as a marker for negation has on the gestural level the same meaning as the grammaticalized marking in sign languages and has no different emotional meaning. In the visual and auditory modality, head shake can often be observed in non-negative contexts to gesturally signal e. g. uncertainty and intensification (cf. McClave 2000; Kendon 2002; Pfau & Steinbach 2006a; Calbris 2011; van Loon et al. 2014; Pfau 2015). But, "both these uses can in principle be traced back to the basic negative function, as an uncertain statement can be argued to be under the scope of an implicit negative predicate such as 'not sure', while intensification may involve the implied meaning of 'unbelievable'" (van Loon et al. 2014, 2141). Such a tracing back to one basic gestural or affective function seems to be impossible for the different uses of AU 7.

Beyond, it is interesting to relate the results of the current study to compositional accounts, which attribute meanings or pragmatic functions to certain nonmanual components. Such accounts demonstrate how individual nonmanual features can be combined with each other to achieve complex meanings as it is the case in, for example, counterfactual conditionals (cf. Nespor & Sandler 1999; Dachkovsky 2008; Herrmann 2012; Dachkovsky et al. 2013). We focus on two questions: i) Can compositional accounts be adopted for lexical facial components? ii) Do the interpretations of facial actions which are isolated from the communication context fit with compositional accounts?

Nespor & Sandler (1999, 165) "suggest that facial expressions, which are meaningful, are comparable to the tones that make up melodies in the intonational phonology of spoken language". The argumentation by Dachkovsky (2008, 78f.) points in this direction as well:

> [S]pecific meanings of individual facial components, as well as their constellations, are similar to the general pragmatic meanings of tones in spoken languages. These intonational meanings are very general, but at the same time they are preserved in all the lexical and syntactic environments where a particular intonational component is used.

One prominent facial component within compositional accounts is squint (AU 7, optionally combined with AU 6). Nespor & Sandler (1999) designate squint in ISL as marker for information which is shared by addressee and signer. Dachkovsky (2008, 73) describes that "it points out to the addressee that the information so marked is not automatically or immediately accessible and is to be retrieved from his/her background knowledge" (see also Dachkovsky et al. 2013). Just as in ISL, squint occurs as "signal that certain information is known to the addressee, but not automatically accessed from the discourse context" in ASL as well (Dachkovsky et al. 2013, 230). However, Dachkovsky et al. (2013) find two differences of squint in ASL compared to ISL: i) In ASL, squint frequently occurs affectively, for instance, in the sense of evoking empathy. From this fact they infer "that squint is not as systematic or grammaticalised in ASL as it is in ISL"(Dachkovsky et al. 2013, 230). ii) Furthermore, they find a phonetic difference in the articulation of squint. Whereas, in ISL, AU 7 is used for this function, in ASL, it is AU 6. With respect to DGS, Herrmann (2012, 374) explains the meaning of squint as follows (see also Herrmann 2013, 174):

> A squint in declaratives led the addressee to interpret the sentence as part of the common ground. In interrogatives, a squint indicated that the relevant item or issue is assumed to have been previously known by the signer and/or the addressee.

When focusing on squint as part of lexical signs in DGS, it becomes apparent that the specific meaning *low accessibility* (Dachkovsky et al. 2013) or rather *reference to common knowledge* (Herrmann 2012) does not apply generally to lexical facial components as well. Examples which show that the assumed inherent meaning does not fit are BLURRY and ANNOY (see Figure 6.9).[15]

Fig. 6.9: AU 7 within the signs BLURRY (left) and ANNOY (right)

Another superarticulatory feature that plays a crucial role within compositional accounts is brow raise. In Dachkovsky (2008) and Dachkovsky et al. (2013, 218) it is described that this facial action has the meaning *incompleteness and continuation dependency* in ISL:

> [B]row raise signals continuation in the sense that the constituent marked by it is to be interpreted in light of subsequent information. On this interpretation, the function of brow raise is analogous to the meaning of high tone in many spoken languages.

As it is the case with squint, examples of lexical signs in DGS which have AU 1+2 as inherent parts reveal that this specific meaning does not always apply when focusing on the lexical level. Figure 6.10 shows the signs SUDDEN and SHOCK in DGS. Whereas the meaning and use of SUDDEN can be linked to *continuation dependency*, this does not directly apply to SHOCK.

With regard to the elicited MeaAtts of the current study, the data reveal fewer general distinct meanings for individual facial muscle actions than expected from the view of compositional accounts. Isolated from the language context and communication context individual facial expressions are labeled with meanings that belong to different MeaAtt categories. At this point, it is obvious that, for deaf subjects, MeaAtts are strongly influenced by lexical signs with an inherent facial

15 The sign BLURRY could be related to low accessibility in a more general meaning as visual accessibility is limited when something is perceived blurrily.

Fig. 6.10: AU 1+2 within the signs SUDDEN (left) and SHOCK (right)

expression. A clear example that an individual facial action has different meanings is stimulus a) *lateral tongue show* (AU 17+R19+R25+26). Signers assigned this stimulus to MeaAtt categories such as *closeness, mockery*, and *tasty*. Hearing subjects attributed MeaAtt categories like *reflection, amusement*, and *irrelevance*. Similarly, *brow raise* (AU 1+2) got various meanings such as *interrogative, awareness, surprise*, and *consent* but not the absolute meaning *incompleteness and continuation*. Out of context this facial action has different meanings. Hence, there does not seem to be just one pragmatic meaning for all occurrences of an individual facial muscle contraction for deaf German people as well as for hearing German people.

However, different meanings of individual facial actions can be reduced to a common denominator when referring to the biological function. This is an argument that Ekman (1979, 201) presents for the facial actions brow raise (AU 1+2) and brow lowerer (AU 4) as conversational signals in spoken languages:

> [T]he role played by these two actions in conversational signals may be selected on the basis of their current biological function: 1+2 increasing and 4 decreasing visual input. Their role in conversational signals would thus be viewed as analogues to their biological adaptive value.

Following this line of reasoning, the attributed affective meanings, gestural meanings, and the grammatical functions of AU 1+2 and AU 7 can be traced back to a common denominator when referring to biological functions. Regarding AU 7, one can state that the common ground of affective meanings such as *anger* as well as *scepticism* and lexical uses in BLURRY and ANNOY is based on the biological function of *decreasing visual input* in a proper and metaphorical sense. *Decreasing visual input* is related to *anger* and *scepticism* in the form of meanings such as *do not want to see the trigger for the affect in the field of view*, to BLURRY in the form of meanings such as *cannot see the whole field of view* or *want to blind out disruptive factors from field of view*, and to ANNOY in the form of meanings such as *focus the annoying and blind out other disruptive factors from field of view*. This line of argumentation fits with the gestural meanings *concentration*, *reflection*, and the grammatical function *low accessibility* in the form of the meaning *focus on one specific aspect and blind out other disruptive factors from field of view*.

Lastly, it has to be emphasized that I do not aim at contradicting the theoretical account that intonation is compositionally organized in sign languages and comparable with intonation in spoken languages. Regarding specific grammatical markings, such as the brow raise as a marker for interrogatives and conditionals, the analogy to high tones in spoken languages is obvious. But, when including lexical, gestural, and affective uses of the discussed facial actions into the assumption of "invariant meanings" (Dachkovsky 2008, 62) the basis for the inherent meanings of specific facial actions has to be a more general one than assumed so far. In my view, basic biological functions of facial actions are the adequate basis for a compositional account that deals with invariant meanings of specific facial components and has the potential to include lexical markings in sign languages as well as gestural and affective meanings. Such a linking to general biological functions seems to be more difficult for facial actions in the lower face such as tongue show.

Finally, I summarize the results with respect to the three questions which were posed in the introductory Section 6.1:

1. Even isolated from the communication context, facial expressions are associated with affective, gestural, and 'grammatical' meanings within both groups of participants. The fact that 'grammatical' MeaAtts occur within both groups of participants can be seen as indicator for the clear gestural origin of specific grammatical facial markers in sign languages. The main difference between deaf and hearing participants is the fact that MeaAtts by deaf subjects are strongly influenced by signs with a corresponding lexical facial expression. Isolated facial actions often directly activate lexical entries of signs with a corresponding lexical facial expression. This suggests that specific facial expressions are inherent parts of the mental lexical entries of certain signs. In contrast, the impact of grammatical facial markings on MeaAtts is much lower. The amount of 'grammatical' MeaAtts is only 23% higher for deaf subjects compared to hearing subjects. It can be assumed that this is due to the fact that grammatical facial markers are depending on the sentence level. Facial actions by deaf signers are used in four functions: i) gesture, ii) affect, iii) grammar, and iv) sign.
2. Regarding the inventory of facial gestures, we found commonalities as well as differences between deaf and hearing subjects. For conventionalized gestures

or rather lexicalized gestures in DGS, both groups connect the same meanings. Furthermore, the analysis reveals commonalities in terms of MeaAtts related to affective states. Beyond, the general distribution of affective and gestural MeaAtts for the stimuli is the same for deaf and hearing subjects. However, with respect to non-conventionalized gestures different main interpretations by hearing and deaf subjects arise. This seems to be triggered by the interface between gestures, emotions, and sign language for deaf signers. The presented previous results on the comparison of the inventory of facial gestures by deaf and hearing people have to be supplemented in follow-up studies by means of empirical sign and speech production studies.

3. Only to a limited extent, meaning attributions to isolated facial expressions support compositional accounts, which attribute meaning to certain nonmanual components (cf. Nespor & Sandler 1999; Dachkovsky 2008; Herrmann 2012; Dachkovsky et al. 2013; Cavicchio & Sandler 2015). When interpreted without the language and communication context, individual facial actions were not associated with only one strict invariant meaning, but were labeled with meanings that belong to different MeaAtt categories. For deaf subjects, MeaAtts are strongly influenced by lexical signs with an inherent facial expression. Different meanings for some individual facial actions can be reduced to a common denominator when referring to more general biological functions.

When considering the results of the current study, it has to be noted that different intensities of facial action may have an impact on MeaAtts. This would be an interesting topic for further research. Moreover, a further step can be taken to elicit more data from hearing subjects with DGS competence so that it is possible to compare three subject groups: deaf people with DGS competence, hearing people without DGS competence, and hearing people with DGS competence. Furthermore, it would be interesting to carry out the same study including exactly the same design and stimuli for other spoken and signed languages. Beyond, to get a deeper insight into the manual actions at the interface between gesture and sign, it would be nice to carry out the *MeaAtt Study* for manual stimuli in the form of manual gestures of hearing people and lexical signs of DGS.

Part III: **Discussion and theoretical implications**

7 Towards a new classification of lexical nonmanuals

As outlined in Chapter 3, so far, there is no consensus about the status of lexical nonmanuals in different sign languages. In order to gain more insights into the nature of these markings in DGS, I conducted three empirical studies which were presented in the previous chapters. In the following, I provide a novel classification of lexical nonmanuals which is based on my empirical findings and previous theoretical approaches.

Firstly, I briefly discuss the overlap between phonemes and morphemes which is typical for sign languages (see Section 7.1). In Section 7.2, I mainly concentrate on formal aspects of lexical nonmanuals. It is shown that three different nonmanual sign types are relevant for lexical nonmanuals – i) facial expression, ii) facial expression and torso/body action, iii) torso/body action – and that lexical nonmanuals consist of different components, sub-components, and features (see Section 7.2.1). Furthermore, two articulation patterns are distinguished in order to capture the articulatory nature of lexical nonmanuals: i) muscle contraction based articulation pattern (MuCon-AP) and ii) component based articulation pattern (Com-AP; see Section 7.2.2). Moreover, it is appropriate to differentiate between constant lexical nonmanuals and dynamic lexical nonmanuals. The action type of dynamic nonmanuals can be further split-up into mirroring nonmanuals and non-mirroring nonmanuals. The term *mirroring nonmanuals* is inspired by *echo phonology* (Woll & Sieratzki 1998; Woll 2001; 2009; 2014), but implies modifications of this approach regarding the definition of the phenomenon and nonmanual components involved in the mirroring (see Section 7.2.3). Lexical nonmanuals are temporally structured by the syllable and lexical nonmanuals are relevant with respect to the sonority of signs and the syllable weight (see Section 7.2.4). Another interesting formal aspect of lexical nonmanuals is that signers not only seem to have a dominant hand for signing but a dominant half of the upper body (see Section 7.2.5). In Section 7.3, semantic aspects of lexical nonmanuals are discussed and I suggest a five-part categorization: i) lexical nonmanual imitation of action (see Section 7.3.1), ii) lexical nonmanual highlighting of a characteristic aspect of the sign meaning (see Section 7.3.2), iii) lexicalized affective nonmanuals (see Section 7.3.3), iv) lexicalized gestural nonmanuals (see Section 7.3.4), and v) lexical non-iconic nonmanuals (see Section 7.3.5). Section 7.4 deals with further characteristics of lexical nonmanuals. Here, I start with a diachronic perspective by looking at age group differences (see Section 7.4.1). Subsequently, I focus on the interaction between lexical nonmanuals and mouthings (see Section 7.4.2). Moreover, two further central properties of lexical nonmanuals are discussed: i)

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distinctive function and ii) semantic accentuation (see Section 7.4.3). Finally, in Section 7.5, I focus on the representation of lexical nonmanuals in the mental lexicon and, in Section 7.6, I provide an implementation of lexical nonmanuals into a model for sign language phonology, namely the Prosodic Model by Brentari (1998).

7.1 Overlap of phonemes and morphemes

One central property of human languages is the "duality of patterning" (Hockett 1960): Meaningless units (phonemes) are combined in order to form meaningful units (morphemes and words) and these units are combined in order to form larger meaningful units. However, regarding sign languages, the distinction between meaningless and meaningful elements is not as clear-cut as in spoken languages. "Just because a property is iconic, doesn't mean it can't also be phonological. Unfortunately, some phonologists studying sign languages called attention away from iconicity for a long time" (Brentari 2012, 46). In the lexicons of sign languages, iconicity has a much higher significance than in the lexicons of spoken languages. This is due to the fact that spoken languages are restricted to acoustic iconicity (cf. Meir 2012, 78). One example of such iconicity in spoken German and spoken English is *Kuckuck* or *cuckoo*. Both words are onomatopoetical (for further examples of iconicitiy in spoken languages, see Taub 2001). The term *iconicity* is used for "the regular mapping between fomational elements of an expression and components of its meaning" (Meir et al. 2007, 539).

Johnston & Schembri (1999, 118) use the term *phonomorphemes* in order to express

> that the minimal identifiable emic units of the language — handshape, location, orientation, movement and nonmanual features — are the substantive building blocks and are themselves meaningful. This is not to disregard the frequent instances of signs in which these phonomorphemes do not appear to act as individual meaningful units.

Thus, in sign languages, manual and nonmanual components of signs are often "not devoid of meaning" (Meir 2012, 78; see also Johnston & Schembri 2010). Regarding the manual elements of signs, Meir (2012, 78f.) illustrates this with the sign EAT in ISL (see also Meir et al. 2007). Similarly, many DGS signs fit this iconic scheme as, for instance, the verb DRINK in DGS. Like the sign EAT, the sign DRINK shows a "mapping between its formational elements and components of its meaning" (Meir 2012, 79). Hence, it is iconic. The sign DRINK is articulated with a bent flat hand. In the same form, this handshape is used when holding a glass in reality. The movement of the sign starts in the neutral signing space and is directed towards the mouth. The formational units of the sign are combined in such a way that it looks like an imitation of drinking in reality. Whereas the sign DRINK is an example for fully iconic signs, other signs show iconic properties only to some extent. This means that only one or some individual formational units imply an iconic form-meaning relation. Besides fully and partially iconic signs, sign languages have arbitrary signs as well (cf. Meir 2012, 79). One further important aspect of iconicity in sign languages is the fact that signs for concrete actions and objects as well as signs for abstract concepts exhibit iconicity (Woll 2014, 1). Moreover, in many cases it appears to be difficult to decide whether manual and nonmanual parts of signs show an iconic form-meaning mapping: "individual judgements may vary as to whether a given sign is to be accepted as iconic or not" (Zeshan 2000, 52; for further information on iconicity, see Taub 2001).

Usually, the meaningful property of morphemes functions as a differentiation criterion to phonemes, which are meaningless. But, in sign languages, due to the iconicity of phonemes, a complex overlap arises which leads to theoretical challenges for the differentiation between phonemes and morphemes (cf. also Coerts 1992, 35, 45; Schwager & Zeshan 2008, 511f.; Meir 2012, 79). These units are less clearly distinguishable than in spoken languages.

However, as Study III: *Meaning Attribution to Isolated Facial Expressions* (see Chapter 6) reveals, it is by no means the case that most facial muscular actions carry specific independent meanings that are comparable with the meanings of morphemes. It appears that only a small subset of nonmanual actions has one specific meaning as it is the case for head shake. Just as in spoken languages, some formational units in sign languages (e. g. head shake) may function as phonemes or as morphemes in different contexts. One example of spoken German is the formational unit *n* which is a very frequently occurring phoneme, e. g. the first phoneme in the German word *Nase* ('nose'). On the morphological level, this formational unit functions, inter alia, as morpheme for the marking of plural, e. g. *Kerze* (singular; 'candle') – *Kerzen* (plural; 'candles').

When analyzing phonological properties of nonmanuals, it is essential to exactly differentiate between iconicity and morphological functions. Many nonmanual formational units of signs are iconic. Nevertheless, in the basic form of signs, these units are not meaning bearing like true morphemes which add additional meaning to a sign. In general, the unit morpheme "is a problematic concept in sign languages. If we take morpheme to mean 'the smallest unit that associates form and meaning', many sublexical formal elements are morphemes as well" (van der Kooij & Crasborn 2008, 1316). With respect to sign languages, it is important to use the term *morpheme* only in such cases in which a unit clearly has a morphological function and adds a meaning which is not expressed otherwise. In this context, it is crucial that in the interviews with deaf signers as part of Study I: *Lexical Judgment and the Meaning of Signs* (see Section 4.4.2.4) it becomes apparent that lexical nonmanual components can be used for morphological increase and decrease (for further discussion of the morphological use of lexical components, see Section 7.5).

Nonmanual as well as manual parts of signs often appear as semantically transparent building blocks. Whereas signs are analyzed in detail for the individual manual formational units, it frequently seems to be the case that the meaning bearing property of lexical nonmanuals leads to a priori holistic treatments. When collecting examples of lexical nonmanuals other than mouth patterns given in the research literature, the frequent description as elements that correspond to the meaning of the respective signs sticks out (cf. e. g. Happ 2005, 22; Happ & Vorköper 2006, 240f.; Papaspyrou et al. 2008, 71). However, similarly to the analysis of manual components, it is necessary to empirically investigate whether lexical nonmanuals such as facial expressions on the lower face, facial expressions on the upper face as well as body and head actions have to be split up into individual components and features.

The issue of the overlap between formal and iconic properties of phonological units must not lead to the practice that the theoretical treatment of lexical nonmanuals is influenced by mixing the formal aspects of nonmanual articulations and semantic aspects, such as iconicity. It is preferable to consider these two crucial aspects of nonmanuals separately. Therefore, in the following sections, I analyze, in the first step, the articulatory properties of nonmanuals without taking iconicity into account (see Section 7.2). In the second step, the semantic characteristics of nonmanuals are discussed (see Section 7.3).

7.2 Formational aspects

In the following sections, I analyze various formational aspects of lexical nonmanuals. It will be investigated whether it is possible to capture nonmanuals with phonological descriptions. At this, I mainly consider lexical nonmanuals in citation form: “that is the form which would be listed in a dictionary, or the form which might be given by a native signer in response to a question, ‘What is the sign for x?’” (Deuchar 1984, 79). Of course, in natural communication signs are combined with each other in order to form complex utterances and they may diverge from citation forms. This is the same with words in spoken languages when used in utterances where they “will deviate from their pronunciation as listed in the dictionary” (Deuchar 1984, 79).

7.2.1 Nonmanual sign types, components, sub-components, and features

As a main classification, lexical nonmanuals can be described with three nonmanual sign types: i) *signs with a lexical facial expression*, ii) *signs with a lexical facial expression and torso/head action*, iii) *signs with a lexical torso/head action*. Within this main classification, it seems to be appropriate to grasp torso and head actions together. It appears that lexical forward body leans (AU 107) and backward body leans (AU 108) may be minimized and be performed solely with the next smaller articulator, the head (AU 57, AU 58, AU 53, AU 54). Furthermore, a lexical head action can additionally be performed with the next bigger articulator. For example, in one stimulus, which is used within Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4) and Study II: *Lexical Decision with Reaction Times* (see Chapter 5), the sign REVERE is articulated with a head action down. This nonmanual action may be signed with a forward body lean as well. The size of torso/head actions depends on the communication situation as well as on morphological decrease and increase (see Section 7.5). Besides, facial expressions on the upper and lower face have to be dealt with on the lexical level. The signs ALWAYS and SUPER are examples for signs with a lexical facial expression without lexical head/torso action. Moreover, DGS comprises several signs with a lexical facial expression and head/torso action, such as ARROGANT and LAZE.

Regarding the nonmanual sign types i) signs with a lexical facial expression and ii) signs with a lexical facial expression and torso/head action, my investigations indicate that the upper face with the three sub-components *eyebrow action*, *eye aperture*, and *eye gaze* is more important than often suggested. An example that clearly shows the relevance of lexical facial expressions in the form of muscular contractions in the upper face is the sign WINK. Study II: *Lexical Decision with Reaction Times* (see Chapter 5) underlines the relevance of this facial expression on the upper face. The study reveals a difference in the reaction times when participants process this sign with the nonmanual marking AU L46 (2x) and without the nonmanual marking. The average reaction time for the sign with the nonmanual marking is 674ms compared to 712ms without the nonmanual marking. Hence, the processing of the sign WINK with the nonmanual marking is on average 5% faster (see Section 5.4.1.1).[1] Further examples for lexical facial expressions on the upper face are the signs CONCENTRATE (see Figure 7.1) and FOG (for further information on the sign FOG, see Section 4.4.3).

1 However, this result is not statistically significant due to the too small sample size when looking at individual signs. Nevertheless, the statistical results show clear differences between the reaction times for signs with lexical nonmanuals (NMF signs) and manipulated signs with lacking lexical nonmanuals (m-NMF signs).

Fig. 7.1: Three articulations of the sign CONCENTRATE with lexical nonmanual marking on the upper face (small opened eyes, lowered eyebrows) and head action (head down, head forward)

In Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4), lexical signs in the three nonmanual sign types were analyzed based on judgments of adequacy by deaf signers. The stimuli in the three nonmanual sign types were presented to the signers in two conditions: i) with nonmanual features (NMF) and ii) without these nonmanual features (m-NMF). The manipulation effect is very clear and similar among the three nonmanual sign types. The rating difference between NMF signs and m-NMF signs for the three nonmanual sign types ranges from 25% to 34% in the questionnaire and from 53% to 61% in the interview (see Section 4.4.1.4).

By using the same stimulus videos as in Study I and measuring the reaction times by the selection of the fitting answer term out of two possible terms, Study II: *Lexical Decision with Reaction Times* (see Chapter 5) reveals an increased processing workload for m-NMF signs. Nonmanuals in the three nonmanual sign types clearly belong to signs and have an impact on processing, facilitating comprehension. On average, the percentage differences in the reaction times for NMF and m-NMF signs are as follows: i) signs with a lexical facial expression 9%, ii) signs with a lexical facial expression and torso/head action 8%, iii) signs with a torso/head action 14%.

In Chapter 3.1.1, I raised the question how many nonmanual components should be assumed for an adequate phonological description of lexical nonmanuals: Is it appropriate to treat different lexical nonmanuals as one lexical nonmanual component (= facial expressions/head actions/torso actions) as it is, for instance, assumed by Johnston & Schembri (2010)? Or is it appropriate to assume two lexical nonmanual components (= facial expressions and head/torso actions), three lexical nonmanual components (= facial expressions, head actions, and torso actions), or four lexical nonmanual components (= facial expressions on the lower face, facial expressions on the upper face, head actions, and torso actions)? Based on the results of my empirical analyses, I prefer the latter option. For the articulation of signs, sign languages have two channels: the manual channel and the nonmanual channel. The manual channel includes the four components *handshape, orientation, movement*, and *place of articulation*. The nonmanual channel comprises the four components *torso action, head action, upper face action*, and *lower face action*. The components upper face action and lower face action are subdivided into sub-components (see Table 7.1).[2] Moreover, I analyze whether the nonmanual components and sub-components can be split up into single phonological features. I assume that it is adequate to use AUs as features of the nonmanual components and sub-components. Table 7.1 includes all features which, according to the current state of my investigations, appear to be relevant for lexical markings.

The AUs 33 and 34 have been merged into one phonological feature. This is due to the observation that it seems to be irrelevant for lexical markings whether a sign which is specified for air action is articulated with a blow (i.e. "[a]ir is blown out through the lips" (Ekman et al. 2002b, 310)) or with a puff (i.e. "cheeks puff out as air is forced into the mouth, but the lips remain closed keeping the air in" (Ekman et al. 2002b, 311)). The occurrence of a blow instead of a puff is often due to other phonological features. For example, when a sign includes tongue show (AU 19), parted lips (AU 25), and the sub-component air action it is articulatorily caused that the air escapes. Figure 7.2 shows one example that supports the assumption that the distinction between AU 33 and AU 34 is phonologically irrelevant and both AUs are allophones. In the left picture, the signer articulates the sign EFFORT with a blow and in the right picture with a puff.[3] It may well be that further investigations reveal that other AUs listed in Table 7.1 have to be merged into one single phonological feature as well.

Some of the nonmanual components and sub-components appear to be very productive lexical markings whereas others seem to be rarely used for lexical markings. Very productive sub-components are, for instance, tongue action and eye aperture. Rarely occurring lexical sub-components seem to be, for example, cheek action and neck action.

One difference between manual and nonmanual components seems to be the fact that usually all manual components are realized in all signs, whereas many regular signs show no nonmanual marking. But, as the nonmanual components are always physically present within each sign, I assume that they are specified

2 The nonmanual components were generally discussed in Section 2.1 and Section 2.3.2.

3 The sign EFFORT may be articulated with a bilateral or unilateral air action, see Section 7.2.5.

Fig. 7.2: AU 33 (left) vs. AU 34 (right) as part of the sign EFFORT (data elicitation Pendzich 2012)

either as neutral or for certain muscle actions. In this view, the only component that can really be absent within a sign is the manual component movement (apart from transitional movements between signs, which are not phonological). It is a matter of debate whether signs without a phonological movement exist in different sign languages. One possible case in DGS seems to be the sign GERMAN which is articulated at the forehead. According to the current state of research, it has to be stated that signs without a primary or secondary movement appear to be atypical (cf. Pendzich 2016a).

It seems to be appropriate to capture lexical nonmanuals, firstly, with respect to the three nonmanual sign types – i) signs with a lexical facial expression, ii) signs with a lexical facial expression and torso/head action, and iii) signs with a lexical torso/head action – and, secondly, with respect to the nonmanual components, sub-components, and features. In the following Section 7.2.2, I discuss how the articulation of lexical nonmanuals seems to be specified by these different components, sub-components, and features.

Tab. 7.1: Nonmanual components, sub-components, and features for lexical markings

Component	Sub-component	Feature	
		AU number	AU name
Torso action	–	101*	Body turn left
		102*	Body turn right
		107*	Body forward
		108*	Body back
		0.1*	Body neutral

Component	Sub-component	Feature AU number	AU name
Head action	–	51	Head turn left
		52	Head turn right
		55	Head tilt left
		56	Head tilt right
		84	Head shake back and forth
		53	Head up
		54	Head down
		85	Head nod up and down
		57	Head forward
		58	Head back
		0.2*	Head neutral
Upper face action	Eyebrow action	1	Inner brow raiser
		2	Outer brow raiser
		4	Brow lowerer
	Eye aperture	5	Upper lid raiser
		6	Cheek raiser and lid compressor
		7	Lids tightener
		43	Eye closure
		45	Blink
		46	Wink
	Eye gaze	61	Eyes left
		62	Eyes right
		63	Eyes up
		64	Eyes down
		0.3*	Upper face neutral
Lower face action	Nose action	9	Nose wrinkler
	Cheek action	35	Cheek suck
	Mouth aperture	25	Lips part
		26	Jaw drop

Component	Sub-component	Feature AU number	AU name
		27	Mouth stretch
	Lip and corner of the mouth action	10	Upper lip raiser
		12	Lip corner puller
		15	Lip corner depressor
		16	Lower lip depressor
		18	Lip pucker
		20	Lip stretcher
		22	Lip funneler
		23	Lip tightener
		24	Lip presser
	Tongue action	19	Tongue show
		36	Tongue bulge
		37	Lip wipe
	Chin action	17	Chin raiser
	Air action	33/34	Blow or puff
	Neck action	21	Neck tightener
		0.4*	Lower face neutral

* Newly implemented AUs (see also Section 2.3.2)

7.2.2 Articulation patterns

Regarding the articulation of lexical nonmanuals, there are two opposing research positions. On the one hand, it is assumed that single nonmanual elements can hardly be differentiated from one another (cf. e. g. Becker 1998; Fontana 2008). Becker (1998, 259) states that facial expressions and posture often act so closely together that they need to be considered as a wholeness. Fontana (2008, 118) specifies that “[m]outh gestures can easily be seen as global and synthetic. They cannot be segmented and are perceived as global meaningful whole in close synchrony with signing” (see also Fontana 2008, 110). On the other hand, nonmanuals, in particular mouth patterns, are regarded as decomposable into components or features (cf. e. g. Ajello et al. 2001). Ajello et al. (2001, 243) state that “[f]rom the point of view of their structural organisation, mouth gestures present the same formational mechanism of sublexical elements as do manual signs”.

In general, the analysis of articulation patterns of lexical nonmanuals is made difficult particularly due to a high amount of dialectal variation in DGS.[4] Therefore, in many cases, it is difficult to decide whether an observed variability of lexical nonmanuals within a sign is a property of the respective nonmanual marking or due to dialectal variation. According to the current state of research, it is not possible to resolve this issue in general. In order to get deeper insights into dialectal nonmanual variation in DGS, in Study I: *Lexical Judgment and the Meaning of Signs*, I analyzed the articulation of different signs by the participants and the explanatory statements by the participants concerning different nonmanual sign variants (see Section 4.4.2.2). This reveals that it is difficult to draw the distinction between dialectal variants of lexical nonmanuals and variants due to subtle differences in the meaning. For instance, one participant explained that the same manual sign LAZE exists with two different nonmanual markings (see Figure 4.15 in Section 4.4.2.2). Further studies are necessary to investigate whether such different nonmanual articulations are due to dialectal variation or differences in the meaning.

Based on my empirical studies on DGS, I assume phonological specifications of nonmanuals in the form of either muscle contractions or components and sub-components. According to this, in the following, I introduce two articulation patterns which seem to be crucial for the nature of lexical nonmanuals: i) *muscle contraction based articulation pattern* (MuCon-AP; see Section 7.2.2.1) and ii) *component based articulation pattern* (Com-AP; see Section 7.2.2.2).[5] This classification should be treated as a proposal. Further studies are required to verify whether the two articulation patterns match the storing of nonmanuals in the mental lexicon. In addition to the two articulation patterns of lexical nonmanuals, it can often

4 For information on dialectal variation in DGS, see e. g. Hillenmeyer & Tilmann (2012) and Macht & Steinbach (2019). An important milestone for the investigation of dialectal variation all over Germany is the current DGS Corpus project of the University of Hamburg and the *Akademie der Wissenschaften in Hamburg*, see http://www.sign-lang.uni-hamburg.de/dgs-korpus/index.php/projekt.html. In future studies, it may be promising to study dialectal variation regarding lexical nonmanuals by using the Hamburg DGS Corpus.

5 In Pendzich (2014), I used the German terms *komponentenbasiertes Muster* and *holistisches Muster* for the description of lexical facial expressions. However, the empirical studies on lexical nonmanuals carried out subsequently revealed that it is more adequate to use the term *muscle contraction based articulation pattern* instead of *komponentenbasiertes Muster* and the term *component based articulation pattern* instead of *holistisches Muster*. These definitions are not inconsistent with one another, but are based on different uses of the term *component*. Whereas in Pendzich (2014), I used the term for specific muscle contractions such as lowered brows, my further studies showed that a distinction between two types of lexically specified nonmanuals should be made: i) components and sub-components and ii) muscle contractions.

be observed that further nonmanuals are sporadically used as individual style by signers which could be described as *gestural strengthening*.

7.2.2.1 Muscle contraction based articulation pattern (MuCon-AP)

The analysis of lexical nonmanuals yields that, for many signs in DGS, one or more components or sub-components of the face, torso, and/or head seem to be precisely defined with respect to features in the form of muscle contractions. For this pattern, I implement the term *muscle contraction based articulation pattern* (MuCon-AP).

One example of a lexical facial expression on the lower face belonging to the MuCon-AP is the sign WASTE, which is articulated with a very consistent lexical mouth pattern in the form of a tongue show against the lower lip and a blow (AU 19+25+26+33). As shown in Figure 7.3, one participant uses two manually different sign variants for WASTE, which are both articulated with the same lexical nonmanual marking.

Fig. 7.3: The sign WASTE as an example of MuCon-AP on the lower face (data elicitation Pendzich 2012)

Regarding the feature tongue show (AU 19), a common phonetic variance has to be noted. Tongue show may or may not be combined with a blow (AU 33).[6] A further example that reveals this phonetic variation within the MuCon-AP is the sign

6 Similarly, Dachkovsky et al. (2013) discuss "[p]honetic differences in the realisations of grammatical facial expressions". Regarding the intonation system in ASL and ISL, they explain two different articulations of squint which seem to be "the same facial 'tone'" (Dachkovsky et al. 2013, 240): "ISL most often produces narrowed eyes through the interaction of lower lid tighten (AU 7)

LAZE. The sub-component mouth aperture shows the features AU 25+26 and the sub-component tongue action is defined by the feature AU 19, which includes the phonetic variance of the use or non-use of blow (AU 33). In addition, the sign LAZE is defined by a backward torso action (AU 108) in the MuCon-AP, which may be maximized by a combination with a head action (AU 53) or minimized and articulated solely with the head (AU 53). As explained in Section 7.2.1, torso and head actions show a special relationship regarding joint articulations or replacing articulations. I treat this phenomenon as phonetic variation.

A further example of the MuCon-AP is the sign RECENTLY. This sign is articulated with a specific muscle contraction in the form of AU 19 of the sub-component tongue action. As shown in Figure 7.4, the sign may be used with a lateral or central tongue show (cf. Pendzich 2012). This can be described as phonetic variation, perhaps due to differences in dialects, and has no effect on the meaning of the sign (cf. Herrmann & Pendzich 2014).

Fig. 7.4: The sign RECENTLY as an example of MuCon-AP on the lower face (data elicitation Pendzich 2012)

For upper face actions belonging to the MuCon-AP, the sign TIRED is an illustrative example. As Figure 7.5 visualizes, there are at least two commonly used signs for *tired* in DGS, which differ in the manual articulation whereas the lexical nonmanual marking is identical: Both manual sign variants are articulated with closed eyes (AU 43E). At first, for the sign TIRED which is articulated near the eyes, it could be assumed that the eye closure is a reflex blink. However, this is refuted, on the one hand, due to a longer duration of the eye closure than would be caused

and nasolabial deepen (AU 11), while ASL typically employs a combination of cheek raise (AU 6) and upper lip raise (AU 10) for a similar effect" (Dachkovsky et al. 2013, 240).

by a reflex blink. On the other hand, the eye closure is used with the sign which is articulated on the chest as well (cf. Pendzich 2012, 91).

Fig. 7.5: The sign TIRED as an example of MuCon-AP on the upper face (Pendzich 2012)

With regard to the feature eye closure (AU 43), it has to be noted that it seems that many signs with a small eye aperture can include closed eyes. In light of this, it is assumed that the sign TIRED may be articulated with slightly open eyes instead of closed eyes. Thus, a reduction of the eye aperture (AU 43 or as a phonetic variance AU7) seems to be lexicalized whereby the intensity can differ (cf. Pendzich 2014). Concerning this matter, results of the interviews as part of Study I: *Lexical Judgment and the Meaning of Signs* are interesting as well. Participants described similar differences of intensity for nonmanuals of other signs (see Section 4.4.2.4). It can be assumed that differences of intensity, such as for the sign TIRED, may express morphological gradual differences of meaning. This means that a lexicalized component, sub-component or feature may function as a morphological marker (see Section 7.5).

In the interviews of Study I, the participants precisely named missing nonmanual markings when evaluating signs which were shown without the corresponding lexical nonmanuals. For example, concerning the stimulus sign REVERE without the lexical head action AU 54, it has been mentioned that the posture is wrong and that the sign includes a forward action. The sign REVERE is defined for the MuCon-AP.

The sign SLEEP is an example of the MuCon-AP with respect to the component head action and the sub-component eye aperture. Both are precisely defined with respect to the muscular contraction. The eye aperture is specified for AU 43E. The head action is determined for AU 55 or 56 in accordance to the side of the signing hand (see Figure 7.6).

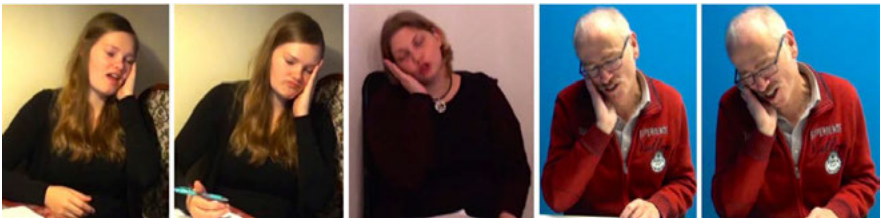

Fig. 7.6: The sign SLEEP as an example of MuCon-AP on the upper face and head

7.2.2.2 Component based articulation pattern (Com-AP)

Besides the MuCon-AP, my investigations reveal a second articulation pattern for which I suggest the term *component based articulation pattern* (Com-AP). Within this pattern, a lexically specified nonmanual marking includes an articulatory variability. This means that one or more individual nonmanual components or sub-components are determined, but their exact specification with respect to muscle contractions is flexible to some extent. The Com-AP rather than the MuCon-AP can be seen in relation to the frequent holistic descriptions of lexical nonmanuals as elements that correspond to the meaning of the respective signs without indicating the exact form (cf. e. g. Happ 2005, 22; Happ & Vorköper 2006, 240f.; Papaspyrou et al. 2008, 71; see also Section 2.1 and Section 7.1).

The Com-AP includes signs with variable muscular actions. It appears that the variability of lexical nonmanuals occurs in the limits of the articulatory properties of the respective component or sub-component. For example, the sign BLURRY is, apart from other lexical nonmanual specifications, defined by the sub-component eyebrow action, but the precise muscular contraction is variable with respect to AU 1, 2, and 4 (see Figure 7.7).

Fig. 7.7: The sign BLURRY as an example of Com-AP for the sub-component eyebrow action

Another example is the sign PROTECTION, which shows Com-AP for the component torso action (see Figure 7.8 and Figure 7.9). The sign is articulated with a body backward action (AU 108) or a forward action (AU 107). It can be realized together with an action of the next smaller articulator the head. Furthermore, it may be performed only with the head. Regarding the head action, it has to be noted that a head backward action (AU 58) may be additionally realized with a head up (AU 53) and a head forward action (AU 57) may be additionally articulated with a head down (AU 54). Figure 7.8 illustrates backward actions and Figure 7.9 shows forward actions.

Fig. 7.8: The sign PROTECTION as an example of Com-AP for the component torso: backward action

Fig. 7.9: The sign PROTECTION as an example of Com-AP for the component torso: forward action

The sign SUPER is specified for both articulation patterns (see Figure 7.10[7]): for the lower face, the MuCon-AP is relevant and, for the upper face, the Com-AP. Regarding the lower face, the sign is specified for the sub-components chin action with AU 17, mouth aperture with AU U25, and air actions with AU U33. Furthermore, the sign is determined for the component upper face whereby the sub-components show articulatory variability. The data elicitations reveal that the sub-component eyebrow action includes variability of AU 1, 2, and 4. The sub-component eye aperture appears variable with respect to AU 5, 7, and 43. Usually, at least one of both sub-components is used in addition to the mouth pattern when signing SUPER.[8] In line with this, one of my deaf informants with DGS as native language explained that the facial expression of the sign SUPER is always the same on the lower face, whereas the facial expression on the upper face is variable but always occurs. He said that the facial expression on the upper face is context-dependent. As illustrated on the picture on the right side of Figure 7.10, the facial expression on the lower face may be replaced by a mouthing (for the interaction between mouthings and lexical nonmanuals, see Section 7.4.2).

Finally, it has to be emphasized that the described variability included in the Com-AP has not to be confused with phonetic variance of lexical nonmanuals and morphological variation of lexical nonmanuals due to decrease and increase. Both of these phenomena are characteristics of the Com-AP as well the MuCon-AP. The latter phenomenon and the impact of morphological uses of lexical nonmanuals for the modeling of lexical entries will be discussed in Section 7.5.

7 The picture on the right side is taken from the data elicitation Pendzich (2012).

8 This classification is based on the elicited data in the presented empirical studies, the data elicitation in Pendzich 2012, and the discussion with a deaf informant using DGS as native language.

Fig. 7.10: The sign SUPER as an example of MuCon-AP on the lower face and Com-AP on the upper face

7.2.3 Constant nonmanuals vs. dynamic nonmanuals

Lexical nonmanuals occur in two different action types: A sign may be specified for i) constant nonmanuals or ii) dynamic nonmanuals. Constant as well as dynamic nonmanuals are temporally synchronized with the manual articulation. With respect to mouth patterns, Pfau & Quer (2010, 384) describe that "the mouth pattern may either change or remain constant during the articulation of the sign". Also regarding mouth patterns, Vogt-Svendsen (1983, 94f.) differentiates between "static position" and "movement". In line with Pfau & Quer (2010, 384), I prefer using the term *constant* instead of *static*. This is due to the fact that nonmanuals always include a muscular action. Hence, they cannot be static in the proper meaning of the word, namely showing no movement. The term *constant* appears to be more convenient to capture nonmanual actions which are unchanging in their configuration. Another appropriate term is *mouth holds* (Woll 2001, 91)[9] or in relation to lexical nonmanuals in general *nonmanual holds*.

The action type of dynamic nonmanuals can be further subdivided into mirroring nonmanuals and non-mirroring nonmanuals. Woll & Sieratzki (1998; see also Woll 2001; 2009; 2014) were the first who called attention to an interesting articulation pattern which is referred to as *echo phonology*. In addition, the term *semantically empty mouth gestures* is used by Crasborn et al. (2008). My term *mirroring nonmanuals* is inspired by the term *echo phonology* but implies modifications of this approach. These modifications relate to the definition of the phenomenon on the one hand, and the nonmanual components involved in the echoing on the other hand.[10]

9 Woll (2001, 91) uses the term *mouth holds* for adverbial mouth gestures.

10 Woll (2014, 1) takes the approach that "[e]cho phonology provides naturalistic examples of a possible mechanism accounting for part of the evolution of language" (see also Woll 2001).

Woll (2001; 2009; 2014) describes echo phonology as mouth actions, which mirror or echo actions of the hands:

> The term "echo phonology" is used, since the mouth action is a visual and motoric "echo" of the hand action in a number of respects: onset and offset, dynamic characteristics (speed and acceleration) and type of movement (e. g., opening or closing of the hand, wiggling of the fingers). (Woll 2014, 4)

Woll (2001, 91) includes two types of mouth movements: "either the exhalation or inhalation of breath, or a change in mouth configuration during the articulation of the sign" (see also Woll 2009, 210).[11] Furthermore, Woll (2009, 210f.) gives the following restrictive specification for echo phonology: "Most importantly, the action of the mouth in signs with echo phonology, while echoing that of the hands, is not in itself iconic" (see also Woll & Sieratzki 1998, 531f.; Woll 2001, 97; Woll 2009, 221; Woll 2014, 4, 8). One example from BSL mentioned by Woll (2014, 4) is the sign TRUE: "the upper hand moves downwards to contact the lower hand, and this action is accompanied by mouth closure, synchronized with the hand contact". An example from DGS for echo phonology in accordance with the definition by Woll (2001; 2009; 2014; see also Woll & Sieratzki 1998) is the sign OWN, which is illustrated in Figure 7.11.

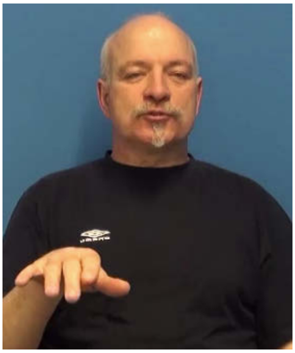

Fig. 7.11: The sign OWN with a non-iconic lexical mouth pattern

Whereas this is a very interesting approach, it has to be noted that my analyses make no claim about the origins of spoken language phonology.

11 Woll & Sieratzki (1998, 531f.) give the following description: "All examples require the exhalation or inhalation of breath, usually with a change in mouth configuration during the articulation of the sign (rather than static mouth arrangements such as "tongue protrusion," [sic] which are also found in sign languages, but associated with adverbials)".

The sign OWN has no path movement but a secondary movement in the form of finger wiggling. The mouth pattern is aligned with this manual movement. It belongs to Woll's category *exhalation of breath*. In my terminology, the sign is specified for the nonmanual sub-component mouth aperture with the feature AU 25, the sub-component lip and corner of the mouth action with the feature AU 22, and the sub-component air action with the feature AU 33A. According to Woll's condition for echo phonology, the mouth pattern *is not in itself iconic*.

I consider the phenomenon of echoing between manual and nonmanual components mainly based on formational aspects and consider semantic characteristics like iconicity subordinated. The semantics of lexical nonmanuals are analyzed more closely in the second step (see Section 7.3). Based on this analytical separation, I treat the phenomenon of echoing between manual and nonmanual components in a modified version of Woll's approach towards echo phonology and use the term *mirroring nonmanuals*. The following four aspects are analyzed: 1) iconic and non-iconic mirroring nonmanuals, 2) mirroring in both directions (i.e. a nonmanual action may mirror a manual action, a manual action may mirror a nonmanual action), 3) further nonmanual components besides lower face actions, and 4) mirroring with respect to handshape change, movement type, and movement reduplication.

In the following, I discuss, on the one hand, constant nonmanuals and, on the other hand, dynamic nonmanuals with the two subtypes mirroring nonmanuals and non-mirroring nonmanuals. These distinct action types are illustrated with signs of DGS and with respect to different nonmanual components. In further studies, the distinct action types have to be analyzed with respect to the frequency of the different nonmanual components. Furthermore, it would be interesting to investigate the proposed classification for other sign languages as well.

7.2.3.1 Constant nonmanuals

Constant nonmanuals are lexical nonmanual markings which show no change in their configuration during the articulation of the corresponding manual sign. One example for constant nonmanual actions on the lower face is the sign RECENTLY. The sign is manually articulated with a reduplicated movement from the neutral signing space towards the shoulder. The sign occurs with two different handshapes, either the indexfinger or the angled flat hand. Whereas the movement is reduplicated the tongue show (AU 19) remains constant. Furthermore, the sign RECENTLY exists with another nonmanual sign variant. This is defined for the sub-component lip and corner of the mouth action with the feature lip pucker (AU 18), the sub-component mouth aperture with the feature lips part (AU 25), and the sub-component air action with the feature blow (AU 33). Like the other nonmanual sign variant, this nonmanual action remains constant while the manual movement is reduplicated. I elicited this sign only with one of the mentioned manual variants, namely with the angled flat hand. Future studies have to investigate whether this nonmanual sign variant is used with the indexfinger handshape as well. DGS includes several signs with a constant nonmanual marking whereas the manual movement is reduplicated, as it is the case in the sign RECENTLY. Further examples are, for instance, URGENT, LAUGH, and ANNOY.

An example with constant nonmanuals in the form of a head action is the sign SLEEP. The one or two handed sign is articulated with flat hand laterally on the head. The nonmanual component head action is determined for a head tilt to the side of the articulating hand(s) (AU 55 or AU 56).

Mirroring appears to be more striking for dynamic nonmanuals. Here, manual and nonmanual components include a simultaneous change in their configuration. It is important to differentiate between the terms *synchronized* and *mirroring*. The first term clearly applies to all lexical nonmanuals – constant, dynamic, mirroring, non-mirroring – and means that the actions by manual and nonmanual articulators are performed in parallel and with the same speed.

7.2.3.2 Dynamic nonmanuals

The term *dynamic nonmanuals* is used for lexical nonmanual markings which include a change in their configuration during the articulation of the corresponding manual sign. One example for dynamic facial expressions is an open mouth at the initial point of a sign and a closed mouth at the end point of the sign. Regarding head action, head nod is an example for dynamic nonmanuals since a head nod includes two different head positions by definition. Dynamic nonmanuals occur in two different forms: i) non-mirroring nonmanuals and ii) mirroring nonmanuals. These sub-types are discussed in the following.

i) Non-mirroring nonmanuals

I define dynamic non-mirroring nonmanuals as lexical nonmanual markings that show a change in their configuration which does not mirror the manual articulation with respect to a change in handshape, movement type or movement reduplication.

One example for a dynamic nonmanual marking and a manual articulation which do not mirror each other is the sign PIPE (see Figure 7.12). The sign is articulated with a handshape in the form of a bent thumb and indexfinger which is hold laterally in front of the face. Whereas the sign is performed completely without a manual primary or secondary movement, it includes a reduplicated nonmanual action with the features blow (AU U33), chin raiser (AU 17), lip presser (AU U24), and lips part (AU U25). In the research, it is controversially discussed whether signs with just a hold position without any manual movement are well-formed (for a discussion of syllables in sign languages see Pendzich (2016a); see also Section 7.2.4).

Dynamic non-mirroring nonmanuals seem to occur much less in DGS than mirroring nonmanuals which will be discussed in the following.

Fig. 7.12: The sign PIPE as an example for dynamic non-mirroring nonmanuals on the lower face

ii) Mirroring nonmanuals

Happ (2005, 21f.) describes that mouth patterns depend on the manual articulation of signs. If the respective sign requires a change in the handshape, the mouth pattern follows the hand. When the sign starts with an opened hand and ends with a closed hand, the mouth is correspondingly opened with the first handshape and closed with the second handshape. However, this does not mean that all signs with a handshape change include a mouth pattern (e.g. PICK-UP, see Figure 7.18 in Section 7.2.4). Beyond, mirroring nonmanuals reveal four interesting properties, which I explain below: 1) non-iconic and iconic mirroring nonmanuals, 2) mirroring in both directions (i.e. a nonmanual action may mirror a manual action, a manual action may mirror a nonmanual action), 3) different mirroring components, and 4) mirroring with respect to handshape change, movement type, and movement reduplication.

Non-iconic and iconic mirroring nonmanuals

Independent of iconicity, DGS includes signs in which features of the manual and nonmanual components are mirroring each other. An example is the sign BITE-OFF. The mouth aperture changes from opened to closed analogously and simultaneously with the handshape change from an opened hand to a closed hand (see Figure 7.13).

Fig. 7.13: The sign BITE-OFF as an example for dynamic mirroring nonmanuals on the lower face (iconic)

The illustrated mouth pattern is an obligatory part of the DGS sign BITE-OFF in citation form. In contrast to my approach, Crasborn et al. (2008, 50) do not consider mouth patterns in which "the mouth performs an action of the mouth itself" as lexically associated. According to them, such mouth patterns build a separate type *enacting mouth gestures* and are considered separately from *echo phonology* (see also Woll 2001).

The sign UNOFFICIAL-WAY is an example for mirroring nonmanuals which are non-iconic (see Figure 7.14). The sign is articulated with a manual rotation of the wrist which is mirrored by a rotation of the tongue against the cheek (AU 36).

According to my previous investigations, DGS comprises markedly more signs with iconic mirroring mouth patterns (e. g. BITE-OFF) than non-iconic mirroring mouth patterns (e. g. UNOFFICIAL-WAY). Furthermore, it seems to be the case that non-iconic, abstract mirroring nonmanuals only occur for the component lower face and not for the other nonmanual components.

Fig. 7.14: The sign UNOFFICIAL-WAY as an example for dynamic mirroring nonmanuals on the lower face (non-iconic)

Mirroring in both directions

The example UNOFFICIAL-WAY (see Figure 7.14) can be seen as an example for the mirroring of a manual action by a mouth action. In contrast, for the sign BITE-OFF the other way around appears more plausible: The mouth directly imitates the action which is done when biting in reality and this action is mirrored by the hands. Therefore, I define the term *mirroring nonmanuals* independent of which action – manual or nonmanual – is mirrored: The term *mirroring nonmanuals* is used to describe that with manual and nonmanual components an analogous changing action is simultaneously expressed. Either a nonmanual action may mirror a manual action or a manual action may mirror a nonmanual action. In contrast, concerning the phenomenon of echo phonology, Woll (2001, 92) emphasizes that "the hands 'drive' the mouth, and not the other way around".

When relating the pathway of the mirroring of manual and nonmanual components to iconicity, it seems to be the case that non-iconic nonmanuals mirror the action by the hands and iconic nonmanuals are mirrored by the hands.

Different mirroring components

Whereas Woll (2001; 2009; 2014; Woll & Sieratzki 1998) investigates echo phonology with regard to facial actions on the lower face, I extent the analysis of mirroring nonmanuals to two further nonmanual components: head/torso action and upper face action. Also, Pfau & Quer (2010, 385) mention head actions besides mouth patterns under the term *echo phonology*.

The DGS sign AWAKE is an example for signs in which, instead of the mouth, the upper face with the sub-component eye aperture includes a muscle action in analogy to the action by the hands. Figure 7.15 illustrates the simultaneity of the change in the eye aperture from slightly open to wide open and the change in the hand aperture from slightly open to wide open (cf. Pendzich 2012, 108f.; Pendzich 2014, 431).

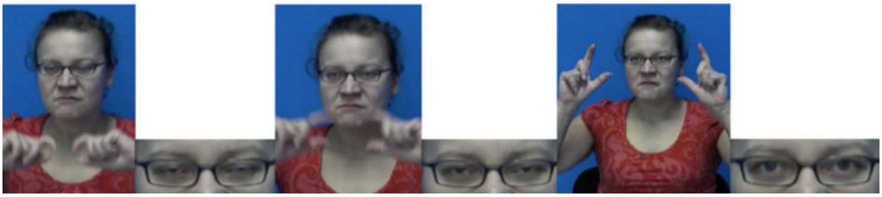

Fig. 7.15: The sign AWAKE as an example for dynamic mirroring nonmanuals on the upper face (Pendzich 2012 and Pendzich 2014)

It has to be mentioned that my elicited data reveal variability in the articulation of the eye aperture within the sign AWAKE: The eyes are either constantly wide open during the hand form change (= constant nonmanuals) or the eye aperture changes from closed to neutral or from slightly open/closed to wide open which is synchronized with the hand form change (= dynamic nonmanuals). In further studies, the sign AWAKE has to be analyzed in different contexts in order to come to know whether the variability between a constant wide eye aperture and a change in the eye aperture is caused by a semantic difference between *awake* and *wake-up* (cf. Pendzich 2012; Pendzich 2014).

A further example for mirroring nonmanuals regarding the sub-component eye aperture seems to be the sign SUDDEN (two-handed secondary movement with the flat hand from closed to opened in the neutral signing space). One difference between mirroring nonmanuals on the lower and upper face is the visual salience. Mirror nonmanuals in the form of mouth patterns are visual more conspicuous than the described mirror nonmanuals on the upper face. Nevertheless, it appears to be relevant to include the components eye aperture and eyebrow action into the analysis of mirroring nonmanuals. In further investigations, it has to be figured out whether signs exist which include simultaneous mirroring nonmanuals on the lower and upper face (cf. Pendzich 2012; Pendzich 2014).

Examples for the mirroring component head/torso action are the signs REVERE and LAZE which are discussed in the next subsection.

Mirroring with respect to handshape change, movement type, and movement reduplication

I consider three different manual action types under the phenomenon of mirroring nonmanuals: i) change of handshape in the form of an alteration of the degree of aperture, ii) movement type, and iii) movement reduplication.

A clear example of mirroring of a handshape change is the sign BITE-OF (see Figure 7.13). My investigation suggests that lexical nonmanual markings and handshape changes in the form of an alternation of the degree of aperture do not have to mirror each other, but show a strong tendency for mirroring. As mentioned above, the sign AWAKE with nonmanuals on the upper face is elicited, on the one hand, with mirroring nonmanuals and, on the other hand, with constant nonmanuals. But, it could well be that the occurrence of both constant nonmanuals and mirroring nonmanuals with handshape changes is only characteristic for the upper face and not for the lower face. So far, I detected no sign from DGS with a change of the handshape aperture and constant nonmanuals on the lower face. Regarding this, further studies are necessary. However, there are signs with an aperture change of the handshape without nonmanual marking, e. g. the sign PICK-UP (see Figure 7.18 in Section 7.2.4). Furthermore, it has to be mentioned that my analyzed data reveal one sign in which the phonological mirroring of the handshape change by a mouth aperture change is inverse. This phenomenon occurs within the DGS sign DISAPPEAR. The sign has one path movement with a secondary movement in the form of a closing of the handshape. This manual movement is aligned with a mouth pattern (see Figure 7.16). When closely analyzing the mouth aperture caused by the blow of air within the sign DISAPPEAR, the following pattern becomes apparent: i) the initial point of the sign is characterized by an opened handshape and a closed mouth, ii) the end point of the sign is determined by a closed handshape and an opened mouth due to the escape of air. It could well be that only signs which are specified for the sub-component air action, such as the sign DISAPPEAR, contradict the regularity of analogous aperture changes between the hands and nonmanuals. It seems that these signs have to be treated separately.

Fig. 7.16: Inverse mirroring nonmanuals: the sign DISAPPEAR

An example for mirroring of movement type is the sign REVERE. The two handed sign is articulated with the handshape in the form of straddled indexfinger and middle finger and a downward movement in the neutral signing space. The nonmanual component head action is determined for a head down movement (AU 54). The manual and nonmanual movements are mirroring each other. The sign LAZE is a further example for mirroring of movement type. In addition to the facial expression on the lower face, the sign LAZE is defined by a backward torso action (AU 108) in combination with a non-reduplicated manual movement to the front and downwards (see Figure 4.15 in Chapter 4.4.2.2). AU 108 may be maximized by a combination with a head action (AU 53) or minimized and articulated solely with the head (AU 53). As discussed in Section 7.2.1, torso and head actions reveal a special relationship regarding joint articulations or replacing articulations. The manual movement and torso/head movement of LAZE are mirroring each other, but, interestingly, the manual and nonmanual movements are performed in opposing directions: The manual movement is orientated to the front and the nonmanual movement is orientated backwards.

Mirroring nonmanuals with respect to movement reduplication refer to an equal number of nonmanually and manually performed actions and a simultaneous articulation of these actions. One example is the sign WINK. The number of the nonmanual action in the form of the sub-component eye aperture with the feature wink (AU 46) corresponds to the number of the manual secondary movement (thumb and indexfinger change from an open to a closed handshape, next to the head). The sign WINK may either be articulated with one manual secondary movement and one nonmanual action or with a twice articulated manual secondary movement and a twice performed nonmanual action. Study I: *Lexical Judgment and the Meaning of Signs* and Study II: *Lexical Decision with Reaction Times* include the sign WINK as a stimulus. Within this stimulus video the sign is articulated with a reduplicated manual secondary movement and a reduplicated AU 46. In the interview as part of Study I, the participants articulated the sign either in the same form or with one manual secondary movement and one nonmanual action.

An example for mirroring of reduplication with the head is the sign NOD (secondary movement of the wrist near the head). In the stimulus video of Study I and Study II, it is signed with one hand movement and one head nod (AU 85). However, many participants described that they use the sign with a reduplicated hand and head movement. Hence, the number of movements of the head and the number of movements of the hand are interdependent. A further example is the sign NOT-YET, which is a stimulus of Study I and Study II as well. The sign is performed with a twice articulated manual movement (secondary movement of the wrist with the flat hand in the neutral signing space) and a head shake back and forth (AU 84).[12]

In contrast to signs with an aperture change in the handshape, for signs with manual movement reduplication, both types – constant nonmanuals (e.g. RECENTLY) and mirroring nonmanuals (e.g. NOD)– seem to occur frequently.

12 In their analysis of different head movements based on the data from two native signers of FinSL, Puupponen et al. (2015, 62) distinguish between seven functions of head movements: Emphasis, boundary marking, domain marking, affirmation, interrogative, copying, and indicating. With respect to mirroring nonmanuals, it would be interesting to further study the category *copying*. Puupponen et al. (2015, 75) describe this category as follows: "Copying head movements were usually instances of head nods or nodding in which the motion of the head copied the temporal pattern of global manual (path) movements". They classify such copying as i) emphasis by which the visibility of a co-articulated manual sign is increased or as ii) "non-deliberate co-articulation". But, they do not list the particular signs which occur with such copying head movements and do not address the question whether these could be inherent lexical head movements.

7.2.4 Lexical nonmanuals and syllables

The syllable is an important unit in the phonology and prosody of spoken as well as signed languages.[13] Even though the term was initially defined on the basis of the auditory modality and despite differences regarding the articulatory and perceptive bases, the term can be transferred to the visual modality of sign languages. Much research on the syllable in sign languages focuses on ASL (cf. Sandler 1989; Wilbur 1990; Perlmutter 1992; Brentari 1998). In addition, there is research on the syllable in a number of other sign languages, for instance, NGT (cf. van der Kooij & Crasborn 2008), FinSL (cf. Jantunen & Takkinen 2010), ISL (Sandler 2008), BSL (cf. Woll 2001), and DGS (cf. Pfau 1997; Happ & Vorköper 2006; Steinbach 2007; Pendzich 2016a).

Syllables in spoken languages are defined as sequences of opening and closing processes of the vocal tract. In contrast, syllables in sign languages can be determined as consisting of places of articulations or positions and movements. Whereas, in spoken languages, vowels mostly function as syllable nuclei, in sign languages, syllable nuclei are mostly realized by movements (cf. Brentari 1998; Keller & Leuninger 2004; Steinbach 2007; Hall 2011).

The close connection between the syllable and sonority is important for the definition of the syllable in spoken languages. Similarly, sonority is essential for the analysis of the syllable in sign languages as well. Due to the disparate modalities, completely distinct phonetic bases exist in spoken and sign languages and sonority has to be defined differently. However, in both cases, sonority concerns the salience in the perception (cf. Brentari 1998, 28, 217; Jantunen & Takkinen 2010, 314). With regard to spoken languages, sonority is commonly taken as an auditory factor (cf. Hall 2011, 230f.). In contrast, sonority has to be treated as a visual factor in sign languages. Accordingly, the term *visual sonority* is used (cf. Brentari 1998, 216; Sandler & Lillo-Martin 2006, 236). Movements by the hands have a higher visual salience than positions (cf. Perlmutter 1992, 419; Pfau 1997, 13). The principle of sonority is crucial for the structure of syllables. The sonority increases from the onset to the syllable nucleus and then decreases to the coda (cf. Steinbach 2007; Hall 2011; in contrast, see the argumentation for "ASL syllable's lack of sonority sequencing" by Corina 1990, 41). As shown in (6) and (7), in both modalities, segments can be arranged on a scale of sonority (cf. Sandler & Lillo-Martin 2006; Steinbach 2007; Hall 2011; see also the similar hierarchy in Corina 1990 and the overview on alternative sonority hierarchies in sign languages in Brentari 1998, 218, 227f.).

13 This section is based on parts of Pendzich (2016a).

(6) *Sonority hierarchy in spoken languages*
vowels > liquids > nasals > fricatives > plosives

(7) *Sonority hierarchy in sign languages*
primary movements > secondary movements > positions

In sign languages, the impacts of the sonority principle on the structure of syllables are not merely sequential like in spoken language but also simultaneous. Secondary movements either occur in parallel with a position or a primary movement. This can be illustrated with the signs HOLIDAY and PICK-UP. The sign HOLIDAY is articulated with a secondary movement in the form of a finger wiggling on a position (see Figure 7.17).

Fig. 7.17: Position with secondary movement in the form of finger wiggling within the sign HOLIDAY

The sign PICK-UP is performed with a secondary movement in the form of a change in the handshape from opened to closed in combination with a primary movement (see Figure 7.18; for further information on syllables in sign languages, see Pendzich 2016a).

Fig. 7.18: Primary movement with secondary movement in the form of handshape change within the sign PICK-UP

With respect to nonmanuals, it is crucial that they may increase the sonority of signs (cf. Brentari 1998, 224; Jantunen & Takkinen 2010, 316-318). One example given by Brentari (1998, 222-224) is the ASL sign PERPLEXED. Whereas, in citation form, this sign is articulated solely with an aperture change of the hand on the forehead, there are three possible forms for an increase of salience: i) addition of a movement with the wrist, ii) addition of a movement with the elbow, and iii) addition of a head movement. In this respect, further studies are necessary which investigate sonority increase by different nonmanual markings in sign languages. At the same time, it is essential to capture the differences between inherent lexical nonmanuals and optional gestural and affective nonmanual markings (cf. Pendzich 2016a). As mentioned in Section 7.2.3.2, the DGS sign PIPE is articulated with a handshape in the form of a bent thumb and indexfinger which is hold laterally in front of the face. Whereas the sign is performed completely without a manual primary or secondary movement, it includes a reduplicated nonmanual movement with the features blow (AU U33), chin raiser (AU 17), lip presser (AU 24), and lips part (AU U25; see Figure 7.12). Similarly, for FinSL, the existence of signs consisting of a manual position with a nonmanual movement is documented (FinSL signs: HAS/HAVE-HEARD and NICE; cf. Jantunen 2006, 337; Jantunen & Takkinen 2010, 327f.). In the visual modality and auditory modality, syllables with rarely sonorous nuclei like positions without manual secondary movements in sign languages and consonants in spoken languages turn out to be marked. This syllable type is represented only by very few signs in DGS, e. g. the sign GERMAN. In this respect, the DGS sign PIPE is very interesting as it is articulated with a position combined with a nonmanual movement. It seems to be appropriate to assume that lexical nonmanuals function in the same way as manual secondary movements, that is making a manual position or a manual primary movement more sonorous. It would be revealing to carry out corpus studies in order to investigate whether more signs with a manual position combined with a nonmanual action occur in DGS or whether the sign PIPE is an exception. As it seems to be required to consider lexical nonmanuals with respect to the sonority of signs, I propose an extension of the sonority scale. To begin with, I consider manual secondary movements and nonmanual actions as being on the same sonority level, which is illustrated in (8).

(8) *Sonority hierarchy in sign languages with incorporation of nonmanuals*
manual primary movements > manual secondary movements & nonmanual actions > manual positions

In future studies, it has to be investigated whether manual secondary movements and nonmanual actions have to be separated on the scale and whether a difference in the sonority of constant and dynamic nonmanuals (see Section 7.2.3) as well as the various AUs (see Section 7.2.1) can be found. For instance, nonmanuals such as a head action and an eye action seem to be not similarly salient.[14] In addition, the sonority hierarchy may be further split up with respect to different types of manual primary movements, manual secondary movements, and manual positions.

With regard to the movement of signs, light and heavy syllables can be distinguished. A light syllable has a simple movement in the form of a manual secondary movement or a manual primary movement, e. g. the sign HOLIDAY (see Figure 7.17). A heavy syllable contains a complex movement consisting of a path movement and a simultaneous secondary movement, e. g. the sign PICK-UP (see Figure 7.18). This difference in the complexity can be seen as analogy to the syllable weight in spoken languages (cf. Brentari 1998, 80f., 237; van der Kooij & Crasborn 2008; Brentari 2012, 29; Pendzich 2016a). The finding of my empirical studies that the status of certain nonmanual components in DGS is comparable to that of the manual components of signs (see Chapter 4, Chapter 5, and Chapter 6) provides new evidence that it is appropriate to extend the definition of syllable weight with respect to lexically specified nonmanuals (see also Jantunen 2006 and Jantunen & Takkinen 2010 who argue for the extension of the definition of move-

14 Jantunen (2005) argues that i) movements by the torso and head are more sonorous than manual movements and ii) mouth patterns are less sonorous than manual movements (cf. Jantunen & Takkinen (2010, 317), where the only in Finnish published approach by Jantunen (2005) is reported: Jantunen (2005): Mistä on pienet tavut tehty? Analyysi suomalaisen viittomakielen tavusta prosodisen mallin viitekehyksessä. Licentiate thesis, University of Jyväskylä, Finland).

ment complexity with respect to nonmanual movements based on FinSL). Lexical nonmanuals clearly increase the complexity of syllables. Furthermore, like the specifications of manual secondary movements, lexical nonmanual actions as, for instance, a change in the eye aperture, a head action, and a tongue action are temporally structured by the syllable (see also Sandler & Lillo-Martin 2006, 219, 222).

For the relationship between lexical nonmanuals and syllables, the following points have to be emphasized: i) Lexical nonmanuals have to be considered with respect to the sonority of signs. According to this, I proposed an extension of the sonority scale. ii) The definition of the syllable weight should include lexical nonmanuals. iii) The syllable structure controls the temporal course of lexical nonmanual actions.

7.2.5 Dominant half of the upper body

A further interesting aspect of lexical nonmanuals is the alignment between the articulating hand and unilateral nonmanuals (cf. Pendzich 2012; Pendzich 2013). Signs with a unilateral nonmanual marking show the following phonetic variances: i) articulation on the right or left side in analogy to the articulating hand and ii) bilateral articulation of the nonmanual marking.

An example for a lexical unilateral nonmanual marking on the upper face is the sign WINK. It is articulated with a nonmanual action in the form of the subcomponent eye aperture with the feature wink (AU 46) and a manual secondary movement (thumb and indexfinger change from an opened to a closed handshape, next to the head). I discussed the sign WINK with the participants of Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4). This yields that the sign articulated with a wink on the left side of the face (AU L46) and with the right hand seems to be not completely well-formed (see Section 4.4.2.3). Furthermore, this finding is confirmed by the statistical results of the judgment task in Study I. The sign WINK was shown in the stimulus with AU L46 whereas the sign is manually articulated with the right hand. The statistical analyses of all single stimulus signs (see Section 4.4.1.2) yield that the sign WINK, which is the only stimulus sign without lateral alignment between the nonmanual marking and the articulating hand, is the worst judged sign (within the NMF condition) in the questionnaire and the interview. In addition, it is crucial to consider the spontaneous articulations by signers. At this, two clear tendencies can be observed: i) lateral alignment between the hand and the face half and ii) use of a bilateral wink (see Figure 4.17 in Section 4.4.2.3). Regarding the sign WINK, it has to be noted that, in general, some people have articulatory difficulties in the articulation of a unilateral wink.

Whereas the sign WINK is an example for a unilateral or bilateral nonmanual marking on the upper face, the sign SUPER is an example for the lower face (see Figure 4.18 in Section 4.4.2.3; see also Pendzich 2012, 88, 97). The unilateral or bilateral action is performed with the sub-components air action, mouth aperture, and chin action. Another example is the sign ALWAYS which is articulated, regarding the lower face, with the same AUs as the sign SUPER (AU 17+25+33; see Figure 4.19 in Section 4.4.2.3). A further example is the sign EFFORT which shows a phonetic variance between a unilateral mouth pattern in alignment with the signing hand and a bilateral mouth pattern as well (see Figure 7.19; cf. Pendzich 2012, 86). As Figure 7.19 illustrates the same signer may vary between unilateral and bilateral nonmanual articulations of signs (cf. Pendzich 2012, 86).

Fig. 7.19: The sign EFFORT with phonetic variance (unilateral or bilateral) in the lexical facial expression (data elicitation Pendzich 2012)

An example for the component tongue action is the sign RECENTLY. It may either be articulated with a centered tongue show (AU C19) or with a unilateral tongue show (AU U19) in alignment with the signing hand (see Figure 7.4 in Section 7.2.2.1).

With respect to unilateral head/torso actions, the sign SLEEP is an example. It is performed with a head tilt to the side of the articulating hand (AU 55 or AU 56). However, it has to be emphasized that the phenomenon of the alignment between unilateral nonmanuals and the articulating hand has to be treated differently for head/torso actions than for facial actions. The following three characteristics of unilateral head/torso actions have to be noted: i) Whereas it is possible to articulate exactly the same action with one face half or both face halves, it is articulatorily not possible to perform a unilateral head/torso action in exactly the same form bilaterally. ii) As the sign SLEEP exemplifies, for certain lexical head/torso actions it is hardly possible to perform them in the opposite direction to the articulating hand without creating a totally different non-sign. For the sign SLEEP, this would mean that the hand articulates a movement to the head while the head tilt is made away from the hand. iii) Head/torso actions are often lexically specified for an action to the opposite direction of the signing hand. One example is the sign IGNORE. As shown in Figure 7.20, the right hand articulates a movement to the right side whereas the head/torso performs an action to the left side.

Fig. 7.20: The sign IGNORE with a head/torso action to the opposite direction of the articulating hand and a bilateral facial action in the lower face (left) vs. a unilateral facial action on the lower face (right)

Furthermore, the sign IGNORE is an interesting example because it directly illustrates the difference between head/torso actions and facial actions with respect to the phenomenon of lateral alignment between nonmanual and manual articulators. Whereas the head/torso action is performed to the left side, the air action is bilaterally, and the tongue action is articulated either bilaterally or unilaterally to the right side in accordance with the right hand.

Moreover, my data elicitations reveal that signers automatically adapt lexical nonmanuals with respect to the lateral alignment when signing with the non-dominant hand instead of the dominant hand.

Two clear properties can be observed for unilateral lexical nonmanuals: on the one hand, an alignment between the articulating hand and the articulating side of the face, and, on the other hand, a bilateral articulation of facial expressions instead of a unilateral articulation. With regard to unilateral articulations on the upper and/or lower face, signs are well-formed when showing a lateral alignment between nonmanual and manual articulators; whereas, signs appear not to be completely well-formed when performed without this lateral alignment, such articulations are, nevertheless, better than articulations with lacking lexical nonmanual markings. This gradation in the well-formedness is depicted in Figure 7.21.

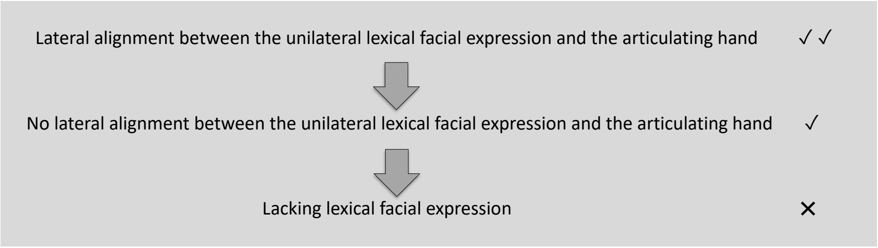

Fig. 7.21: Gradation in the well-formedness of signs with lexical unilateral facial actions

The fact that unilateral facial actions depend on the side of the articulating hand leads to the finding that not only the term *dominant hand* but also the term *dominant face half* or even the wider term *dominant half of the upper body* seems to be useful in order to describe the nature of sign languages.

7.3 Semantic categorization

For the semantic categorization of lexical nonmanuals, I propose the following five categories: i) *lexical nonmanual imitation of action* (e.g. WINK), ii) *lexical nonmanual highlighting of a characteristic aspect of the sign meaning* (e.g. THIN/SLIM), iii) *lexicalized affective nonmanuals* (e.g. SOUR), iv) *lexicalized gestural nonmanuals* (e.g. NOT-YET), and v) *lexical non-iconic nonmanuals* (e.g. OWN; see Figure 7.22).[15] These different categories refer to the source of the nonmanuals but not to language processing. For the categories i)-iii), the strategy "body as subject" (cf. Meir et al. 2007) is essential: "The signer's body is not merely a formal location for the articulation of signs, but may, in principle, be associated with a particular meaning or a particular function" (Meir et al. 2007, 542f.). Moreover, the analysis of signs and words with respect to arbitrariness and iconicity shows that the boundary between both is more blurred in sign languages than in spoken languages. Sign languages show "a continuum from highly iconic to completely arbitrary" (Schermer 2016, 175). The major part of lexical nonmanuals turns out to be iconic in various forms and degrees. In contrast to the diverse possibilities to linguistically utilise iconicity in sign languages, spoken languages show a lim-

15 In Pendzich 2012; 2013; 2014, I propose this categorization but only with respect to lexical facial expressions and based on four categories. My further analyses revealed that this categorization can be used for lexical head/torso actions as well and that it is useful to add the category *lexicalized gestural nonmanuals* (see also Pendzich 2016b).

ited oral-auditory iconicity (see also Section 7.1). All signs within the categories i)-iii) imply iconic potential. Within the category *lexicalized gestural nonmanuals*, some nonmanuals are iconically motivated. Even though lexical nonmanuals often reveal an iconic relation to the meaning of the respective sign, they exhibit clear formational patterns (see Section 7.2) and are articulatorily systematically connected with the manual structure of the corresponding signs. The latter property differentiates them from pure gestures.

Fig. 7.22: Examples for the semantic categorization of lexical nonmanuals: WINK (top: left), THIN/SLIM, SOUR, NOT-YET, and OWN (bottom: right)

As Leuninger et al. (2005, 341f.) mention lexical facial expressions are ordinarily congruent with the lexical meaning of the respective sign. This observation can be expanded with respect to lexical head/torso actions. Nonmanuals which are lexical do not contradict the meaning of the sign. Besides congruent nonmanuals, occurrences of nonmanuals which are conflicting with the lexical meaning of the sign can be observed in signing. However, these markings are not lexical, but used for the expression of irony. Ironical facial expressions communicate the epistemic attitude of the signer. For example, with an ironic facial expression the doubt that a person is really happy may be expressed. It is possible to use the sign HAPPY and simultaneously contradict the lexical meaning of the sign by means of an incongruent facial expression which is no lexical part of the sign (cf. Leuninger et al. 2005, 342; Happ & Vorköper 2006, 240; Pendzich 2012, 44). Furthermore, the expression of irony is possible by means of an omission of lexical nonmanuals without adding an incongruent nonmanual marking. In the interviews of Study I: *Lexical Judgment and the Meaning of Signs*, three participants explained that the sign SUPER can be used ironically without nonmanual marking (see Section 4.4.2.4).

7.3.1 Lexical nonmanual imitation of action

The category *lexical nonmanual imitation of action* includes all lexical nonmanual markings in which one or more nonmanual articulators are used to directly copy an action which is produced with the same body part(s) in reality. Hence, the nonmanual articulator(s) used in certain signs represent themselves. This can be described as body part iconicity. Vogt-Svendsen (1983, 90) observes the phenomenon of nonmanual imitation with respect to mouth patterns in NSL: "[T]here are [...] some signs where the mouth simply functions as an instrument to imitate specific actions, such as eating or drinking".[16] However, it has to be accentuated that such nonmanual imitations are not spontaneously created, but lexically specified and follow phonological regularities. For instance, the DGS sign BITE-OFF is lexically specified for a mouth aperture which changes once from opened to closed (see Figure 7.13 in Section 7.2.3.2).[17] This aperture change has to be articulated in analogy to the handshape change from an opened hand to a closed hand. It is, for example, not adequate to combine the non-reduplicated handshape change with a reduplicated mouth pattern as this would not coincide with the lexicalized form of the sign. If the sign is reduplicated due to aspectual markings, the reduplication concerns both the manual and nonmanual parts of the sign.

The DGS sign PIPE already mentioned in Section 7.2.3.2 (see Figure 7.12) is a further example for a lexical imitation of an action by means of a facial expression on the lower face. The reduplicated nonmanual action with the features blow (AU U33), chin raiser (AU 17), and lip presser (AU 24) directly imitates the inhaling and blowing out of the smoke of the pipe. An example for lexical imitating head

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16 Similarly, Becker (2016, 212) notes that the mouth pattern within the DGS sign BITE-OFF mimics the act of biting.

17 Liddell (1980, 16f.) discusses the sign BITE for ASL.

actions is the sign SLEEP where the lateral head tilt (AU 55 or AU 56) against the dominant hand imitates the typical horizontal sleeping position on the side. The sign LAZE is an example for lexical imitation of action with the nonmanual component torso action and the sub-components tongue action and mouth aperture. The sign is nonmanually articulated with a tongue show and a backward lean of the torso (AU 19+25+26+108). In the interviews with deaf signers as part of Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4), it has been explained that the nonmanuals within LAZE are based on the image how laze looks. Likewise, for the sign WINK, which includes a lexical nonmanual marking on the upper face in the form of a wink (AU 46), it has been mentioned that the articulation of a wink is needed because it copies the reality. During the discussion of the sign WINK, it has been stated that the signing without the lexical facial expression is typical of hearing people who start to learn sign language. Deaf people do not use the sign without the nonmanual marking, but hearing people would use it like this.

With respect to the category *lexical nonmanual imitation of action*, it has to be noted that Woll (2001; 2009; 2014) uses a similar category which she names *enaction*. Woll (2009, 210) describes that "the action performed by the mouth represents that action directly (e. g. in CHEW, the mouth performs a 'chewing' action, while the sign is articulated on the hands)" (see also Woll 2014, 4).[18] However, in contrast to my approach, Woll (2001; 2009; 2014) does not analyze these nonmanuals as lexical markings.[19] Furthermore, Crasborn et al. (2008) use the category *enacting mouth gestures (mouth 4 mouth)* for the analysis of mouth patterns in BSL, NGT, and SSL. But, the following two properties of their category differentiate it from my approach: "[i]ndependent meaning", "[n]ot lexically associated" (Crasborn et al. 2008, 50). The nonmanuals which I capture under the nonmanual imitation category reveal an iconic form-meaning relation but do not convey independent meaning. They are clearly lexically associated. Moreover, whereas the enaction category by Woll (2001; 2009; 2014) and Crasborn et al. (2008) refers to mouth patterns only, I relate nonmanual imitations to head/torso actions and upper face actions as well.

Further examples for this category are the signs FALL-ASLEEP, KISS, and SPIT (see Figure 7.23).

18 Further examples from BSL given by Woll (2001, 90) are "puffing air in BALLOON, biting action in APPLE".

19 Whereas in Woll (2014) these mouth patterns are listed under adverbials, in Woll (2009, 210) and Woll (2001, 88, 90) enaction is listed besides mouthings and adverbials.

Fig. 7.23: The signs FALL-ASLEEP (left), KISS (in the middle), and SPIT (right) as examples for the category lexical nonmanual imitation of action

7.3.2 Lexical nonmanual highlighting of a characteristic aspect of the sign meaning

Lexical nonmanuals within this category establish an iconic form-meaning relation by depicting a specific aspect of the meaning of the sign. Whereas in the previous category nonmanual articulators always stand for themselves, in this category nonmanual articulators either stand for themselves but in a more metaphorical sense or do not stand for themselves.

One example is the sign THIN/SLIM which is articulated with the features lip pucker (AU 18), check suck (AU 35), and jaw drop (AU 26; see the left picture in Figure 7.24[20]; cf. Pendzich 2012, 112). By means of the lexical facial expression on the lower face the sign THIN/SLIM highlights a characteristic aspect of the property slim, namely that slim people have typically a narrow face.

An important role within this category of lexical nonmanuals plays body leans. With respect to ASL, Wilbur & Patschke (1998, 282) state that lexical forward body leans and backward body leans "reinforce the semantics of verbs conveying the notion of 'involvement/non-involvement'". The direction of such leans (forward or backward) is determined in line with the semantics of the lexical sign (cf. Wilbur & Patschke 1998, 282). Furthermore, such "leans participate in a positive/negative semantic contrast within the structure of the lexicon" (Wilbur & Patschke 1998, 283). Similarly, van der Kooij et al. (2006) give examples for signs with lexical backward or forward leans in NGT in which the semantics of

20 The sign THIN/SLIM is given as an example for lexical facial expressions by Happ & Vorköper (2006, 241) and Herrmann (2013, 40) as well.

involvement/non-involvement or, in a wider perspective, inclusion/exclusion of the signs determine the form of the leans. Likewise, Happ & Vorköper (2006, 242f.) describe the marking of inclusion and exclusion which especially occurs in the system of personal pronouns in DGS. A further example from DGS is the sign REJECT (two handed, movement with the flat hand on the non-dominant hand) which is signed with a backward torso lean or an analogical head action. This sign fits to the observation by Wilbur & Patschke (1998), Happ & Vorköper (2006), and van der Kooij et al. (2006) and highlights one characteristic aspect of the sign meaning, namely the non-involvement or exclusion.

Another example is the sign DIZZINESS (see the right picture in Figure 7.24) which is produced with a slight back and forth head shake (AU 84) in combination with the circular movement of the dominant hand. This nonmanual marking highlights the feeling that the head is spinning which is typical within a fit of dizziness.[21]

Fig. 7.24: The signs THIN/SLIM (left) and DIZZINESS (right) as examples for the category lexical nonmanual highlighting of a characteristic aspect of the sign meaning (left picture: data elicitation Pendzich (2012))

7.3.3 Lexicalized affective nonmanuals

A further modality-specific pattern of lexicalization concerns lexical nonmanuals within signs for affective concepts. Some of such signs are produced with specific

21 Whether the small eye aperture and the lowered eye brows in the right picture in Figure 7.24 are lexical markings of the sign DIZZINESS needs to be studied further. In the Internet dictionary *Spread the Sign* and the *Kestner dictionary* (Kestner, Karin and Tiemo Hollmann. 2009-2010. *Das große Wörterbuch der Deutschen Gebärdensprache*. Verlag Kestner) the sign is performed with the head movement as well but not with the same facial expression.

facial expressions, head actions, and/or torso actions. To this group belong, on the one hand, signs for emotional states (e. g. SAD) and, on the other hand, signs for physical conditions (e. g. TIRED) or reactions to an external trigger (e. g. SOUR). Similarly, Pfau & Quer (2010, 383) pay attention to this type of nonmanuals:

> In DGS and Sign Language of the Netherlands (NGT) (and probably most other sign languages), adjectival signs like HAPPY, ANGRY and SURPRISED are usually accompanied by an expression that reflects the respective emotional state. Besides emotions, sensations can also motivate the presence of a particular facial expression. This holds, for instance, for the NGT sign SOUR in which the facial expression is related to the sensation of sour taste (imagine yourself biting a lemon).

For BSL, Sutton-Spence & Woll (1999, 90) state that emotional facial expressions "must accompany the relevant sign for an emotion, e. g. sad for SAD, angry for ANGRY, surprised for SURPRISED".

The category *lexicalized affective nonmanuals* is related to the phenomenon which Ekman (2004, 47) calls *referential expression* and defines as "a facial movement that refers to an emotion that is not felt by the person showing it". Furthermore, Ekman (2004, 47) explains that "[t]ypically the referential expression is either much briefer or much longer than the actual emotional expression, and it involves only one set of facial movements, not the complete array of facial movements associated with an emotional expression". Whereas Ekman (2004) describes this phenomenon as an optional means of expression by hearing people, it is very interesting that such referential expressions have become lexical parts of certain signs in sign languages.

An example for lexicalized affective nonmanuals on the lower face is the DGS sign HAPPY (two handed, movement of the thumbs from contact to separation in the neutral signing space) which is lexically specified for a lip corner puller (AU 12; see also Hohenberger 2008, 271). An example for the upper face is the sign TIRED which may be articulated with slightly open eyes or closed eyes (see Figure 7.5 in Section 7.2.2.1). The sign SOUR (bent straddled flat hand, movement in front of the lower face) is nonmanually articulated with the sub-component eye brow action, the sub-component eye aperture with the features AU 6, 7, 43, the sub-component lip and corner of the mouth action with the feature AU 20, and the component head action with the feature AU 58 (see Figure 7.25; see also Pendzich 2012, 99).

Fig. 7.25: The sign SOUR as an example for the category lexicalized affective nonmanuals (data elicitation Pendzich 2012)

With respect to the semantic category *lexicalized affective n onmanuals*, some notes regarding the spreading behavior of nonmanual markings and the interaction with other nonmanuals are important.[22] In certain contexts, a lexicalized affective nonmanual marking may spread onto other signs due to a paralinguistic use of the same nonmanuals or due to action role shift (for further information on action role shift, see Section 2.2.1). Such a spreading of lexical nonmanuals can be defined as an overlap or blending of lexical and paralinguistic nonmanuals (cf. Pendzich 2012, 111). For instance, when a signer utters the sentence in (9), it could well be that the signer does not only use nonmanuals which are related to the emotional state sad during the articulation of the sign SAD.[23] In addition to the lexical nonmanual marking of the sign SAD, the signer may use emphatic non-

22 In future studies, it has to be investigated in detail whether lexical nonmanuals within the different semantic categories show a spreading behavior, and, if so, which underlying conditions can be found. Concerning this matter, Sandler (1989) mentions two interesting properties of lexical nonmanuals. On the one hand, she points to the behavior of lexical nonmanuals in compounds: "In the compounds I examined, there was also some evidence of NMS spread. Facial expressions associated with one member of the compound in citation form characterized both members in the compound form" (Sandler 1989, 199). On the other hand, Sandler (1989, 200) refers to the interaction between different sorts of nonmanuals: "Recalling the relative clause marking, for example, it is conceivable that a lexically marked NMS can occur in the same environment, simultaneously, with a phrasal NMS. This suggests that the scope of NMS and the interaction of different types of NMS vary in ways that have yet to be fully described. Precise formal characterization of this domain awaits future research".

23 The DGS sign SAD is a typical example for lexical nonmanuals which is often mentioned in the literature, see Keller & Leuninger 2004, 299; Happ 2005, 22; Leuninger 2005, 165; Leuninger et al. 2005, 341; Happ & Vorköper 2006, 240; Herrmann 2013, 40; Becker 2016, 212.

manuals. I discussed this issue with one of my deaf informants. This reveals that the use of the sign SAD without emphatic spreading of the lexical nonmanuals is typical in objective contexts. In personal contexts, spreading may occur. The upper pictures in Figure 7.26 show the sentence in (9) without emphatic involvement. The lower pictures represent the sentence with an interaction between an emphatic use of nonmanuals and a lexical use of nonmanuals.

(9) LITTLE GIRL IX_3 SAD BECAUSE IX_3 $POSS_3$ CUDDLY-TOY LOSE [DGS]
'The little girl is sad because she lost her cuddly toy.'

Fig. 7.26: Declarative sentence 'The little girl is sad because she lost her cuddly toy.' in DGS without emphatic nonmanuals (at the top), with emphatic nonmanuals (at the bottom)

When closely analyzing these sentences, it becomes apparent that the signer uses an inner brow raise (AU 1) in both sentences from the beginning of the utterance. One important difference between both elicited sentences is that, in the first sentence (at the top in Figure 7.26, see also Figure 7.27), the signer articulates a brow lowerer (AU 4) not until the onset of the sign SAD and in clear alignment with this sign. With the end of the sign SAD the articulation of the AU 4 stops. In addition, during the sign SAD a head down action is used (AU 54). In contrast, from the beginning of the second sentence (at the bottom in Figure 7.26), the signer produces an inner brow raise (AU 1) combined with a brow lowerer (AU 4) which does not end after the sign SAD. However, it can be observed that the intensity of AU 4 increases with the onset of the sign SAD.

Fig. 7.27: Lexical nonmanuals within the sign SAD

This example illustrates that it is of utmost importance to be aware of the complex interplay between lexicalized affective nonmanuals, emphatic nonmanuals, and nonmanuals as part of action role shift. In line with my argumentation for the spreading of lexical nonmanuals, Sutton-Spence & Woll (1999, 90) explain that lexical emotional facial expressions can be layered on further signs in BSL.

Especially regarding the category *lexicalized affective nonmanuals*, a comparison with hearing speakers is interesting in order to gain further insights into the interface between lexical nonmanuals and gestural and emphatic uses of nonmanuals. At this, the question is whether also hearing speakers use similar nonmanuals as signers when articulating words such as *sad*.

7.3.4 Lexicalized gestural nonmanuals

The category *lexicalized gestural nonmanuals* especially clearly illustrates the fluent boundary between gesture and sign in the visual modality. It underlines that signers systematically integrate nonmanual gestures into their language system (see Wilcox 2004 and Pfau & Steinbach 2006a for further information on the incorporation of gestures into sign languages). In this group fall all signs with a lexical nonmanual marking that has a counterpart in a nonmanual gesture.

The results of Study III: *Meaning Attribution to Isolated Facial Expressions* (see Chapter 6) clearly point out some of these signs. One example is the sign BE-QUIET which is articulated with a lip funneler and a blow (AU 22+25+33A). This facial gesture in combination with a manual gesture in the form of a movement with the index finger in front of the lips, which is also used by hearing people, has become a lexical sign in DGS. The sign ANNOY (two handed, straddled index finger and middle finger, movement in the neutral signing space) is articulated with slightly open eyes, a nose wrinkle, and a tongue show (AU 6+7+9+C19+25+26+43). It can be assumed that the lexicalized tongue show originates from the gesture *sticking-out-the-tongue*. The sign KISS illustrates that some signs may fit in two semantic categories. I already mentioned this sign as an example for the category *lexical nonmanual imitation of action* (see Section 7.3.1). However, as a lip pucker (AU 18) is also often used gesturally, the sign KISS belongs to both categories (see Figure 7.23). With respect to head actions, the sign YES (closed hand with stretched thumb and pinkie, movement in the neutral signing space) is an example. The gesture head nod up and down (AU 85) has become a lexical part of the sign YES.

7.3.5 Lexical non-iconic nonmanuals

Lexical nonmanuals which show no obvious iconic relation to the meaning of the sign belong to the category *lexical non-iconic nonmanuals*. Coerts (1992, 35) notes the occurrence of signs "with non-iconic or non-transparent nonmanual components" in NGT. For mouth patterns with this property, Crasborn et al. (2008) use the term *semantically empty*. Likewise, the mouth patterns which Woll (2001; 2009; 2014; Woll & Sieratzki 1998) considers under the term *echo phonology* are also "not in itself iconic" (Woll 2009, 210f.). I use the term *non-iconic* instead of *arbitrary*, as the latter term might be too strong with respect to lexical nonmanuals. As Ebbinghaus & Heßmann (2001, 147) illustrate, different signs with the same mouth pattern can be associated with certain semantic classes. They mention that signs with the mouth pattern "MG[ph] (i.e. the sudden release of a bilabial closure)" could be attributed to various semantic categories such as, for instance, "something is got rid of" or "something collides with something". Ebbinghaus & Heßmann (2001, 149) conclude that mouth patterns in DGS are not arbitrary (see also Ebbinghaus & Heßmann 1995, 52). Likewise, Elliott & Jacobs (2013, 2) mention that they "do not have data on facial expressions used either by hearing or deaf people that are completely arbitrarily related to their meaning".

The property non-iconic should not be treated as an absolute criterion. Initially iconically motivated nonmanuals may lose their pictorial nature over time so that their iconicity is not transparent any more for language users. Iconic nonmanuals may change into rather non-iconic nonmanuals. Channon & van der Hulst (2011, 2) state that "[a]lmost all signs originate from an iconic gesture, but over time, phonetic and phonological changes make its iconic basis no longer recognizable".

Study III: *Meaning Attribution to Isolated Facial Expressions* (see Chapter 6) has shown that isolated from the language context most facial markers do not have just one exact meaning. In addition to this study, it would be revealing to carry out a study regarding iconicity of lexical nonmanuals. Signs with lexical nonmanuals could be presented to deaf signers and their task would be to explain whether a lexical nonmanual marking reveals a pictorial relation to the meaning of the respective sign for them. So far, what seems to be important with respect to iconicity is a differentiation between lower face actions, upper face actions, head actions, and torso actions. Most lexical non-iconic nonmanuals seem to be performed with the lower face. This seems to be related to the articulatory fact that the upper face, head, and torso cannot express as many different forms as the lower face.

Steinbach (2007, 149) notes that some signs include an unsystematic, idiosyncratic mouth pattern. He gives two examples from DGS: the sign DO-NOT-WANT and the sign OWN (see also Hohenberger & Happ 2001; Keller 2001; Happ & Vorköper 2006; Hohenberger2008; Konrad 2011). The sign DO-NOT-WANT is articulated with a *laf*-mouth pattern. This implies the voiceless or quiet articulation of the three phonemes (see Figure 7.28). As these three phonemes do not refer to a spoken word, their visual articulation has to be treated as a non-iconic mouth pattern and not as a mouthing.

Fig. 7.28: Lexical non-iconic nonmanual marking within the sign DO-NOT-WANT

The sign OWN (straddled flat hand, secondary movement in the form of finger wiggling in the neutral signing space) is specified for the nonmanual sub-components mouth aperture with the feature AU 25, the sub-component lip and corner of the mouth action with the feature AU 22, and the sub-component air action with the feature AU 33A. This nonmanual marking is not pictorial in itself and, therefore, is considered as non-iconic (see Figure 7.11 in Section 7.2.3). A further example with the same nonmanual marking is the sign LIFE-PARTNER (see Figure 7.29). In this case, possibly the lexical mouth pattern developed from a mouthing referring to the German word *Schatz* ('treasure'). The articulation of the initial phoneme of this German word visually results in the mouth pattern used within the sign LIFE-PARTNER.

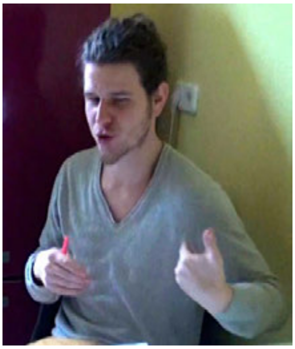


Fig. 7.29: Lexical non-iconic nonmanual marking within the sign LIFE-PARTNER

Another sign with lexical nonmanuals on the lower face is the sign ONCE-UPON-A-TIME (see also Hohenberger 2008, 272). The lexical nonmanual marking in the form of an upper lip raiser (AU 10), parted lips (AU 25), and a blow (AU 33A) which accompanies the manual sign (two handed, straddled flat hand with finger contact of the thumb and index finger, movement in the neutral signing space) is non-iconic. The sign RECENTLY is an example for a non-iconic tongue show (AU 19; see Figure 7.4 in Section 7.2.2.1). The tongue show can be performed either laterally to the right or left (AU R19 or AU L19) or centrally (AU C19).[24]

7.4 Further characteristics

In the following, three further topics which are relevant to capture the nature of lexical nonmanuals are discussed. Like spoken languages sign languages are subject to diachronic change. It is interesting to consider this with respect to lexical nonmanuals (see Section 7.4.1). Moreover, when focusing on mouthings and lexical nonmanuals, an interesting picture of interaction arises (see Section 7.4.2). In order to define the linguistic status of lexical nonmanuals, two further properties of lexical nonmanuals are particularly crucial: i) distinctive function and ii) semantic accentuation (see Section 7.4.3).

24 It is interesting that a tongue show is a nonmanual feature of the sign JUST-NOW in NSL as well (cf. Vogt-Svendsen 1983, 93).

7.4.1 Diachronic change

The analysis of diachronic processes in sign languages is made difficult by the fact that historical stages of these languages are rarely documented. On the one hand, this is due to the late begin of research on sign languages. On the other hand, the documentation of sign languages depends on technical achievements as these languages can be best captured with video recording. Another method which can be used in order to gain insights into diachronic change is the comparison of the signing by older and younger people.

So far, diachronic aspects of lexical nonmanuals have rarely been addressed. With respect to mouth patterns, Woll (2009, 221) emphasizes that "[f]urther research is needed to explore […] whether echo phonology is subject to change (for example, added or transformed in a process of sign conventionalization)" (see also Woll 2014, 8; for further information on echo phonology, see Section 7.2.3). Jantunen (2006, 341) predicts for FinSL that "nonmanual movements will tend to be dropped (because of their infrequency)". In contrast to the hypothesis by Jantunen (2006), my investigation reveals that lexical nonmanuals seem to be more essential for younger signers than for older signers. My approaches on age group differences are the first empirical investigation of diachronic change of lexical nonmanuals in DGS.

Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4) uncovers a statistically significant difference between older signers (mean age: 54.4) and younger signers (mean age: 23.9) with respect to their ratings of signs with lexical nonmanuals which were presented in a manipulated version without these nonmanual markings (see Section 4.4.1.3). These manipulated stimuli were rated 34% (in the questionnaire) or 26% (in the interview) worse by the group of younger signers compared to the group of older signers. This finding is significant at all usual levels and indicates that lexical nonmanuals are more important for younger signers. Nevertheless, the results reveal that lexical markings are also essential for older signers. On average, they rated the signs with the lexical nonmanual markings with 5.69 in the questionnaire and 5.75 in the interview. In contrast, the manipulated signs without the lexical nonmanual markings were rated on average with 5.15 in the questionnaire and 2.99 in the interview.

The assumption of diachronic change regarding lexical nonmanuals is also supported by Study II: *Lexical Decision with Reaction Times* (see Chapter 5). The analysis reveals a statistically significant difference between the reaction times for nonmanual manipulated signs by older signers (mean age: 52.8) and younger signers (mean age: 23.9; see Section 5.4.1.4). The average reaction times for the nonmanual manipulated signs are 789ms for the younger signers and 937ms for the older signers. In comparison to the reaction times for the non-manipulated signs, the nonmanual manipulation shows an effect of +89ms (13%, $p = 0.01$) for the younger signers and +85ms (10%, $p = 0.08$) for the older signers.

In addition to these results, a follow-up discussion with one of my deaf informants exposed interesting aspects regarding diachronic change of lexical nonmanuals (see Section 4.5). My informant described that lexical facial expressions are performed by older generations as well, but the articulation was very reduced in the past. Nowadays, facial expressions are articulated stronger. The reduced use of facial expressions by older signers seems to be due to the education system and an adaption to hearing people. Particularly in upscale contexts (e. g. a political speech), certain lexical facial expressions are not articulated. One example is the use of the sign DISGUST, which clearly has lexical nonmanuals classified as inherent parts of the sign (see Figure 4.23 in Section 4.5). In upscale contexts, especially by older signers, this sign would not be performed with a strong tongue show (AU 19). This seems to derive from the circumstance that not the signing with the hands but the use of certain facial expressions, regrettably, tends to be perceived negatively by many hearing people. In this context, it is appropriate to refer to the existence of *display rules*. This term is used by Ekman (1979, 179f.) in order to refer to social norms regarding the expression of emotions (see also Ekman 2004, 45). This restrictive phenomenon can be transferred to the use of linguistic nonmanuals by signers. In certain contexts, display rules seem to play a role. Moreover, my deaf informant described that younger signers are often more self-confident and articulate much more facial expressions. Differences of style among signers clearly exist, but lexical facial expressions are articulated.

7.4.2 The interaction of lexical nonmanuals and mouthings

The interaction between lexical nonmanuals and mouthings is particularly relevant with respect to lexical mouth patterns as both types of mouth actions are produced with the same muscles. Regarding facial expressions on the upper face and head/torso actions, the use of a mouthing implies no articulatory constraints. Especially for mouthings and mouth patterns, the following types of interaction are crucial: i) *displacement*, ii) *merging*, and iii) *mimic articulation of mouthing*.[25]

The occurrence of a mouthing can lead to i) *displacement* of a lexical facial expression on the lower face. For example, the sign DISAPPEAR which has a mouth pattern in the form of chin raiser, parted lips, and blow (AU 17+25+33A) may be articulated with a mouthing. Regarding such a replacing of a mouth pattern by a

25 Parts of this section are based on Pendzich 2012 and have already been published in Pendzich 2014.

mouthing, Vogt-Svendsen (2001, 25) mentions the following observation for NSL: "It seems that if a mouthing does not differ radically in form from the mouth gesture, the mouthing may replace that mouth gesture." As the sign DISAPPEAR illustrates, this is no necessary condition for displacement in DGS. The mouth pattern shows no clear similarity to the German word *verschwunden* ('disappear'). Another interesting example for displacement is the sign ARROGANT. In the *mouthing classification task* (see Section 4.4.4) as part of Study I: *Lexical Judgment and the Meaning of Signs*, the participants' estimations regarding the sign ARROGANT vary between no use of a mouthing and variability between the use of a mouthing and a mouth pattern. One participant explained that the sign with the facial expression is used rather as a swearword. If the sign ARROGANT is not used as a swearword, it is better articulated with the mouthing. In the interviews as part of Study I (see Chapter 4), one participant mentioned that the sign ARROGANT may be performed with a mouthing instead of the facial expression, but the head up action must occur (see Figure 4.20 in Section 4.4.2.4). Hence, the use of a mouthing may either lead to a complete displacement of a lexical nonmanual marking or only to a partial displacement. This depends on the components of the respective lexical nonmanual marking. It supports my approach to capture lexical nonmanuals in different individual components instead of assuming one component for lexical nonmanuals.[26] Moreover, the sign ARROGANT, as the sign DISAPPEAR as well, underpins that an articulatory similarity between a mouth pattern and a mouthing is no crucial condition for a displacement in DGS. Interestingly, certain signs appear to be very resistant against a displacement by a mouthing. The *mouthing classification task* (see Section 4.4.4) reveals a strong resistance against a mouthing for the sign FAVORITE. 16 participants stated that a mouthing is never used with this sign and only one participant assumed a variability in the form that the mouthing is sometimes used and sometimes not.

Regarding *displacement*, I made an additional interesting observation which has to be investigated further in future studies. It seems to be the case that signs which are articulated with a movement of the hand(s) near the mouth and which have a lexical facial expression on the lower face are more resistant against the displacement by a mouthing than signs with another place of articulation. DGS comprises two signs for the meaning *without*, which are illustrated in Figure 7.30. Whereas the sign WITHOUT1 with a hand movement near the mouth is articulated with a mouth pattern in the form of lip pucker (AU 18), lips part (AU 25), and blow

26 For *displacement*, it has to be further empirically investigated whether the nonmanual components facial expression in the upper face, head action, and torso action are affected by the use of mouthing.

(AU 33A), the sign WITHOUT2 with a hand movement in the neutral signing space is articulated with a mouthing. The *mouthing classification task* (see Section 4.4.4) reveals that the sign WITHOUT1 shows a strong tendency for a disuse of mouthing (the sign WITHOUT2 was no stimulus of the study).

Fig. 7.30: Two different signs for the meaning *without*: WITHOUT1 (left) and WITHOUT2 (right)

Another example which complies with my resistance hypothesis is the sign FAVORITE which has a lip pucker (AU 18) as a lexical part. For this sign, as mentioned above, the *mouthing classification task* reveals a strong resistance against a mouthing.

Another phenomenon of the interaction between mouthings and mouth patterns is ii) *merging* of both types of mouth actions. For instance, it is possible to combine the lexical lip corner puller (AU 12) within the sign HAPPY with a mouthing. This contrasts with the view of Hohenberger & Happ (2001, 177) who state that "the incompatibility of both functions naturally forces the signer to decide for one or the other function". At this, the question arises how a mouth pattern is exactly defined by Hohenberger & Happ (2001). If, for example, actions with the lip corners are included in this category, it is evident that merging between mouthings and mouth patterns is possible. But, merging has articulatory limitations. For instance, it is barely possible to merge a mouthing with a mouth pattern in the form of a unilateral or bilateral blow with expanded cheeks (AU 33) as in the sign SUPER. In Figure 7.10 in Section 7.2.2.2, the sign SUPER is illustrated in both variants either with the lexical mouth pattern or with a mouthing which replaces the mouth pattern.

Whereas *merging* implies that a lexical mouth pattern and a mouthing are simultaneously combined, type iii) *mimic articulation of mouthing* is a special form to perform mouthings. Mouthings in this category show strong visual similarities to facial expressions. Muscle actions which are part of the word articulation are realized in a marked intensified or modified manner. Such articulations of mouthings can be described as mimic realizations. In some cases, it can be difficult to differentiate between a mouthing and a mouth pattern (cf. Ebbinghaus & Heßmann 1995; Vogt-Svendsen 2001). One example for a mimic articulation of mouthing is the sign FAST. Concerning the lower face, one of my deaf participants (cf. Pendzich 2012) used a centered tongue show (AU C19), which begins simultaneously with the articulation of the phoneme /l/ as part of the German mouthing *schnell* ('fast'). As AU C19 is no lexical part of the sign FAST, this example has not to be treated as a merging but as a mimic articulation of mouthing. The implementation of the category mimic articulation of mouthing is justified by the fact that in other cases mouthings are articulated in neutral form.

With respect to the linguistic status of mouthings, it is crucial that certain mouthings just as lexical nonmanuals are classified as obligatory parts of signs by deaf signers. The results of the *Mouthing classification task* (see Section 4.4.4) show the relevance of mouthings as integral part of certain signs and reveal that signers have clear intuitions concerning the status of mouthings. Signs with a strong tendency towards the use of mouthings are NOT-YET, PROTECTION, SEARCH, and STRESS. Within these signs, the combination of the lexical nonmanual marking and the mouthing is articulatorily possible without constraints. The signs NOT-YET, PROTECTION, and SEARCH are lexically specified for a head/torso action and the sign STRESS is articulated with a lexical facial expression on the upper face. It seems to be appropriate to assign to mouthings which are classified by deaf signers as obligatory the same linguistic status as to lexical nonmanual markings. This approach is further supported by the following aspects: i) The articulation of mouthings often shows articulatory similarities to the articulation of mouth patterns (= mimic articulation of mouthing). ii) Mouthings may diachronically change into mouth patterns (cf. Coerts 1992, 32). iii) It can be observed that mouthings are used without sufficient competence in the respective spoken language. The fact that certain signs may be articulated with mouthings by deaf children before they have acquired the corresponding word of the respective spoken language supports that those mouthings belong to the phonological form of signs (cf. Keller 2001; Rainò 2001; Emmorey 2002, 39f.). Furthermore, the use of mouthings by signers who learn another sign language as foreign language without learning the respective spoken language is crucial (cf. Woll 2009, 209). At least in these cases, mouthings seem to be stored in the mental lexicon as facial expressions.

Although nonmanuals reveal a more complex range of linguistic functions than mouthings, it is important to distinguish between different functions of mouthings as well. It is not possible to adequately capture the phenomenon of mouthings when treating them as a whole without the differentiation between different functions. In the first step, it is crucial to differentiate between the properties i) obligatory and ii) variable. Concerning the attribution of mouthing variability in the *mouthing classification task* (see Section 4.4.4), which means that a mouthing is sometimes articulated and sometimes not, it would be revealing to analyze the reasons for the variability more closely. In some cases, dialectal variation may play a role. Possibly, some signs contain specific conditions for the use of a mouthing. Further crucial factors seem to be language register,[27] communication context, educational background, and the use of mouthings due to the communication with hearing people. As a result of a closer investigation of these different factors, property ii) of mouthings should be further split up into variability due to clear constraints and variability due to optional uses of mouthings.

7.4.3 Distinctive function and semantic accentuation

As mentioned in Section 3.1.2, for the definition of the linguistic status of lexical nonmanuals, it is crucial to analyze whether minimal pairs based on nonmanual differences exist in various sign languages. In order to gain first empirically based insights into this issue for DGS, I carried out a *translation task* (see Section 4.4.3) as part of Study I: *Lexical Judgment and the Meaning of Signs*. Within this translation task participants saw stimulus signs in randomized order in two conditions: each sign with the assumed lexical nonmanual marking and without this nonmanual marking. Their task was to explain the meaning of each sign. This translation task enables to analyze the impact of lexical nonmanuals on the meaning of lexical signs. The results reveal that two central properties of lexical nonmanuals have to be considered: i) distinctive function and ii) semantic accentuation .

The concrete impact of lexical nonmanual markings with respect to the meaning of signs varies for different signs. Firstly, DGS comprises signs for which an omission of the lexical nonmanual marking does not lead to another meaning of the sign. The sign with lacking lexical nonmanuals has the same meaning as the sign with the lexical nonmanual marking. Secondly, for certain signs, the lexical marking has such a strong impact that the sign has no meaning without the lexical nonmanual marking. Thirdly, there are signs which have different meanings based on lexical nonmanuals (partially in combination with mouthings). In these cases, lexical nonmanual markings have a distinctive function. Fourthly, some

27 Likewise, for NGT, Sande & Crasborn 2009 show that the use of mouthings is dependent on registers. They investigate the use of mouthings in a narrative register and an interactive register and reveal that significantly more mouthings are used in the interactive register.

signs are ambiguous without their lexical nonmanual marking and lead signers to activate different meanings. In the following, I consider the two latter types more closely.

7.4.3.1 Distinctive function

As described in Section 4.4.3, when including mouthings as a combinatory factor, there are seven possible types of minimal pairs based on nonmanual markings. Below, I give a brief overview of these types (for more information, see Table 4.13 and the discussion in Section 4.4.3):

i) Sign A with a nonmanual marking and without a mouthing vs. sign B without a nonmanual marking and without a mouthing (the data elicitation revealed no potential sign pair for this type)

ii) Sign A with a nonmanual marking and without a mouthing vs. sign B without a nonmanual marking and with a mouthing (e. g. ALWAYS – LEAD)

iii) Sign A with a nonmanual marking and without a mouthing vs. sign B with another nonmanual marking and without a mouthing (e. g. CONCENTRATE – CONSERVATIVE)

iv) Sign A with a nonmanual marking and without a mouthing vs. sign B with another nonmanual marking and with a mouthing (e. g. ARROGANT – PROUD)

v) Sign A with a nonmanual marking and with a mouthing vs. sign B without a nonmanual marking and without a mouthing (the data elicitation revealed no potential sign pair for this type)

vi) Sign A with a nonmanual marking and with a mouthing vs. sign B without a nonmanual marking and with a mouthing (e. g. SEARCH – ORAL)

vii) Sign A with a nonmanual marking and with a mouthing vs. sign B with another nonmanual marking and with a mouthing (e. g. NOT-YET – OW)

The study reveals no potential minimal pair with respect to lexical nonmanuals in which one sign of the pair has no lexical nonmanual marking and no mouthing (= type i) and v)). However, it may well be that future investigations uncover such pairs in DGS.

Manual minimal pairs are based on a difference in only one of the four manual components: handshape, orientation, movement or place of articulation. Likewise, it has to be investigated whether in minimal pairs which are based on lexical nonmanuals the distinctive function is due to one single nonmanual component or more nonmanual components. This differentiation has to be added to the overview of the seven nonmanual sign pair types given above. As explained in Section 7.2.1, I assume that the nonmanual channel comprises the four components torso action, head action, upper face action, and lower face action. The two components upper face action and lower face action are subdivided into sub-components. Moreover, I assume that nonmanual components and sub-components can be split up into single phonological features in the form of AUs. The sign pair ALWAYS – LEAD is an example for the distinctive function of the component lower face. Whereas in the sign ALWAYS this component is determined for the features AU 17+U25+U33, the same component is specified as neutral within the sign LEAD (AU 0.4) and includes a mouthing.[28] The fact that only one nonmanual component is different between both signs reveals an analogy to the structure of manual minimal pairs in which similarly only one component is different, e. g. the handshape in the sign pair FAMILY – ROOM.

A further example is the sign pair WASTE – EVALUATE (see Figure 7.31). The sign WASTE is determined for the component lower face with AU 19+25+26+33A/33. The same component is neutral within the sign EVALUATE (AU 0.4).

Fig. 7.31: Nonmanual minimal pair WASTE – EVALUATE

As explained in Section 7.2.1, one difference between manual and nonmanual components seems to be that usually all manual components are present within a sign, whereas many signs show no nonmanual marking. But, as the nonmanual components are always physically present within each sign, I assume that they are specified either as neutral or for certain muscle actions. According to this, the only component which can be completely absent within a sign is the manual component movement (apart from transitional movements between signs, which are not phonological).

28 Furthermore, the signs LEAD and TRANSFER form a manual minimal pair. Whereas the sign LEAD is performed with a straight movement the sign TRANSFER is articulated with a curved movement. The components handshape, orientation, and place of articulation are identical.

A further example for a minimal pair based on nonmanuals seem to be the signs SEARCH – ORAL. Whereas the sign SEARCH is specified for the component head action with the features AU 54+84, within the sign ORAL this component is specified as neutral (AU 0.2). An example for the component upper face is the sign pair WINK – FESTIVAL CLIND'OEIL. However, the second sign is a proper name. The first sign is lexically specified for the feature AU 46 and within the latter sign the component upper face is determined as neutral (AU 0.3). A further example for the upper face seems to be the sign pair STRESS – ANNOYED/PEEVE (see also Pendzich 2012, 126). The sign STRESS is specified for the component upper face with the features AU 4+7. The sign ANNOYED/PEEVE appears to be determined for the same component but with the features AU 5+61/62. Besides such examples with a difference in only one nonmanual component, there are signs in which a distinctive function is realized simultaneously by different nonmanual components. An example seems to be the sign pair SHOCK – INFLUENZA. The sign SHOCK includes specifications for the nonmanual components upper face (AU 1+2+5), lower face (AU 25+26), head action (AU 58), and torso action (AU 108). In contrast, the sign INFLUENZA is specified as neutral for all nonmanual components.[29]

Regarding the question whether nonmanual minimal pairs exist, the following reflections are crucial. DGS seems to comprise signs which are differentiated by only one nonmanual component or feature. Such pairs seem to be comparable with manual minimal pairs. The existence of such pairs is essential for the definition of the status of nonmanual components in comparison with manual components. It is, however, important to stress that my results are based on a first empirical step into the analysis of minimal pairs regarding nonmanual markings. More studies on minimal pairs in DGS and other sign languages are required. At this, minimal pairs based on only one nonmanual component, sub-component or feature have to be closely investigated. However, it has to be taken into account that the individual features of the nonmanual components and sub-components are often strongly intertwined with each other. One example is that a tongue show (AU 19) articulatorily requires parted lips (AU 25) and a jaw drop (AU 26) or mouth stretch (AU 27). Furthermore, closer analyses of minimal pairs are also important with respect to the issue of productivity. Crasborn & van der Kooij (2013, 4) mention:

> In none of the signed languages studied so far has evidence been found that non-manual phonetic features are used contrastively throughout the lexicon, but this could in principle be due to the strong focus on ASL and other western sign languages in the literature.

29 For further information on the mentioned possible minimal pairs based on nomanual markings, see Section 4.4.3.

Future studies have to examine the frequency of minimal pairs based on the different manual and nonmanual components and features. While investigating this, it has to be carefully analyzed whether a potential manual minimal pair is specified for a lexical nonmanual marking. One example are the DGS signs MEAN and WINK. When considering the manual components, these signs seem to form a minimal pair based on different locations (articulation in the neutral signing space vs. articulation laterally near the head). But, as within the sign WINK the nonmanual sub-component eye aperture is lexically determined for the feature AU 46, both signs do not form a minimal pair. Thus, some manual minimal pairs drop out when including nonmanuals in the phonological description of signs. Nevertheless, it seems that there remain enough manual minimal pairs in all of the four manual components. The inclusion of nonmanuals does not cancel the previous theory. Four examples of manual minimal pairs composed of signs that are not specified for nonmanuals are BIRD – MEAN (place of articulation), FINISHED – ALREADY (movement), TECHNOLOGY – ELECTRICITY (hand orientation), and FAMILY – ROOM (handshape). The status of the manual components as phonemes does not seem to be affected by the inclusion of nonmanual components, but it could be that the productivity of manual and nonmanual minimal pairs turns out to be more similar than often assumed.

My previous findings are in direct contrast to the assumption by Becker & von Meyenn (2012, 51) who state that no minimal pairs occur in DGS which differ only in nonmanual components. Likewise, Becker (2016, 213) assumes that nonmanual elements do not have a lexically distinctive function in DGS. The findings by Zeshan (2000) for IPSL are similar to my findings for DGS. One example of a nonmanual minimal pair given by Zeshan (2000, 47) is GARAM ('hot') – CUP ('be-silent'). She explains that the first sign includes "a nonmanual configuration with the mouth (and optionally the eyes) wide open". Zeshan (2000, 49) concludes:

> The mouth gesture in GARAM is as important for uniquely identifying the sign as handshape, place of articulation etc., so that a difference in status does not seem justified here. In any case it would be necessary to investigate in more detail a greater number of similar signs in other sign languages with respect to the functioning of such meaning differentiating nonmanual signals.

Also, Vogt-Svendsen (1983, 90f.) found nonmanual minimal pairs which are based on one nonmanual component in NSL:

> A change of the oral component in many of these signs will result in a sign with a different meaning or with no meaning at all. Consequently, the mouth definitely functions as a chereme in much the same way as handshape does. The change from one position of the mouth to another results in a change in meaning even when the manual component remains unchanged.

Vogt-Svendsen (1983) instances the sign pair SOUR (food) – SOUR (person). However, when closely examining the given pictures of these signs, it becomes apparent that the sign SOUR (food) is clearly articulated with muscle contractions on the upper face in addition to the mouth pattern. As this facial expression on the upper face is not mentioned by Vogt-Svendsen (1983), it is not clear whether this marking lexically belongs to the sign as well. If this is the case, the sign pair given by Vogt-Svendsen (1983) would be an example for the other type of sign pairs which I found in my data, namely signs that differ in more than one nonmanual component. This means that different nonmanual components jointly function distinctively. According to the definition of minimal pairs based on spoken languages, such pairs seem to be no minimal pairs. Nevertheless, such pairs should not be neglected. These sign pairs are based on the specificity that sign languages do not have a single channel for the expression of grammatical and lexical information like spoken languages but two completely different channels: the manual channel and the nonmanual channel. Therefore, it seems to be appropriate to extend the definition of minimal pairs in the visual modality. In addition to manual minimal pairs and nonmanual minimal pairs, sign languages seem to have nonmanual channel minimal pairs. The term *nonmanual channel minimal pair* is implemented in order to capture all sign pairs that are manually identical but differ in the nonmanual channel which may include differences in more than one component.

7.4.3.2 Semantic accentuation

Besides the distinctive function of lexical nonmanuals, the *translation task* (see Section 4.4.3) as part of Study I: *Lexical Judgment and the Meaning of Signs* revealed that lexical nonmanuals may accentuate the meaning of signs. This is especially important for manually similar signs. When signers are confronted with isolated and manipulated signs without their lexical nonmanual marking and mouthing, they often activate other signs which are manually different. This illustrates the decisive relevance of lexical nonmanuals. Furthermore, it can be taken as an indicator for a similar phonological status of nonmanual and manual components as both types of components seem to be similarly important for the meaning of signs and lexical activation. It could be opposed that manual markers have a higher productivity than nonmanual markers on the lexical level. But, for instance, regarding handshapes, there are great differences in the productivity as well. Whereas, for example, the flat hand is used in many signs (e. g. FATHER), the handshape in the form of a straddled flat hand with arched middle finger (e. g. INTERNET) occurs less often in DGS signs. Nevertheless, all handshapes have the same phonological status. Similarly, there are differences in the productivity within lexical nonmanuals. For instance, tongue show is very productive.

In many cases, signs with small manual differences are additionally distinguished by lexical nonmanuals. If the lexical nonmanual marking is omitted, this can lead to the activation of the meaning of manually similar signs. In Study I, the participants often described that certain signs with lacking lexical nonmanuals can have various meanings. For example, two participants activated the sign RIGHT instead of the sign REVERE. Nonmanually, these signs differ with respect to the component head action with the feature AU 54 which is a lexical part of the sign REVERE. Concerning the manual components, both signs are determined for the same handshape, movement, and place of articulation. They differ in the hand orientation and the velocity of the movement. As the head down action is an inherent part of the sign REVERE, seeing this sign without this nonmanual marking can lead to the activation of the manually different sign RIGHT which is not lexically specified for AU 54. The signs NOT-YET and FIFTEEN are a further example for the phenomenon of accentuation of different meanings of manually similar signs by lexical nonmanuals. Whereas the sign FIFTEEN has no nonmanual marking, the sign NOT-YET has a lexical head shake (AU 84). Both signs are articulated with the same handshape (= five straddled fingers) and place of articulation (= neutral signing space) but differ in the hand orientation (NOT-YET: palm directed towards the torso vs. FIFTEEN: palm directed towards the floor) and movement (NOT-YET: reduplicated shaking of the wrist vs. FIFTEEN: reduplicated circular movement away from the torso). Another example are the signs LAZE and CALM (see Figure 7.32). In contrast to the sign CALM, the sign LAZE is specified for the nonmanual components lower face action (AU 19+25+26) and torso action (AU 108). Furthermore, both signs differ with respect to the manual movement and hand orientation. The similarity between both signs results from the same handshape and the articulation in the neutral signing space. For the sign LAZE without the lexical nonmanual marking, three participants assigned the meaning *calm*.

Fig. 7.32: The signs LAZE (left) and CALM (right)

The given examples illustrate that lexical nonmanual markings often accentuate differences in the meaning of manually similar signs. This is also relevant in view of the high dialectal variation in DGS. Nonmanual markings lead to a better identification of the respective signs. The *translation task* as part of Study I (see Section 4.4.3) shows that with lacking lexical nonmanuals many signs seem to be ambiguous between different meanings. Similarly, for IPSL, Zeshan (2000) discusses signs under the term *near-minimal pairs* which are manually similar but clearly differ in nonmanual markings. She argues that "the facial expressions are at least as important for identifying the sign than any of the manual components" (Zeshan 2000, 47).

7.5 Nonmanuals in mental lexical entries

Before summarizing the results of my empirical studies with respect to the representation of lexical nonmanuals in mental entries and discussing my proposed model of these mental entries, some brief general information regarding the mental lexicon is required.

The mental lexicon plays a central role in models of speech production and processing. My view is based on the speech production model by Levelt (1989). It has to be noted that psycholinguistic theories have primarily been developed on the basis of spoken languages. However, meanwhile, more and more psycho- and neurolinguistic studies are conducted for sign languages. For instance, the study by Caselli & Cohen-Goldberg (2014, 9) indicates that "the mind stores and accesses words in the same manner, no matter the modality (spoken, print, or signed)". The mental lexicon of every individual is a mentally organized active memory which includes the representation of lexical units and lexical information. The access to this mental lexicon takes place in speech production and speech perception (cf. Meibauer & Rothweiler 1999; Lutzeier 2002; Bußmann 2008). Whereas the exact structure of lexical entries is controversial, there is consensus that the meaning of words, the syntactic category, morphological information, and phonological information is included in such entries (cf. Bußmann 2008). In addition, speakers and signers have knowledge that words or signs with respect to the meaning are adjacent in different ways. Hence, there are meaning related relationships in the mental lexicon such as hypernyms and hyponyms, lexical fields as well as frames and scripts (cf. Dietrich 2007). Considering the model by Levelt (1989) with respect to spoken and sign languages, it can be assumed that the overall design of the language processor is the same for both modalities, but the syntactic, phonological, and morphological representations reveal differences (cf. Hohenberger et al. 2002, 113; for further information on the mental lexicon, see Aitchison 2012).

All of my three empirical studies reveal independent, variously strong evidence for the assumption that lexical nonmanuals are inherent parts of certain lexical signs. The *lexical judgment tasks (questionnaire and interview)* as parts of Study I: *Lexical Judgment and the Meaning of Signs* (see Chapter 4) yield that signers have clear intuitions whether or not nonmanuals belong to certain signs. On a six-point scale, the participants rated signs with nonmanual markings and the same signs in a manipulated version without nonmanual markings accordingly. The overall analysis of the questionnaire data yields that the nonmanual manipulation leads to ratings that are on average 30% worse than the ratings of the same signs with lexical nonmanuals. The difference between both average overall ratings of the two stimulus groups is significant at all usual levels: $p < 0.001$. In the interview, the manipulated signs were rated even 57% worse than the same signs with lexical nonmanuals ($p < 0.001$). The statistical results for the average overall ratings in both lexical judgment tasks clearly reveal the fundamental relevance of specific nonmanuals for lexical entries of certain signs in DGS.

Study II: *Lexical Decision with Reaction Times* (see Chapter 5) is based on the hypothesis that the processing of a sign which includes a lexical nonmanual marking in citation form must be more costly when perceived without this marking. It must lead to an inhibition effect whereby the access to the mental entry of the lexical sign takes more time. Therefore, nonmanual manipulations in terms of an omission of nonmanual markings have to be reflected in a slowing down of reaction times. In accordance with this hypothesis, the statistical analyses of the reaction times reveal an increased processing workload for nonmanually manipulated signs, which indicates the relevance of nonmanuals for lexical processing. The statistical analysis of the overall reaction times for all stimulus pairs yields that the nonmanual manipulation causes longer reaction times. The lexical decision for signs with nonmanual markings compared to the same signs without these nonmanual markings is 11% faster ($p = 0.002$). This further supports the assumption that certain nonmanuals inherently belong to the lexical entries of signs in the mental lexicon. As discussed in Section 4.4.3 and Section 7.4.3, many nonmanual markings within the stimulus signs have a distinctive function or a clear accentuating function which points out that the difference in the reaction times between signs with nonmanuals and the same signs in a manipulated version without these nonmanuals is not just due to a facilitation of the lexical processing by gestural nonmanuals.

Study III: *Meaning Attribution to Isolated Facial Expressions* (see Chapter 6) reveals that isolated from manual components and the communication context certain facial actions trigger the access to mental entries of i) signs with exactly the same lexical facial expression as presented in the respective stimulus and ii) signs with a similar lexical facial expression (see Section 6.4.2). This indicates that specific facial expressions are inherent parts of the mental lexical entries of certain signs. One clear example is the facial action *lip funneler / blow* (AU 22+25+33A) which triggers the activation of the lexical signs LIFE-PARTNER and OWN for some deaf signers. The data show that the meaning attributions to isolated facial expressions by deaf signers very often depend on lexical facial expressions. Based on the 538 meaning descriptions by deaf participants (which often consist of more than one meaning attribution), the categorization by a linguistic colleague and me, and the follow-up discussion with one deaf informant, I counted 218 meaning attributions that reveal links to lexical signs in DGS.

In accordance with my empirical investigations, in Figure 7.33, I propose a model for lexical nonmanuals in mental entries. As my focus of research lies on lexical nonmanuals, neither the mental entry with respect to phonological and morphological information of the manual components nor the syntactic and semantic information which belong to a sign as a whole are considered in the presented model. Furthermore, mouthings are regarded only to some extent.

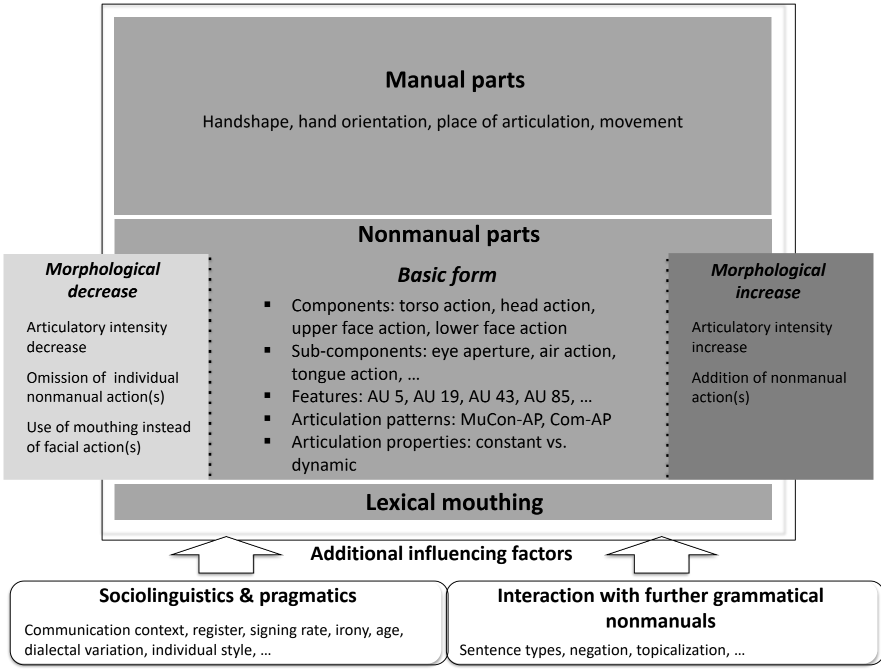


Fig. 7.33: An approach for lexical nonmanuals in mental entries

As shown in Figure 7.33, I assume that lexical nonmanuals are stored together with the manual parts of a sign in one mental entry. Another option would be to assume two individual lexical entries, one for the manual parts and one for the nonmanuals which are associated with each other. Of course, this issue cannot be definitively clarified based on my empirical analyses. In this respect additional research is required. However, according to the previous research, I assume the storing in one lexical entry. This assumption is primarily based on the results of Study II and on the intertwined articulation of nonmanual and manual parts of signs. The latter is not only related to the temporal synchronization of manual and nonmanual parts which also applies for simultaneously nonmanually articulated adjectives and adverbials that are no inherent parts of the signs they accompany. With the intertwined articulation, I refer, in particular, to properties like constant nonmanuals and mirroring nonmanuals (see Section 7.2.3). Regarding mirroring, it has to be underlined that this pattern takes place in both directions, i.e. a nonmanual action may mirror a manual action or a manual action may mirror a nonmanual action. For instance, within the sign WINK, the dominant hand mirrors the lexical action by the eye. Another aspect is the fact that for signs with manual movement reduplication, constant nonmanuals as well as mirroring nonmanuals seem to occur frequently (see Section 7.2.3). One example for constant nonmanual actions while the sign is manually articulated with a reduplicated movement is the sign RECENTLY (see Section 7.2.3.1). An example for mirroring nonmanual actions is the sign NOD in which the number of movements of the head and the number of movements of the hand are interdependent (see Section 7.2.3.2). Such examples illustrate that it does not seem to be inferable from a general rule how the manual and nonmanual parts of a sign have to be combined with each other. In contrast, for signs with lexical nonmanuals, this information seems to be part of each lexical entry. This indicates that the manual and nonmanual parts of a sign are stored together in one mental entry.

It has to be mentioned that certain lexical nonmanuals can occur independently of the manual components. This is the case when a lexical nonmanual marking is used for a morphological modification of another sign. For instance, the lexical facial expression of the sign SLIM/THIN (see Figure 7.24 in Section 7.3.2) may be used simultaneously with the sign WOMAN. In this case, instead of using the complete sign SLIM/THIN, the nonmanual marking may function simultaneously as an adjectival modification. Regarding the mental storing, such occurrences may be due to one of the following three options: i) The information on the manual and nonmanual parts of signs are jointly stored in the mental entries, but the retrieval of these different parts of signs takes place subdivided in the speech production so that it is possible to produce the nonmanual parts of the sign independently of the manual components. ii) It could be argued that in cases like the combination of SLIM/THIN and WOMAN two signs are simultaneously merged so that the manual components of the adjective are dropped and the articulation results in a blending. iii) Another option would be to assume that in such cases the nonmanuals are stored twice: once with the manual parts of the sign and once separately. However, this would mean an uneconomic increase of the load of storing capacity in the human brain (cf. Pendzich 2012, 42, 64). Therefore, I assume that option i) and ii) are more probable. It seems that most, if not all, nonmanual morphemes which can be used simultaneously with other manual signs have a counterpart in a lexical sign composed of the same nonmanuals and additional manual components. A further example is the sign CONCENTRATE. The lexical nonmanual marking of this sign can be used, for instance, simultaneously with the manual verb WORK and functions as adverbial modification.

My approach is in line with the opinion by Pfau & Quer (2010, 382): "Phonological (or lexical) nonmanuals are assumed to be an essential part of sign's phonological description. That is, just like manual parameters such as handshape, movement and location, these nonmanuals have to be specified in the lexical entry of a sign". Likewise, Herrmann (2013, 40) assumes that nonmanual components "play an equally important role and are stored in the mental lexicon together with many signs".

Regarding my proposed model of the mental representation of lexical nonmanuals in Figure 7.33, some more explanations are important. One crucial point is the assumption that lexical nonmanuals are represented, on the one hand, in their basic form and, on the other hand, for some signs, with respect to morphologically decreased and increased forms. In the basic form, lexical nonmanuals are specified for their components, sub-components, and features (see Section 7.2.1). The concrete articulation of these elements is further determined within the articulation patterns (see Section 7.2.2) and articulation properties (see Section 7.2.3). The basic form can be considered as the citation form of signs. In addition, when signs are used in different utterances, they may be articulated in morphologically increased and decreased forms realized by changes in the basic forms of the nonmanual markings. Morphological decrease may be realized by means of an articulatory intensity decrease, an omission of individual nonmanual phonological action(s), and a use of a mouthing instead of one or more phonological facial action(s). Morphological increase may be performed by an articulatory intensity increase and an addition of nonmanual action(s). Whereas the modifications in the form of an articulatory intensity decrease or increase as well as the use of a mouthing instead of facial action(s) seem to be rather rule-based, the modifications in the form of an omission of individual nonmanual action(s) or an addition of nonmanual action(s) seem to be specified for certain signs in the lexical entries. This means that some signs with lexical nonmanuals have different lexicalized inherent forms for decrease and increase. One example which illustrates that the information on the nonmanual articulation of a morphological increase seems to belong in some cases to the lexical entries is the sign REVERE. It seems to be the case that REVERE can be morphologically increased by a tongue show (AU 19). At this, it is important to note that a tongue show cannot be treated as a general marker for increase in the meaning of signs because it cannot be added to every sign. Only for certain signs, this marker is specified for nonmanual morphological increase. Therefore, I assume that this information is part of the lexical entries. In contrast, a morphological rule seems to be the use of a mouthing for morphological decrease. The sign ARROGANT is specified for AU 19+25+26+43+53 in the basic form. When the sign is articulated in a morphologically decreased version, the sign can be performed with a mouthing instead of the facial expression. Whereas the lexical facial expression is displaced by a mouthing, nevertheless, the head action remains. Interestingly, this morphological rule of the use of mouthing for decrease may be blocked by sub-rules. As described in Section 7.4.2, it seems to be the case that signs which are performed with a movement of the hand(s) near the mouth and which are specified for a lexical facial expression on the lower face are more resistant against the displacement by a mouthing than signs with another place of articulation. One example is the sign FAVORITE with a lexicalized lip pucker (AU 18). For this sign, the *mouthing classification task* reveals a strong resistance against a mouthing. Such rules with respect to morphological increase and decrease need to be further investigated.

To differentiate between morphological modifications which are i) idiosyncratic or ii) due to general rules, the two boxes for morphological increase and decrease in Figure 7.33 are located in part inside and in part outside of the lexical entry. In those cases in which no general rule applies, the morphological modification has to be specified in the lexical entry. However, it could well be that all types of morphological increase and decrease are based on general rules but, so far, these rules are not uncovered. A completely rule-based approach would, of course, be more economic. In principle, three different variants of the representation of morphological modifications of the basic form of lexical nonmanuals are possible: i) morphological increase and decrease are completely rule-based, ii) morphological increase and decrease are completely idiosyncratic and specified in mental lexical entries, iii) morphological increase and decrease are partially rule-based and partially idiosyncratic and specified in mental lexical entries (see Figure 7.34).

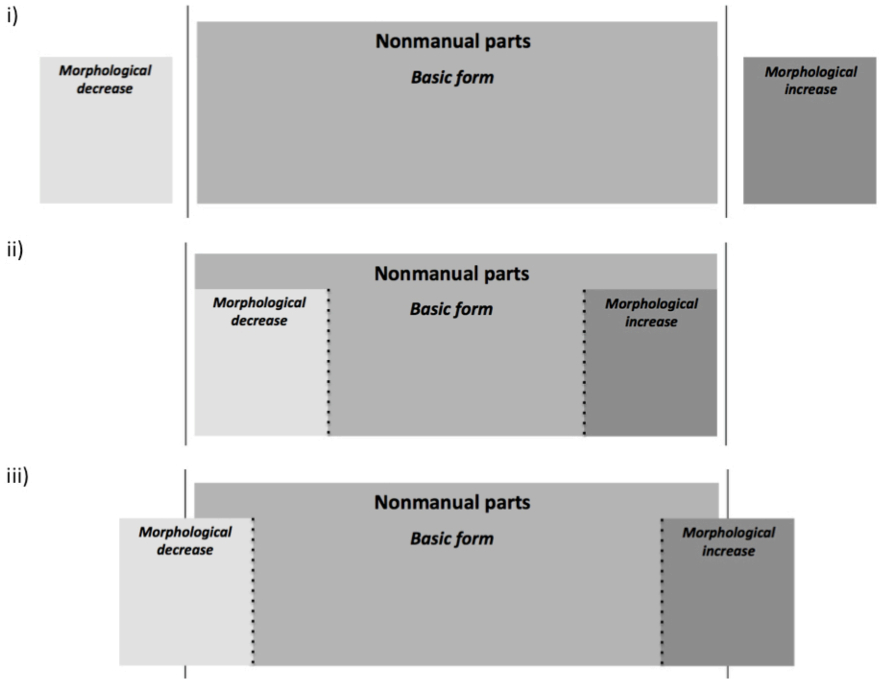


Fig. 7.34: Three potential variants of the mental representation of morphological decrease and increase based on lexical nonmanuals

According to the results of my investigations, provisionally, I assume the third variant in Figure 7.34 (see also Figure 7.33). It appears to be the case that some signs with lexical nonmanuals are stored with morphological increased and decreased forms in mental lexical entries and other signs solely in the basic form. But, my data are not sufficient in order to finally clarify this question. For resolving the issue which of the three potential mental representations of morphological increase and decrease matches the nature of DGS, more studies are required.

In Pendzich (2014), I mention that it would be interesting to investigate whether it is possible to express gradual differences in the meaning of signs by means of lexical nonmanual markings. My new empirical findings indicate that this is indeed the case. Lexical nonmanuals are inherent parts of certain signs, but they can morphologically function as modifying elements in the form of increase and decrease within the same signs depending on the utterance context. This results in simultaneous layerings of phonological and morphological nonmanual markings. Besides, it has to be noted that morphological decrease and increase can also be realized by an addition of a manual sign.

The investigation of decrease and increase of lexical nonmanuals directly leads to another important point of my model for lexical nonmanuals in mental entries. The basic form of lexical nonmanuals may be affected by sociolinguistic and pragmatic factors such as communication context, language register, narrative vs. objective, signing rate, irony, dialectal variation, age, and individual style (see Section 4.4.2 and Section 7.4.1). One example is the reduced articulation or omission of the lexical tongue show in the sign DISGUST when used in formal contexts (see Section 4.5).

Moreover, lexical nonmanuals may be affected by an interaction with further grammatical nonmanuals (e.g. nonmanual markers for interrogative constructions or nonmanual markers for negation). This issue has to be investigated in detail in future studies.

For the model of lexical entries of signs, it is central that certain mouthings just as lexical nonmanuals are classified as obligatory parts of signs by signers (see Section 4.4.4). It appears to be reasonable to assign the same linguistic status to obligatory mouthings as for lexical nonmanual markings. In Figure 7.33, such mouthings are labeled as *lexical mouthings*. Similarly, Rainò (2001, 41) states that "[m]outhing is often optional; however, there are cases where it is phonemic and therefore obligatory". Furthermore, it seems to be the case that some signs contain specific conditions for the use of a mouthing. At this, morphological decrease as well as pragmatic factors such as language register (see Figure 7.33) seem to play an important role. Moreover, it can be assumed that some mouthings are stored in the mental lexicon in a similar way as facial expressions. As discussed in Section 7.4.2, the articulation of mouthings often shows strong articulatory similarities to facial expressions in the lower face. In this respect, the use of mouthings by signers who learn another sign language as foreign language without learning the respective spoken language has to be closely examined as well (cf. Woll 2009, 209). Another central question is how optional mouthings are mentally represented. It can often be observed that signers use far more mouthings with signs during the communication with hearing people. In contrast, they articulate clearly less mouthings in the communication with deaf signers. With respect to optional mouthings, I assume that signers simultaneously activate lexical entries of the corresponding words of the respective spoken language. Whereas Vinson et al. (2010, 1158) conclude from their empirical investigation on BSL that "mouthing is represented and accessed through a largely separable channel, rather than being bundled with manual components in the sign lexicon", I assume that obligatory and optional mouthings have to be treated differently in DGS. In addition, the activation of lexical entries for signs and for corresponding words of the respective spoken language seem to closely interact during language processing. The reaction time study by Morford et al. (2011) shows that deaf bilinguals (ASL and English) activate ASL signs during the language processing of written English words. Furthermore, the ERP study by Hosemann (2015, 41-84) reveals that bimodal deaf people activate orthographic/phonological representations of German words during sentence processing of DGS.

Lexical nonmanuals in sign languages are a highly complex phenomenon. My proposal for the mental representation of lexical nonmanuals is a first attempt in order to capture i) the articulatory characteristics of lexical nonmanuals, ii) the fluid boundary between lexical nonmanuals and the use of nonmanuals for morphological modifications, and iii) the interplay with sociolinguistic, pragmatic, and grammatical factors. Lexical nonmanuals are defined as inherent parts of certain signs. Nevertheless, under specific conditions, these markers can be dropped, reduced or intensified. Of course, my presented model needs to be verified by further empirical studies.

7.6 Extension of Brentari's Prosodic Model

So far, the sublexical structure of nonmanual parts of signs is not well elaborated in any model of sign language phonology (cf. Brentari 2012, 24). In the following, I present a proposal for an extension of the Prosodic Model by Brentari (1998) with respect to nonmanual parts of signs which is based on my empirical results on lexical nonmanuals in DGS.[30]

In the Prosodic Model by Brentari (1998), a fundamental distinction between *inherent features* and *prosodic features* for signs is decisive (see Figure 7.35). The term *inherent features* (IF) refers to the observation that certain properties of signs "are specified once per lexeme and do not change during the lexeme's production" (Brentari 1998, 22). The handshape with constant finger selection and the place of articulation in terms of a main region such as the torso belong to these features. By contrast, *prosodic features* (PF) "can change or are realized as dynamic properties of the signal" (Brentari 1998, 22). A movement may occur, for instance, in the form of an aperture change of the handshape within an individual lexeme or as a path movement between two places in the signing space. On this account, all movement features are located on a prosodic branch of structure. "[H]andshape, orientation, and place of articulation each contain prosodic features—properties that change throughout the articulation of a lexeme—and inherent features that do not change" (Brentari 1998, 25). Whereas inherent features are articulated simultane-

30 I am very greatful to Diane Brentari for the fruitful discussion of my approach on lexical nonmanuals during her stay in Göttingen.

ously, prosodic features are articulated sequentially (cf. Brentari 1998; Brentari 2012).

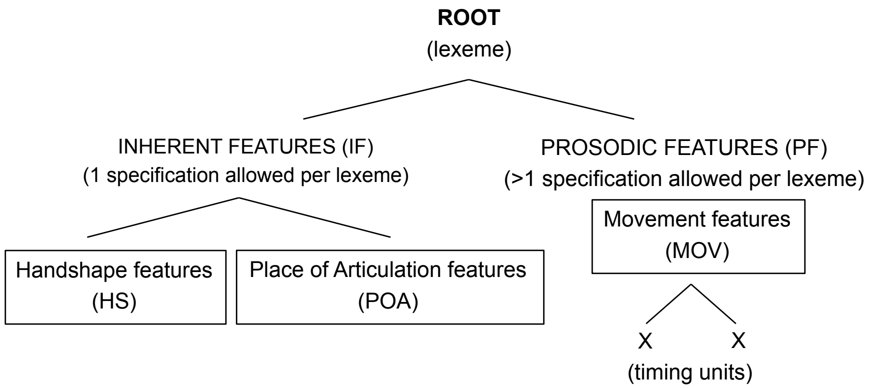


Fig. 7.35: The hierarchical organization of handshape, place of articulation, and movement of a sign in the Prosodic Model (Brentari 1998; Brentari 2012, 23)

Brentari (1998; 2012) does not consider nonmanual features of signs in detail and leaves the closer treatment of these signals for future research (cf. Brentari 1998, 174).[31] However, the following specification of nonmanuals is essential: "Just as there are nonmanual inherent features, so there are nonmanual prosodic features" (Brentari 1998, 175). As shown in Figure 7.36, I included the nonmanual parts of signs in both of these feature types. My extension of Brentari's model is highlighted in grey. The main modification concerns the superordinate division of IF and PF in manual and nonmanual parts of signs. Based on my investigations which reveal some autonomy of nonmanuals in the sense that their articulation cannot always be explained with just a dependence on the manual articulators (see Section 7.2.3), I propose to treat nonmanual and manual parts of signs on separate nodes which are located on the same hierarchical level. A general rule which applies to these nodes is that the specified manual and nonmanual articulations occur in temporal synchronization. Lexical nonmanuals can be subdivided into constant and dynamic nonmanuals (see Section 7.2.3). Furthermore, the differentiation between mirroring nonmanuals and non-mirroring nonmanuals is crucial. Non-mirroring dynamic nonmanuals expose the autonomy of nonmanual parts

31 For FinSL, Jantunen (2006) deals with Brentari's approach with respect to an extension of the concept of movement complexity for nonmanual movements (mouth, head, and torso).

of signs because they are specified for movements which are not performed by the hands (e. g. PIPE, see Section 7.2.3.2). Moreover, the fact that DGS comprises signs in which the hands articulate a reduplicated movement, whereas the nonmanual marking remains constant (e. g. RECENTLY, see Section 7.2.3.1) illustrates the autonomy of lexical nonmanuals. In addition, for some signs, it seems to be the case that a movement by nonmanuals is copied by the hands and not the other way around. For instance, within the sign BITE-OFF, the mouth directly imitates the action which is done when biting in reality and this action is mirrored with the hands (see Section 7.2.3.2).

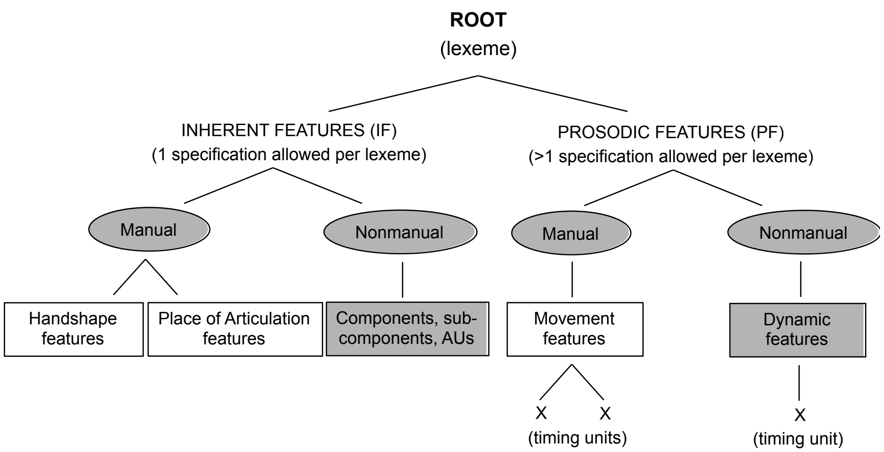


Fig. 7.36: Extension of the Prosodic Model (Brentari 1998; Brentari 2012) with respect to lexical nonmanuals

In contrast to my explained superordinate division of IF and PF in manual and nonmanual parts of signs, Brentari (1998, 94, 98-101) suggests for the implementation of nonmanuals into the Prosodic Model that the articulator node, which is labeled in Figure 7.35 as *handshape features*, branches into a nonmanual tier and a manual tier. However, in my view, as outlined above, nonmanuals have a more independent status.

According to my approach, under Brentari's term *inherent features*, with respect to nonmanuals, components, sub-components, and AUs have to be subsumed (see Section 7.2.1). As defined by Brentari (1998, 22), inherent features "are specified once per lexeme and do not change during the lexeme's production" (see also Figure 7.36). For nonmanuals, this does not mean that only one component, sub-component or AU is specified per lexeme. The property of one specification per lexeme is maintained because a lexeme does not include different *nonmanual events*, even though one lexical nonmanual event is mostly composed of different AUs.[32] An example of two different sequencing nonmanual events would be the articulation of a lateral tongue show (AU 19+25+26) followed by a blow (AU 33). Such a sequential combination would contradict the definition of inherent features and does not occur as a lexical part of signs in DGS. With respect to the articulation patterns of nonmanuals, signs are either precisely specified for certain AUs in the *muscle contraction based articulation pattern* (MuCon-AP; see Section 7.2.2.1) or show some variability with respect to AUs in the *component based articulation pattern* (Com-AP; see Section 7.2.2.2). Whereas the MuCon-AP can be seen in direct analogy to the feature specification of the manual parts of signs, the Com-AP reveals differences to the specification of the manual parts. Due to the Com-AP, apart from the features in the form of AUs, I added the components and sub-components in Figure 7.36. I include all of the four nonmanual components within one node. Alternatively, the components torso action, head action, lower face action, and upper face action could be represented in individual nodes.

Prosodic features of nonmanuals are the specifications for properties such as [dynamic mirroring] and [dynamic non-mirroring]. The [dynamic non-mirroring] feature has to be specified by further features which have to be included in the model. For instance, the number of repetitions of muscle actions cannot be inferred from the manual node and, therefore, needs a feature specification. If a sign contains a constant nonmanual marking instead of a dynamic nonmanual marking, the nonmanual branch of the prosodic features is dropped.

Brentari (2012, 27) defines the two x-symbols which are associated with the movement features as timing slots or segments (see Figure 7.35 and Figure 7.36). "Path features generate two timing slots; all other features generate one timing slot. The inherent features do not generate timing slots at all" (Brentari 2012, 27). Correspondingly, I assume one timing unit for nonmanual dynamic features."When two movement components are articulated simultaneously [...], they align with one another and only two timing slots are projected onto the timing tier" (Brentari 2012, 27). An example of DGS is the sign PICK-UP (see Figure 7.18 in Section 7.2.4). The two movements in the form of a path movement in the neutral signing space and a secondary movement in the form of an aperture change from open to closed are aligned with each other. For the nonmanual dynamic features, I added one timing slot but due to the fact that the manual and nonmanual branches are articulated in synchronization, the timing slot of the nonmanual

32 The term *nonmanual event* is implemented in analogy to the term *facial event* by Ekman et al. (2002b).

dynamic features aligns with the timing slot(s) of the manual movement branch. Nonmanual dynamic features align with manual movements in the same way as manual secondary movements such as a handshape change align with manual path movements. DGS signs such as BITE-OFF (see Figure 7.13 in Section 7.2.3.2) illustrate that nonmanual dynamic features show a similar behavior as manual secondary movements. This supports the proposal to treat nonmanual dynamic features as prosodic features. The relevance of the timing slot of the nonmanual dynamic features becomes evident with signs that neither have a manual path movement nor a manual secondary movement but a nonmanual movement. One example is the sign PIPE, which I discussed in Section 7.2.3.2. However, future studies have to investigate whether such signs have exceptional character or whether DGS comprises more of such signs.

In this section, I suggested an extension of the Prosodic Model by Brentari (1998) for nonmanual parts of signs. This has to be seen as a first step for the implementation of lexical nonmanuals into a phonological model. Based on a wide range of empirical data, my proposed approach has to be verified and the inventory of feature specifications for nonmanuals has to be further expanded.

8 Conclusion

8.1 What are lexical nonmanuals?

In this book, I investigated the nature of lexical nonmanuals which are articulated with the upper face, lower face, head, and torso in DGS. Based on three empirical studies, the analysis of lexical nonmanuals with the Facial Action Coding System (FACS; Ekman et al. 2002b), and the current state of research, I drew various theoretical implications towards a new classification of lexical nonmanuals. As until now there is no consensus in research regarding the theoretical status of these signals in different sign languages, it is of central importance to develop theoretical models which are built on comprehensive empirical studies.

In the first part of this book, I gave detailed theoretical and methodological background information. Before focusing on lexical nonmanuals, I started with a close view on the nonmanual complexity in the visual modality. Nonmanual signals have diverse functions. Besides gestural and affective uses, they act as linguistic markers operating on all grammatical levels of sign languages. An understanding of the complex interaction of the various functions and a knowledge about the distinction of different types of nonmanual markings is a decisive prerequisite for the analysis of all kinds of nonmanuals in sign languages. In addition, a familiarity with the articulatory basis of nonmanuals is crucial. I explained how the nonmanual channel can be subdivided into components, sub-components, and muscle contractions. FACS turns out to be a very useful tool for the investigation of sign languages. The main advantages are an objective description of nonmanuals and the optimal comparability of studies by different researchers.

Regarding the theoretical status of lexical nonmanuals, there are two main views in this area of research: i) Nonmanuals are not regarded as phonological components of signs next to the manual phonological components handshape, hand orientation, movement, and place of articulation (cf. e. g. Ebbinghaus & Heßmann 2001; with respect to nonmanuals apart from mouth patterns, see Crasborn & van der Kooij 2013). ii) Nonmanuals are considered phonological components of signs (cf. e. g. Coerts 1992; Jantunen 2006; Steinbach 2007; Pfau & Quer 2010). In order to define the status of lexical nonmanuals, one important issue is whether nonmanual minimal pairs exist in different sign languages. Therefore, I provided an overview of examples of minimal pairs based on nonmanuals mentioned in the research literature. This revealed a need for comprehensive empirically based studies. In this context, it has to be investigated whether the appearing predominance of nonmanual minimal pairs based on mouth patterns really reflects the nature of sign languages or whether this is due to the frequent research concen-

https://doi.org/10.1515/9783110671667-008

tration on mouth patterns instead of the joint analysis of all lexical nonmanual markers. Another question that arises when investigating lexical nonmanuals is whether signs exist which are performed only by nonmanuals. My outline of the state of research showed that this topic needs further exploration as well. In this respect, it is also important to closely investigate which nonmanual morphological markings used for adjectival and adverbial modifications of signs are based on lexical signs which have the same meaning and have the same nonmanual marking as an inherent part. Based on the state of research, I compiled criteria for the classification of nonmanuals as phonological markings. In the last section of the first part of the book, I concentrated on mouthings. In particular, due to the fact that facial expressions in the lower face and mouthings are articulated with the same muscular basis, it is important to consider mouthings when analyzing lexical nonmanuals.

In the second part, I presented and discussed three of my empirical studies on DGS in detail. These studies on lexical nonmanuals clearly show the relevance of nonmanuals for the well-formedness of signs, the meaning of signs, and the lexical processing. Study I: *Lexical Judgment and the Meaning of Signs* revealed that torso actions, head actions, and muscle contractions in the lower face as well as in the upper face are of great importance on the lexical level in DGS. Signers have clear intuitions about whether or not and which nonmanuals are inherent parts of signs. The statistical analyses show, inter alia, that the manipulated signs with lacking lexical nonmanual markings were rated on average 30% (questionnaire) and 57% (interview) worse than the same signs with the respective nonmanuals ($p < 0.001$).

The statistical analyses of Study II: *Lexical Decision with Reaction Times* revealed an increased processing workload for signs presented without their lexical nonmanuals. Nonmanual manipulations cause longer reaction times. The analysis of the overall reaction times for all stimulus pairs shows that the lexical decision for signs with lexical nonmanuals is on average 11% faster than the lexical decision for the same signs with lacking lexical nonmanuals ($p = 0.002$). This points out the relevance of nonmanuals for lexical processing and may indicate that certain nonmanuals inherently belong to lexical entries of signs in the mental lexicon.

Study III: *Meaning Attribution to Isolated Facial Expressions* demonstrates that meaning attributions by deaf signers are strongly affected by signs with a corresponding lexical facial expression. For deaf signers, isolated from manual components and the communication context certain facial actions trigger the access to mental entries of i) signs with exactly the same lexical facial expression and ii) signs with a similar lexical facial expression. This further confirms that certain facial expressions are inherent parts of mental lexical entries of signs.

In the third part of my book, I brought together the results of my empirical and theoretical investigations of lexical nonmanuals in order to draw theoretical implications towards a new classification of lexical nonmanuals. In the following, I summarize the results of this in-depth discussion by answering the eight research questions which I set up in the introduction:

1. *Are expressions in the lower face, expressions in the upper face, head actions, and torso actions inherent parts of certain lexical signs in DGS?*
   All of the four nonmanual components function as inherent parts of signs in DGS. They occur either jointly or separately as lexical markings. Hence, when investigating lexical nonmanuals, it is necessary to analyze in addition to mouth patterns also head actions, torso actions, and muscle contractions in the upper face. With respect to head actions and torso actions, it has to be noted that these two components often act very closely together on the lexical level. This means that lexical forward body leans (AU 107) and backward body leans (AU 108) may be minimized and solely articulated with the next smaller articulator, the head (AU 57, AU 58, AU 53, AU 54). Similarly, lexical head actions may solely be carried out with the next bigger articulator, the torso, or in combination with the torso. A combination of head and torso actions includes that the head does not merely move together with the torso but articulates an autonomous action, e. g. a backward body lean in combination with a head up action.
2. *Is the lexical relevance of lower face, upper face, head, and torso more balanced than has been suggested so far?*
   Before answering this question, it has to be emphasized that my results are only based on a small extract of signs with lexical nonmanuals in DGS. According to these results, it seems that the most productive nonmanual component on the lexical level is the lower face. Nevertheless, a concentration on just this single component is not adequate in order to capture the nature of lexical nonmanuals. The other three components head action, torso action, and upper face action are fundamental as well. All four nonmanual components carry essential lexical functions, but they seem to differ in their productivity. My statistical analyses of the nonmanual sign types i) signs with a lexical facial expression (lower and/or upper face), ii) signs with a lexical facial expression (lower and/or upper face) and torso/head action, iii) signs with a lexical torso/head action in Study I and Study II point out that all nonmanual components are important on the lexical level. The judgment task in Study I revealed that the effect of the manipulation in the form of an omission of lexical nonmanuals is very clear and similar for each nonmanual sign type. The rating difference between the signs with the nonmanual marking and the same signs without the nonmanual marking for the three nonmanual sign types ranges from 25%

to 34% in the questionnaire and from 53% to 61% in the interview. In addition, the lexical decision task in Study II shows that nonmanuals in all of the three types are lexical parts of signs and have an impact on the processing of signs. On average, the percentage differences between the reaction times for the signs with the nonmanual marking and the same signs without the nonmanual marking are as follows: i) signs with a lexical facial expression 9%, ii) signs with a lexical facial expression and torso/head action 8%, and iii) signs with a torso/head action 14%. While it seems that the productivity of the four nonmanual components is different, the importance of lexical markings is similar independently of which components are involved.

3. *Which forms of articulation, semantic categories, and basic properties of lexical nonmanuals are crucial for the definition of lexical nonmanuals?*
My analyses lead me to assume that nonmanuals are phonologically specified in the form of either muscle contractions or components and sub-components. For these two types, I introduced the terms *muscle contraction based articulation pattern* (MuCon-AP) and *component based articulation pattern* (Com-AP). Signs belonging to the MuCon-AP are precisely defined for one or more nonmanual features in the form of AUs. The sign WASTE is an appropriate example. The sign is articulated with a very consistent lexical facial expression on the lower face: a tongue show against the lower lip and a blow (AU 19+25+26+33). In contrast, signs in the Com-AP are specified for one or more nonmanual components or sub-components and variability with respect to AUs is implied. One example is the sign PROTECTION which is lexically specified for the component torso action. This component is realized as a body backward action (AU 108) or a body forward action (AU 107). It has to be noted that my classification of the articulation of lexical nonmanuals as MuCon-AP and Com-AP should be treated as a proposal. Further studies are necessary to verify whether the two articulation patterns adequately describe the storing of nonmanuals in the mental lexicon.
With respect to forms of articulation, moreover, it is central that lexical nonmanuals occur in two different action types: A sign may be specified for i) a constant nonmanual marking or ii) a dynamic nonmanual marking. Both types of nonmanuals are synchronized with the manual articulation which means that the actions by manual and nonmanual articulators are performed in parallel and with the same speed. Whereas constant lexical nonmanuals include no change in their configuration during the articulation of the corresponding manual sign (e. g. RECENTLY), dynamic lexical nonmanuals show a change in their configuration (e. g. BITE-OFF). Dynamic nonmanuals are further subdivided into mirroring nonmanuals and non-mirroring nonmanuals. My term *mirroring nonmanuals* is inspired by the term *echo phonology* by Woll & Sier-

atzki (1998; Woll 2001; 2009; 2014) but entails modifications of this approach. For my analyses, the following points are essential: 1) non-iconic and iconic mirroring nonmanuals, 2) mirroring in both directions (i.e. a nonmanual action may mirror a manual action, a manual action may mirror a nonmanual action), 3) further nonmanual components besides lower face actions, and 4) mirroring with respect to handshape change, movement type, and movement reduplication. I define dynamic non-mirroring nonmanuals as lexical markings that contain a change in their configuration which does not mirror the manual articulation (e. g. PIPE). In contrast, within dynamic mirroring nonmanuals, features of manual and nonmanual components are mirroring each other (e. g. BITE-OFF).

Another aspect of the articulation of lexical nonmanuals concerns unilateral lexical nonmanuals. Two clear properties become apparent: i) An alignment occurs between the articulating hand and the articulating side of the face. ii) Facial expressions may be articulated bilaterally instead of unilaterally. Signs with unilateral expression on the lower and/or upper face are well-formed when including a lateral alignment between nonmanual and manual articulators. When signed without such a lateral alignment, signs appear to be not completely well-formed. Nevertheless, such articulations are more adequate than articulations with lacking lexical nonmanual markings. Due to the observation that unilateral facial actions depend on the side of the signing hand, I introduce in analogy to the term *dominant hand* the term *dominant face half* or even the wider term *dominant half of the upper body*.

Besides the mentioned formal aspects of lexical nonmanuals, the following semantic categorization is useful in order to capture the nature of lexical nonmanuals: i) *lexical nonmanual imitation of action*, ii) *lexical nonmanual highlighting of a characteristic aspect of the sign meaning*, iii) *lexicalized affective nonmanuals*, iv) *lexicalized gestural nonmanuals*, and v) *lexical non-iconic nonmanuals*. The property non-iconic should not be seen as an absolute criterion because some iconic nonmanuals may lose their iconic status over time. Due to this process, the iconicity may not be transparent any more for language users and iconic nonmanuals may change into rather non-iconic nonmanuals.

One further property of lexical nonmanuals is a complex interaction with mouthings. This is especially relevant for the lower face because both types of mouth actions are produced with the same muscles. For upper face actions, head actions, and torso actions, the use of a mouthing implies no articulatory constraints. Particularly for mouthings and mouth patterns, three types of interaction are central: i) *displacement*, ii) *merging*, and iii) *mimic articulation of mouthing*.

For the definition of the status of lexical nonmanuals, two additional properties are crucial: i) distinctive function and ii) accentuation of different meanings of manually similar signs. The latter function can be observed for many signs which are distinguished only by small manual differences. Many times signers described that certain signs with lacking lexical nonmanuals can have various meanings. When seeing signs without their lexical nonmanuals, signers often activated other signs which have no lexical nonmanual marking but are usually articulated manually slightly different. Lexical nonmanual markings accentuate differences in the meaning of such signs and lead to a better identification of the respective sign. The further important function of lexical nonmanuals, namely distinctiveness, is discussed in answer to the next question.

4. *Do minimal pairs based on nonmanual components exist in DGS?*
The investigation whether or not distinctive nonmanual components exist in different sign languages is a crucial issue which received too little attention in previous research. Before summarizing my results regarding this issue, it has to be emphasized that they are based on a first empirical step into the analysis of nonmanual minimal pairs. More investigations on minimal pairs in DGS and other sign languages are needed. The productivity and frequency of minimal pairs based on the different manual and nonmanual components and features have to be studied closely. So far, my empirical analyses revealed that DGS comprises signs which have different meanings based on lexical nonmanuals (partially in combination with mouthings). Thus, lexical nonmanual markings carry a distinctive function. I presented seven possible types of nonmanual minimal pairs which include mouthings as a combinatory factor. An example for the distinctive function of the component lower face is the sign pair ALWAYS – LEAD. In the sign ALWAYS the lower face component is specified for the features AU 17+U25+U33. In contrast, the same component is determined as neutral within the sign LEAD. Both signs are distinguished by one nonmanual component which demonstrates an analogy to the structure of manual minimal pairs. In addition to such sign pairs with a difference in only one nonmanual component and sign pairs with a difference in only one nonmanual feature, there are signs in which a distinctive function is realized simultaneously by different nonmanual components. The occurrence of such sign pairs is due to the fact that sign languages are expressed via two completely different channels: the manual channel and the nonmanual channel. According to this, an extension of the definition of minimal pairs in the visual modality appears to be appropriate. Besides manual and nonmanual minimal pairs which are directly comparable with minimal pairs in spoken languages, sign languages seem to have nonmanual channel minimal pairs. The term *nonmanual chan-*

nel minimal pair is implemented for capturing all sign pairs that are manually identical but differ in the nonmanual channel which may include differences in more than one component.

5. *Are nonmanual components comparable with manual components of signs?*
   In previous research on phonological components, it is common to explicitly or implicitly attribute more importance to manual than nonmanual parts of signs. It is often assumed that lexical nonmanuals are not comparable with the manual components (cf. e. g. Becker 2016).
   In order to gain first empirical insights into the issue of comparability of manual and nonmanual parts of signs, I compared the ratings of manipulated signs with lacking lexical nonmanuals and manipulated signs with a manual error within the judgment task of Study I. The statistical analysis revealed that the ratings of manually manipulated signs are 28% worse than the ratings of nonmanually manipulated signs, which is significant at all usual significance levels. Manual and nonmanual components are crucial for the well-formedness of signs. Regarding the rating difference between manually and nonmanually manipulated signs, it has to be taken into account that the articulators of the manual components (= hands and arms) are bigger than the articulators of the nonmanual components upper face action and lower face action (= eyes, mouth, etc.). The manual manipulations are more visible and can be seen easier than the nonmanual manipulations. Furthermore, it has to be noted that the kind of manipulation is different for the manual and nonmanual components. Whereas nonmanual manipulations are designed with an omission of nonmanual markings, manual manipulations are based on an error in a manual component.
   As part of Study II, I compared the reaction times for the same manually and nonmanually manipulated signs as in Study I. The statistical analysis yielded that the reaction times for the nonmanually manipulated signs are 14% faster, but this is not statistically significant. Thus, the analysis shows no statistically significant structural difference between the reaction times for manually and nonmanually manipulated signs.
   The existence of minimal pairs based on only one nonmanual component or feature in DGS points to a comparable status of manual and nonmanual parts of signs. However, as mentioned above, the issue of the productivity of nonmanual and manual distinctive components and features needs to be further investigated and compared.
   The observation that lexical nonmanuals appear to be decomposable into components, sub-components, and features reveals an analogy to the manual parts of signs. Furthermore, the existence of a difference between very productive and low productive lexical nonmanual elements becomes apparent.

Very productive sub-components are, for instance, tongue action and eye aperture. Rather low productive lexical sub-components seem to be, for example, cheek action and neck action. Similarly, manual components include very productive and low productive elements. A disparity between manual and nonmanual components seems to be that several signs show no nonmanual marking whereas usually all manual components are parts of a sign. However, due to the fact that nonmanual components are always physically present within each sign, I assume that they are specified either as neutral or for certain muscle actions. Hence, there is only one component which can really be completely absent within a sign: the manual component movement (except for transitional movements between signs, which are not phonological).

The analysis of the syllable structure of signs revealed that lexical nonmanuals seem to show the same behavior like secondary manual movements. Both are temporally structured by the syllable. Moreover, lexical nonmanuals and secondary manual movements have an analogue function: They make a manual position or a primary manual movement more sonorous. Therefore, lexical nonmanuals have to be included in the concept of sonority of signs. Accordingly, I proposed an extension of the sonority scale. In addition, lexical nonmanuals clearly increase the complexity of syllables and should be included in the definition of the syllable weight.

Furthermore, the above described fact that signers often activate signs with slight manual differences when seeing a sign which includes a lexical nonmanual marking in citation form without this marking, can be taken as an indicator for a similar phonological status of nonmanual and manual components. Both types of components appear to be similarly essential for the comprehension of signs.

Due to my investigations, I concluded that the previous manually based phonological models turn out to be not comprehensive enough to adequately capture the means of expressions in DGS and probably further sign languages. Correspondingly, I proposed an extension of the Prosodic Model by Brentari (1998) with respect to nonmanual parts of signs. As my analyses revealed some autonomy of nonmanuals in the sense that it is not possible to explain any articulation of lexical nonmanuals just with a dependence on the manual articulators, I suggested to treat nonmanual and manual parts of signs on separate nodes which are located on the same hierarchical level. A general principle that applies to these nodes is that the specified manual and nonmanual parts of signs are articulated in temporal synchronization. As already mentioned in the answer of the third research question, lexical nonmanuals seem to be determined by the MuCon-AP and the Com-AP. Whereas the MuCon-AP can be seen in direct analogy to the feature specification of the manual parts of signs, the Com-AP reveals differences to the specification of the manual parts. My extension of the Prosodic Model should be seen as a first attempt for the incorporation of lexical nonmanuals into a phonological model. It has to be verified and expanded based on further empirical data.

6. *How are lexical nonmanuals represented in the mental lexicon? Are nonmanuals lexically specified as individual components or rather as holistic units?*
The three empirical studies yielded independent, variously strong evidence for the assumption that lexical nonmanuals are inherent parts of lexical signs. I assume that the manual and nonmanual parts of a sign are stored together in one entry of the mental lexicon. This approach is primarily built upon the result of Study II and the intertwined articulation of nonmanual and manual parts of signs. With the intertwined articulation, I refer especially to properties like constant nonmanuals and dynamic nonmanuals (mirroring and non-mirroring). Concerning mirroring, it has to be highlighted that it occurs in both directions, i.e. a nonmanual action may mirror a manual action or a manual action may mirror a nonmanual action. Furthermore, it is instructive that signs with a manual movement reduplication may include constant nonmanuals or dynamic mirroring nonmanuals. Therefore, it does not seem to be inferable from a general rule how the manual and nonmanual parts of a sign have to be combined within a sign. This information appears to be included in each lexical entry which indicates that the manual and nonmanual parts of a sign are stored together in one mental entry.
A central aspect of the proposed model for the structure of mental entries is the assumption that lexical nonmanuals are represented in their basic form, which can be considered as the citation form of signs, and, for some signs, with morphologically decreased and increased forms. In the basic form, lexical nonmanuals are specified for their components, sub-components, and features. The articulation of these elements is determined within the two articulation patterns: MuCon-AP and Com-AP. Hence, the phonological specification of lexical nonmanuals appears to be more precise than assumed when considering lexical nonmanuals as holistic units. However, as the Com-AP includes variability regarding muscular actions, it can be seen in relation to the holistic descriptions of lexical nonmanuals as units that correspond to the meaning of the respective sign without indicating the exact form (cf. e. g. Happ 2005, 22; Happ & Vorköper 2006, 240f.; Papaspyrou et al. 2008, 71). It seems that the variability of lexical nonmanuals which is included in the descriptions of lexical markings as holistic occurs within the limits of the muscular properties of the component(s) and/or sub-component(s) which are determined according to the Com-AP. In addition to these two articulation patterns, lexical nonmanuals are further specified by the articulation properties constant vs. dynamic.

Furthermore, morphologically increased and decreased forms can be realized by changes in the basic forms of lexical nonmanual markings. Whereas the modifications in the form of an articulatory intensity increase or decrease as well as the use of a mouthing instead of facial action(s) seem to be rather rule-based, the modifications in the form of an addition of nonmanual action(s) or an omission of individual nonmanual action(s) seem to be specified for some signs in the lexical entries. In future studies, the general rules with respect to morphological increase and decrease have to be further investigated. This might reveal that all forms of morphological increase and decrease are rule-based and no form is idiosyncratic and lexically specified. Such a completely rule-based approach would be more economic.

It has to be emphasized that although lexical nonmanuals are inherent parts of certain signs, they may morphologically function as modifying elements. Thereby, simultaneous layerings of phonological and morphological markings with the same nonmanual components are possible. The suggested model for the mental representation of lexical nonmanuals is a first step in order to capture i) the articulatory properties of phonological nonmanuals, ii) the fluid boundary between phonological nonmanuals and the use of nonmanuals for morphological modifications, and iii) the interplay with sociolinguistic, pragmatic, and grammatical factors. Of course, the presented model needs to be verified by further empirical studies.

7. *Are lexical nonmanuals subject to diachronic change? Do these markers play a different role for the younger and older signer generation?*

   In order to take a diachronic perspective, I compared perception data on lexical nonmanuals by signers in two different age groups. This approach is the first empirical investigation of diachronic changes of lexical nonmanuals in DGS. Study I exposed a statistically significant difference between older and younger signers in their ratings of signs which include lexical nonmanuals in citation form but were presented in a manipulated version without these nonmanual markings. The younger age group rated these manipulated stimuli 34% (questionnaire) or rather 26% (interview) worse than the older age group which is significant at all usual significance levels.

   Study II revealed a difference between older signers and younger signers with respect to their reaction times for nonmanually manipulated signs. In comparison to the reaction times for the non-manipulated signs, the nonmanual manipulation has an effect of +89ms (13%, $p = 0.01$) for the younger signers and +85ms (10%, $p = 0.08$) for the older signers. These results of the two studies suggest that lexical nonmanuals are more crucial for younger signers. The lower relevance of lexical nonmanuals for older signers seems to be related to the education system and an adaption to hearing people.

8. *How clear is the boundary between nonmanual phonemes and morphemes?* In sign languages, the distinction between meaningless and meaningful units is not as clear cut as in spoken languages. This applies to manual as well as to nonmanual units. The overlap is due to the fact that iconicity has a much higher importance in the lexicons of languages in the visual modality compared to the lexicons of languages in the auditory modality. For the analysis of nonmanuals with respect to phonology, it is essential to sharply distinguish between iconicity and morphological functions. Nonmanual formational units of signs which have an iconic nature are in the basic form of signs not meaning bearing like true morphemes which add additional meaning to a sign. It is crucial to use the term *morpheme* only for such cases in which a unit clearly functions morphologically and adds a meaning which is not expressed otherwise. As Study III revealed, it is by no means the case that most facial actions carry specific independent meanings. It appears that only a small subset of nonmanual actions has one specific meaning. One clear example is head shake. Similar to spoken languages, some formational units in sign languages may function as phoneme or as morpheme in different contexts. However, the discussed forms of morphological increase and decrease in close interaction with lexical nonmanuals in the basic form of signs clearly illustrate how fluent the boundary between phonemes and morphemes is shaped in sign languages. It is possible to express gradual differences of meaning by modifications of lexical nonmanual markings. Hence, they are not merely inherent lexical parts of signs but can morphologically function as modifying elements.

Finally, to answer the question *What are lexical nonmanuals?* it has to be stated that these markings form a highly complex phenomenon which is an integral part of languages in the visual modality. As the exact status of these markings is controversially discussed in research, mostly the general term *lexical* is used in order to name them. But, what does lexical in this context exactly mean? I use the term *lexical nonmanuals* as a label for lower face actions, upper face actions, head actions, and torso actions which operate on the lexical level as inherent parts of signs. More precisely, I define these actions as phonological components which can be further split up into sub-components and features. Such nonmanuals increase the phonological complexity of signs. In order to give complete phonological descriptions of signs, in addition to the manual components, the nonmanual components have to be taken into account. One option is to compare phonological nonmanuals in sign languages with tone pitches or tones in tonal languages (cf. Köhler & Herrmann 2009; Diamantidis et al. 2010; Pendzich 2012; Herrmann 2013, 49f.; Pfau 2016; see Section 3.1). However, lexical nonmanuals seem to include some properties which differ from tones: i) It is possible to articulate certain signs only with nonmanual components. In contrast, “in tone languages [...] every tone must always be associated with some tone-bearing unit” (Pfau 2008, 64). ii) Study III shows that isolated lexical facial expressions without manual parts of signs can activate the corresponding lexical signs. iii) Lexical nonmanuals are, by majority, iconic. iv) DGS seems to have several different nonmanual distinctive units. Tonal languages may have between two and four/five tone levels (cf. Pfau 2016, 23). v) Pfau (2008, 65) underlines a further essential contrast between nonmanuals and tones: It is not possible to simultaneously articulate different tones. However, different nonmanual markings in sign languages frequently occur simultaneously (see also Pfau 2016).

In summary, the following main properties seem to be crucial for the nature of lexical nonmanuals: a muscle contraction based articulation pattern (MuCon-AP) and a component based articulation pattern (Com-AP), constant and dynamic nonmanuals, mirroring and non-mirroring nonmanuals, differences in the productivity, a dominant half of the upper body, five semantic categories, an interaction with mouthings, a distinctive function, an accentuation of different meanings of manually similar signs, a diachronic change, a fluid boundary between phonological nonmanuals and the use of nonmanuals for morphological modifications, and the interplay with sociolinguistic, pragmatic as well as grammatical factors.

8.2 Outlook for further research

Based on the presented empirical and theoretical results on lexical nonmanuals, in a next step, these markings should be analyzed in various sentences, different contexts, and natural language situations. Such analyses may reveal further insights about i) the interaction of lexical nonmanuals with syntax and prosody and ii) the interplay with nonmanually expressed emotions and gestures. Regarding the first point, it is very interesting to investigate the interaction of lexical nonmanuals with different nonmanually marked sentence types. One example is the yes/no-interrogative *Are you able to wink*? in DGS. Deaf signers use diverse strategies within the interaction of the different nonmanual markings: i) interruption of AU 1+2 as interrogative markers by the AU U46 of WINK (see the left picture in Figure 8.1), ii) unilateral interruption of AU 1+2 as interrogative markers by the AU U46 of WINK (see the middle picture in Figure 8.1), iii) decrease of intensity of AU 1+2 as interrogative markers by the AU U46 of WINK (see the right picture in Figure 8.1). In addition, this is a great example for the drop of the manual components of a sign which is instead articulated solely with the nonmanual component. The signer in the left picture of Figure 8.1 articulates two signs simultaneously by combining the manual components of the sign ABLE-TO and the nonmanual component of WINK. This is a very interesting topic for subsequent research.

Fig. 8.1: Interaction of lexical and grammatical nonmanuals within the yes/no-interrogative 'Are you able to wink?' in DGS: interruption of AU 1+2 (left), unilateral interruption of AU 1+2 (middle), and decrease of intensity of AU 1+2 (right)

Moreover, my investigations directly lead to further studies on specific aspects of lexical nonmanuals. As part of Study I: *Lexical Judgment and the Meaning of Signs*, I started to empirically investigate minimal pairs based on nonmanuals. In order to get further insights into this issue, it would be worthwhile to carry out a follow-up study based on the list with all the meanings attributed by the deaf participants to the stimulus signs with lexical nonmanuals and the manipulated stimulus signs without lexical nonmanuals (see Table 4.12 in Section 4.4.3). In a controlled interview, other deaf signers could be asked whether they connect the same meanings with these signs. By this means, it would be possible to analyze nonmanual minimal pairs, homonyms, ambiguous signs, the relevance of mouthings, and the impact of dialectal variation more quantitatively.

As discussed in connection with the proposed semantic categorization of lexical nonmanuals, it is often quite challenging to distinguish between iconic and non-iconic nonmanuals. In this respect, a study would be useful in which signs with lexical nonmanuals are presented to deaf signers with the task to explain whether or not the respective lexical nonmanual marking includes a pictorial relation to the meaning of the sign. Here, it is especially interesting to relate iconicity to the different nonmanual components.

With respect to the following nine aspects of lexical nonmanuals, it would be worthwhile to carry out corpus studies based on the Hamburg DGS Corpus:[1]

1 See http://www.sign-lang.uni-hamburg.de/dgs-korpus/index.php/projekt.html for further information on the current DGS Corpus project of the University of Hamburg and the *Akademie der Wissenschaften in Hamburg*.

i) dialectal variation of lexical nonmanuals, ii) comparison of the productivity of the four nonmanual components, iii) investigation whether signs which are solely composed of nonmanual components exist in DGS, iv) analysis whether certain signs with lexical nonmanual marking can be used without manual components (cf. Liddell 1980, 17), v) relationship between nonmanually expressed adjectival or adverbial modifications and counterparts in signs with a lexical nonmanual marking, vi) frequency of mirroring nonmanuals with respect to the four nonmanual components, vii) frequency of nonmanual minimal pairs, viii) lexical nonmanual markings under the scope of negation (cf. Liddell 1980, 17), and ix) comparison of the variability in the articulation of nonmanual and manual components of signs.

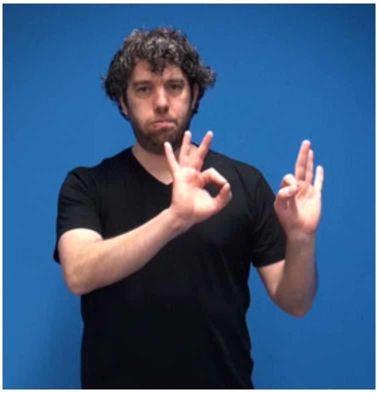
In order to gain deeper insights into the gesture-sign interface, the design of Study III: *Meaning Attribution to Isolated Facial Expressions* could be adopted for manual actions. Stimuli may be gestures of hearing people and lexical signs of deaf people.

With this book, I aim to contribute to an adequate capture of the nature of lexical nonmanuals in DGS. At the same time, the empirical and theoretical investigations point out further interesting questions about lexical nonmanuals which go beyond the scope of my book and will hopefully be addressed in future research on sign languages.

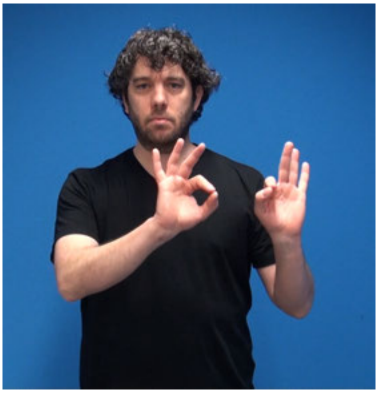
Appendices

A Stimuli in the NMF and m-NMF condition of Study I and Study II

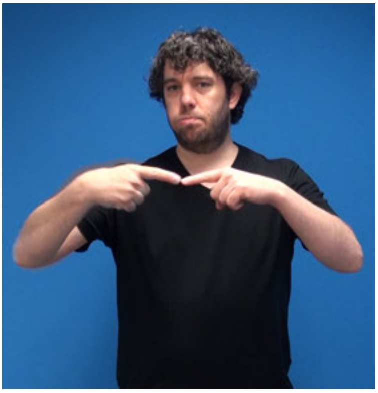
A.1 Signs with a lexical facial expression



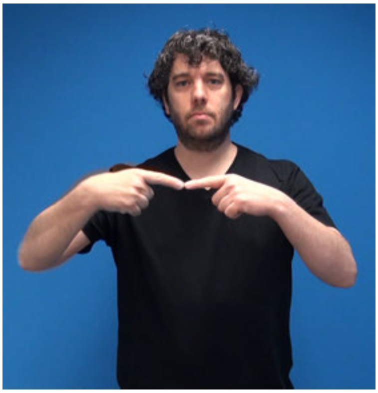
NFM sign ALWAYS



m-NFM sign ALWAYS

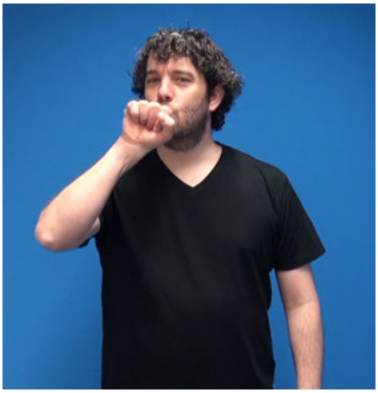


NFM sign BROKEN

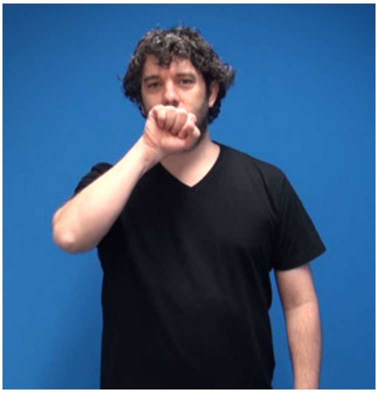


m-NFM sign BROKEN

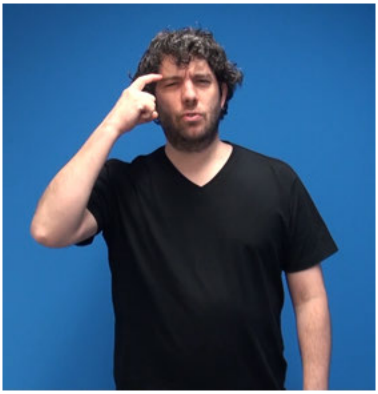
https://doi.org/10.1515/9783110671667-009



NFM sign FAVORITE

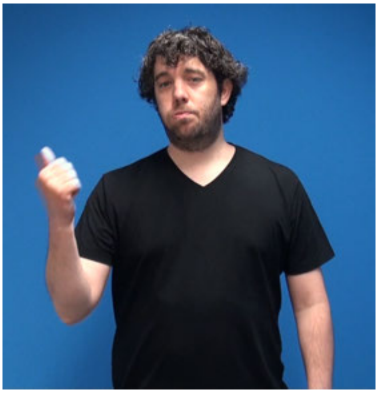


m-NFM sign FAVORITE

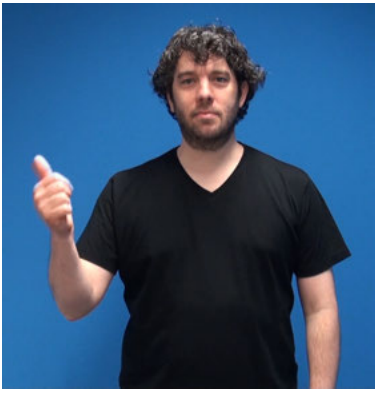


NFM sign STRESS

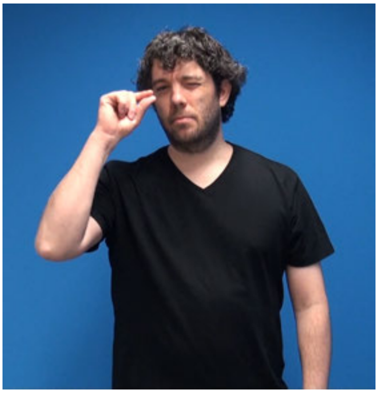
m-NFM sign STRESS



NFM sign SUPER



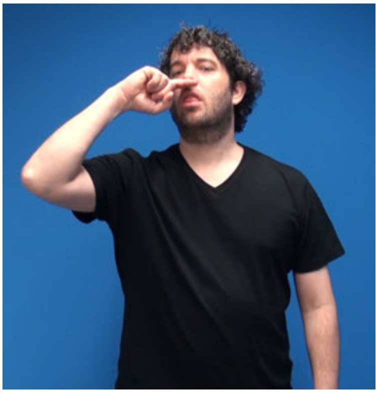
m-NFM sign SUPER



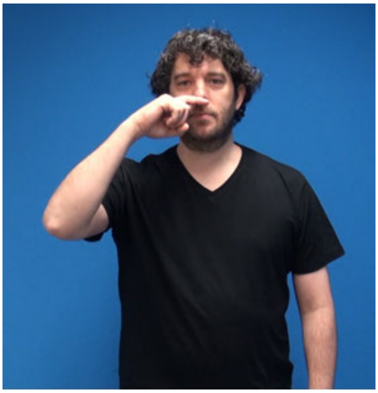
NFM sign WINK

m-NFM sign WINK

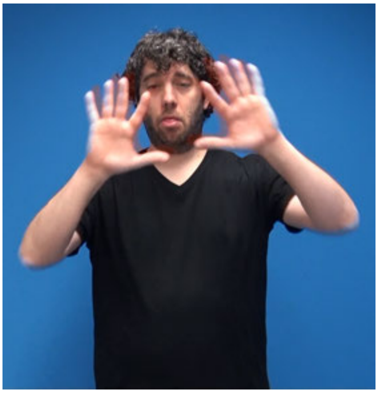
A.2 Signs with a lexical facial expression and torso/head action



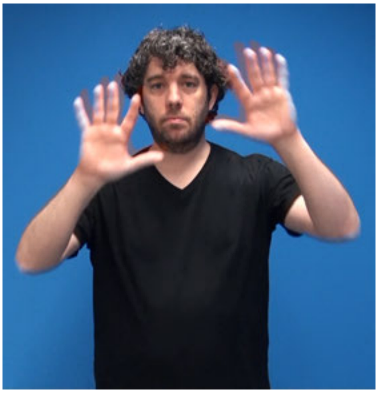
NFM sign ARROGANT



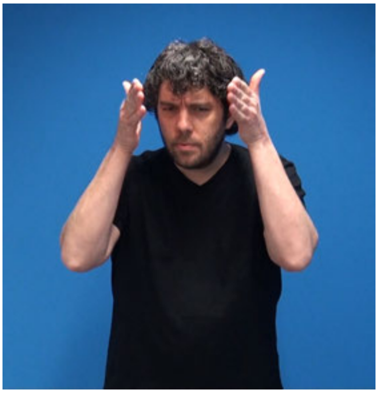
m-NFM sign ARROGANT



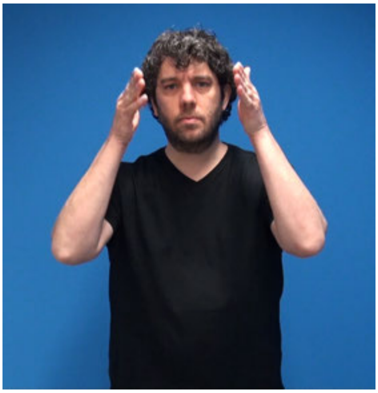
NFM sign BLURRY



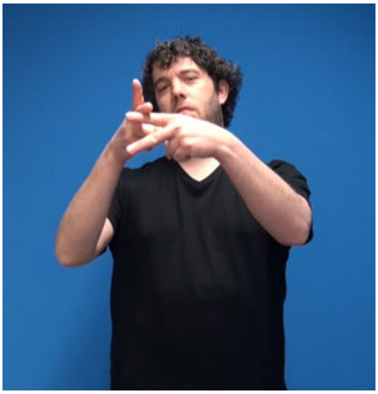
m-NFM sign BLURRY



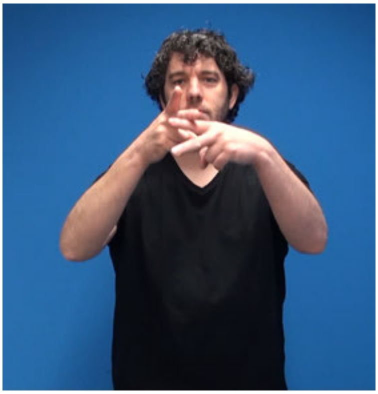
NFM sign CONCENTRATE



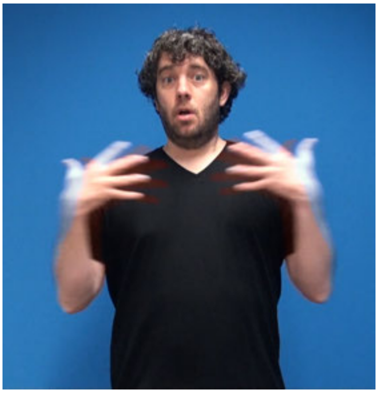
m-NFM sign CONCENTRATE



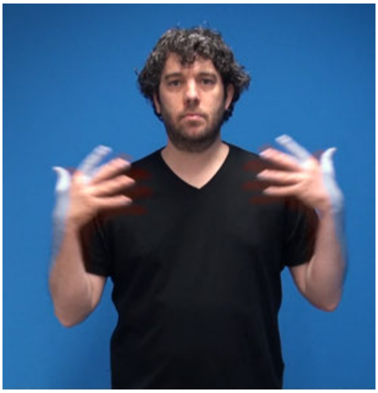
NFM sign LAZE



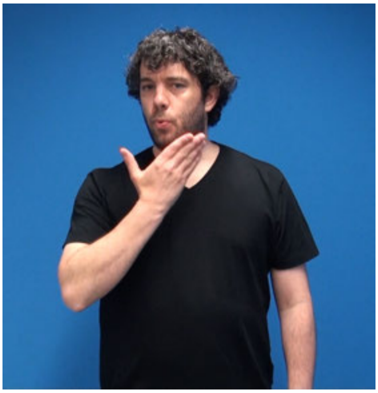
m-NFM sign LAZE



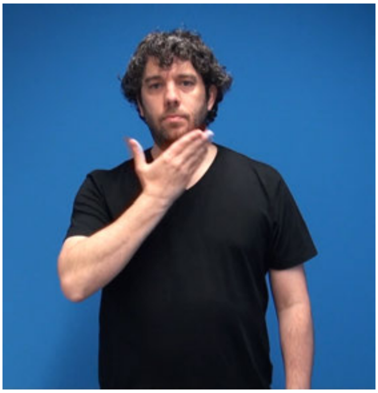
NFM sign SHOCK



m-NFM sign SHOCK



NFM sign WITHOUT

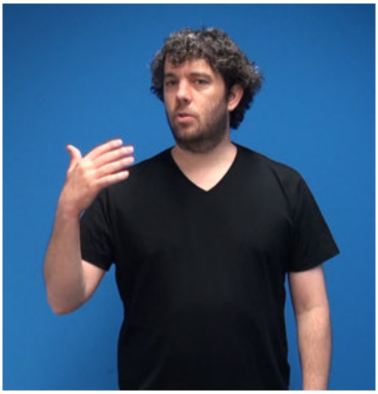


m-NFM sign WITHOUT

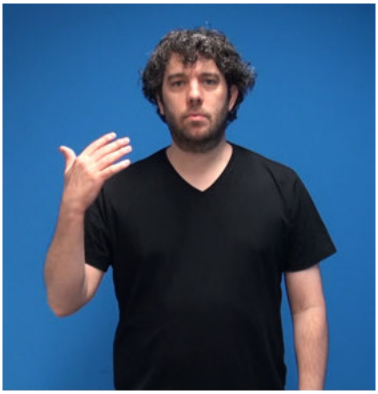
A.3 Signs with a lexical torso/head action

NFM sign NOD

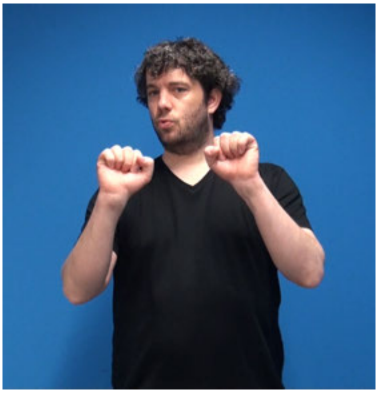
m-NFM sign NOD



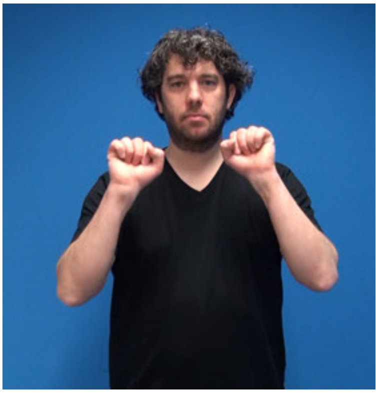
NFM sign NOT-YET



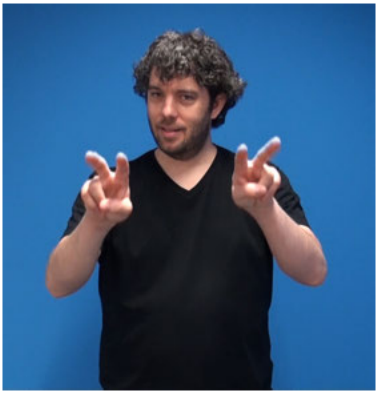
m-NFM sign NOT-YET



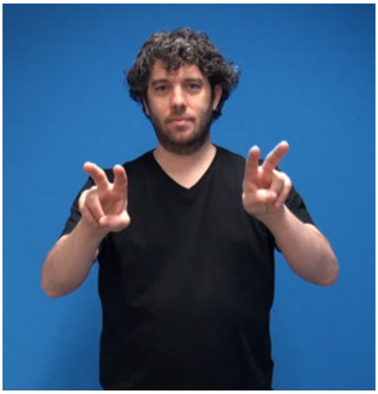
NFM sign PROTECTION



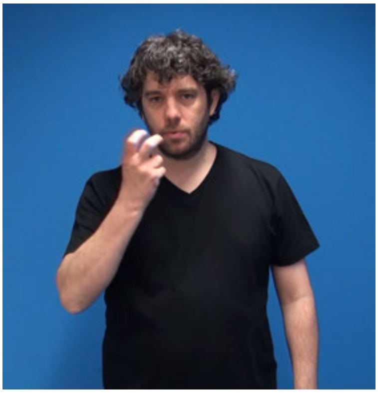
m-NFM sign PROTECTION



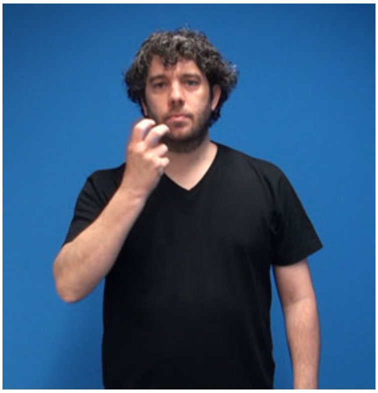
NFM sign REVERE



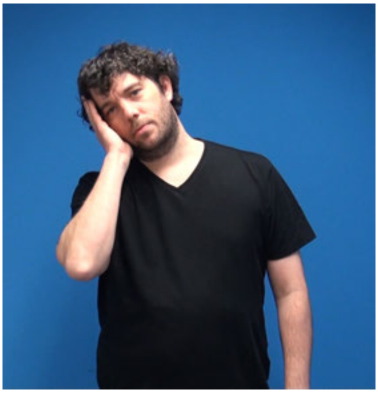
m-NFM sign REVERE



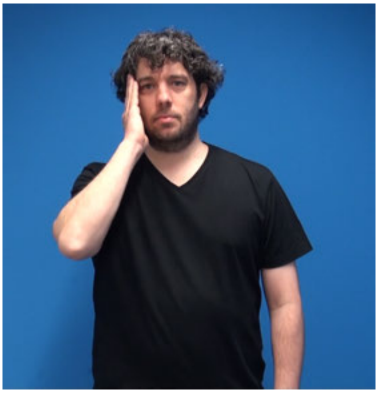
NFM sign SEARCH



m-NFM sign SEARCH



NFM sign SLEEP



m-NFM sign SLEEP

B Manual error types of the fillers in Study I and Study II

B.1 Filler group: Manually manipulated signs without lexical nonmanuals

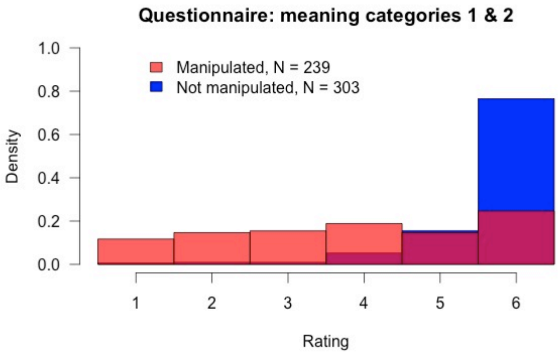
Manually manipulated signs without lexical nonmanuals	Manual component affected by an error
CALCULATE	Movement (secondary)
COMPARE	Handshape
DOCTOR	Hand orientation
GET-TO-KNOW	Handshape
HOUSE	Movement (primary)
NAME	Place of articulation
REASON	Handshape
SPORT	Place of articulation
YOUNG	Hand orientation

B.2 Filler group: Manually manipulated signs with lexical nonmanuals

Manually manipulated signs with lexical nonmanuals	Manual component affected by an error
CLUMSY	Handshape
ENVIOUS	Handshape
EXPULSION	Handshape
HURRIED	Hand orientation
IGNORE	Movement (primary)
NO-IDEA	Hand orientation
SHY	Place of articulation
SQUANDER	Movement (primary)
WHY	Place of articulation

https://doi.org/10.1515/9783110671667-010

C Statistical distribution of the ratings regarding meaning category 1 and 2 in the questionnaire of Study I



https://doi.org/10.1515/9783110671667-011

D Answer words in Study II

D.1 Practice

Signs	Answer words
REPLETE	
m-NMF	*satt* vs. *trocken* (‘replete’ vs. ‘dry’)
SOLIDARITY	
NMF	*satt* vs. *trocken* (‘solidarity’ vs. ‘person’)
OBEY	
NMF	*gehorchen* vs. *backen* (‘obey’ vs. ‘bake’)
BYCICLE	
neutral	*Fahrrad* vs. *Hotel* (‘bycicle’ vs. ‘hotel’)

D.2 Stimuli

i) Signs with a lexical facial expression	Answer words
ALWAYS	
NMF	*immer* vs. *blau* (‘always’ vs. ‘blue’)
m-NMFs	*immer* vs. *blau* (‘always’ vs. ‘blue’)
BROKEN	
NMF	*kaputt* vs. *langsam* (‘broken’ vs. ‘slow’)
m-NMFs	*kaputt* vs. *langsam* (‘broken’ vs. ‘slow’)
FAVORITE	
NMF	*Liebling* vs. *Bus* (‘favorite’ vs. ‘bus’)
m-NMFs	*Liebling* vs. *Bus* (‘favorite’ vs. ‘bus’
STRESS	
NMF	*Stress* vs. *Wunsch* (‘stress’ vs. ‘wish’)
m-NMFs	*Stress* vs. *Wunsch* (‘stress’ vs. ‘wish’)
SUPER	
NMF	*super* vs. *leer* (‘super’ vs. ‘empty’)
m-NMFs	*super* vs. *leer* (‘super’ vs. ‘empty’)
WINK	
NMF	*zwinkern* vs. *lesen* (‘wink’ vs. ‘read’)
m-NMFs	*zwinkern* vs. *lesen* (‘wink’ vs. ‘read’)

https://doi.org/10.1515/9783110671667-012

ii) Signs with a lexical facial expression and torso/head action	Answer words
ARROGANT	
NMF	*arrogant* vs. *hell* ('arrogant' vs. 'bright')
m-NMFs	*arrogant* vs. *hell* ('arrogant' vs. 'bright')
BLURRY	
NMF	*verschwommen* vs. *lieb* ('blurry' vs. 'kind')
m-NMFs	*verschwommen* vs. *lieb* ('blurry' vs. 'kind')
CONCENTRATE	
NMF	*konzentrieren* vs. *sagen* ('concentrate' vs. 'say')
m-NMFs	*konzentrieren* vs. *sagen* ('concentrate' vs. 'say')
LAZE	
NMF	*faulenzen* vs. *denken* ('laze' vs. 'think')
m-NMFs	*faulenzen* vs. *denken* ('laze' vs. 'think')
SCHOCK	
NMF	*Schock* vs. *Blume* ('shock' vs. 'flower')
m-NMFs	*Schock* vs. *Blume* ('shock' vs. 'flower')
WITHOUT	
NMF	*ohne* vs. *gegenüber* ('without' vs. 'across')
m-NMFs	*ohne* vs. *gegenüber* ('without' vs. 'across')

iii) Signs with a lexical torso/head action	Answer words
NOD	
NMF	*nicken* vs. *schreiben* ('nod' vs. 'write')
m-NMFs	*nicken* vs. *schreiben* ('nod' vs. 'write')
NOT-YET	
NMF	*noch-nicht* vs. *trotzdem* ('not-yet' vs. 'nevertheless')
m-NMFs	*noch-nicht* vs. *trotzdem* ('not-yet' vs. 'nevertheless')
PROTECTION	
NMF	*Schutz* vs. *Fernseher* ('protection' vs. 'television')
m-NMFs	*Schutz* vs. *Fernseher* ('protection' vs. 'television')
REVERE	
NMF	*verehren* vs. *laufen* ('revere' vs. 'walk')
m-NMFs	*verehren* vs. *laufen* ('revere' vs. 'walk')
SEARCH	
NMF	*suchen* vs. *hoffen* ('search' vs. 'hope')
m-NMFs	*suchen* vs. *hoffen* ('search' vs. 'hope')
SLEEP	
NMF	*schlafen* vs. *kochen* ('sleep' vs. 'cook')
m-NMFs	*schlafen* vs. *kochen* ('sleep' vs. 'cook')

D.3 Fillers

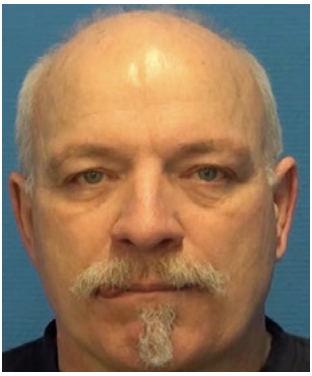
i) Correct signs without lexical nonmanuals	Answer words
ASK	*fragen* vs. *verschwenden* (‘ask’ vs. ‘waste’)
BOOK	*Buch* vs. *Sport* (‘book’ vs. ‘sport’)
CAR	*Auto* vs. *Haus* (‘car’ vs. ‘house’)
CHEAP	*billig* vs. *schüchtern* (‘cheap’ vs. ‘shy’)
EAT	*essen* vs. *ignorieren* (‘eat’ vs. ‘ignore’)
DRIVE	*fahren* vs. *rechnen* (‘drive’ vs. ‘calculate’)
INTERNET	*Internet* vs. *Arzt* (‘internet’ vs. ‘doctor’)
NEW	*neu* vs. *eilig* (‘new’ vs. ‘urgent’)
PARIS	*Paris* vs. *Auto* (‘Paris’ vs. ‘car’)

ii) Manually manipulated signs without lexical non-manuals	Answer words
CALCULATE	*rechnen* vs. *vergleichen* (‘calculate’ vs. ‘compare’)
COMPARE	*vergleichen* vs. *essen* (‘compare’ vs. ‘eat’)
DOCTOR	*Arzt* vs. *Name* (‘doctor’ vs. ‘name’)
GET-TO-KNOW	*kennenlernen* vs. *fahren* (‘get-to-know’ vs. ‘drive’)
HOUSE	*Haus* vs. *Grund* (‘house’ vs. ‘reason’)
NAME	*Name* vs. *Paris* (‘name’ vs. ‘Paris’)
REASON	*Grund* vs. *Internet* (‘reason’ vs. ‘internet’)
SPORT	*Sport* vs. *Vertreibung* (‘sport’ vs. ‘expulsion’)
YOUNG	*jung* vs. *tollpatschig* (‘young’ vs. ‘clumsy’)

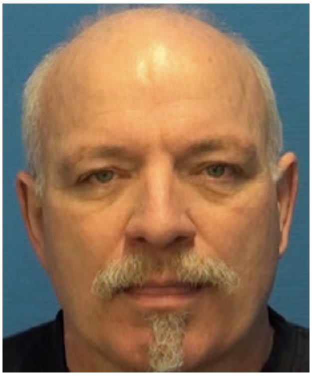
iii) Manually manipulated signs with lexical nonmanuals	Answer words
CLUMSY	*tollpatschig* vs. *keine-Ahnung* ('clumsy' vs. 'no-idea')
ENVIOUS	*neidisch* vs. *billig* ('envious' vs. 'cheap')
EXPULSION	*Vertreibung* vs. *Buch* ('expulsion' vs. 'book')
IGNORE	*ignorieren* vs. *fragen* ('ignore' vs. 'ask')
NO-IDEA	*keine-Ahnung* vs. *warum* ('no-idea' vs. 'why')
SHY	*schüchtern* vs. *neidisch* ('shy' vs. 'envious')
URGENT	*eilig* vs. *jung* ('urgent' vs. 'young')
WASTE	*verschwenden* vs. *kennenlernen* ('waste' vs. 'get-to-know')
WHY	*warum* vs. *neu* ('why' vs. 'new')

iv) Signs merged from two signs by taking the manual components of one sign and the nonmanuals of another	Answer words
EVIL	*böse* vs. *glücklich* ('evil' vs. 'happy')
DISGUSTING	*ekelhaft* vs. *lachen* ('disgusting' vs. 'laugh')
GLADLY	*gern* vs. *traurig* ('gladly' vs. 'sad')
HAPPY	*glücklich* vs. *ekelhaft* ('happy' vs. 'disgusting')
ILL	*krank* vs. *gern* ('ill' vs. 'gladly')
JOYFUL	*fröhlich* vs. *Widerstand* ('joyful' vs. 'resistance')
LAUGH	*lachen* vs. *böse* ('laugh' vs. 'evil')
RESISTANCE	*Widerstand* vs. *krank* ('resistance' vs. 'ill')
SAD	*traurig* vs. *fröhlich* ('sad' vs. 'joyful')

E Still images from the stimulus videos of Study III



Stimulus a)



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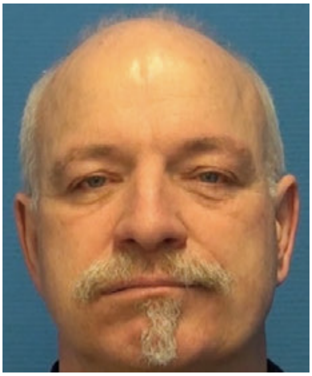
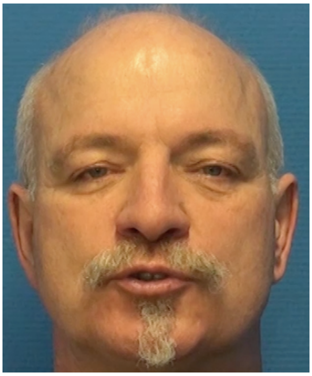


Stimulus c)

Stimulus d)

https://doi.org/10.1515/9783110671667-013



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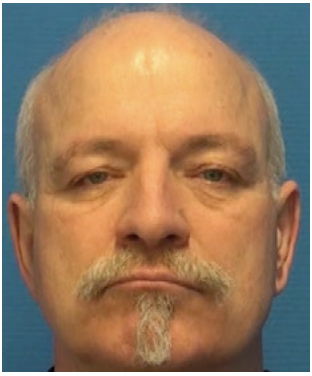

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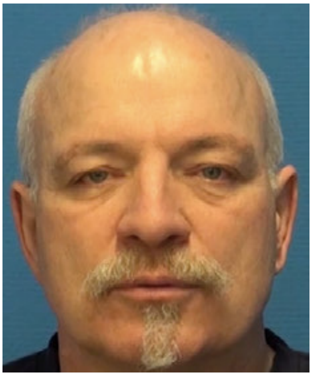

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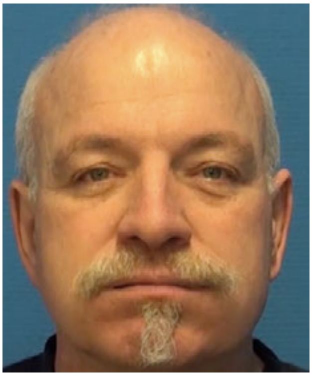

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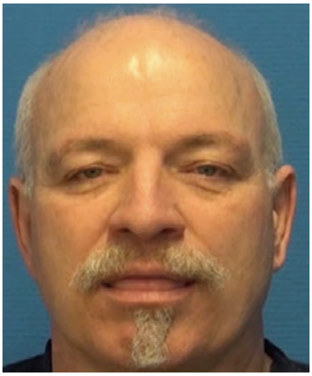
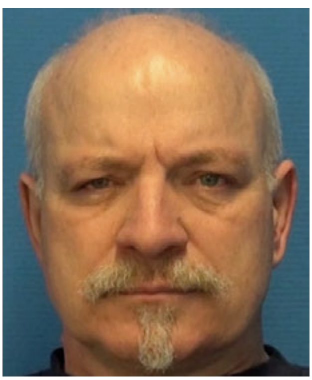
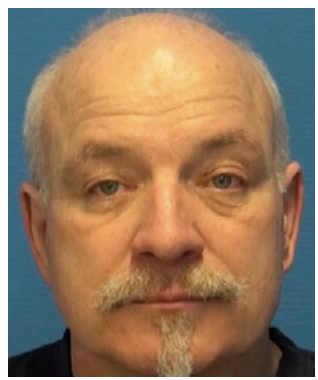


Stimulus i)

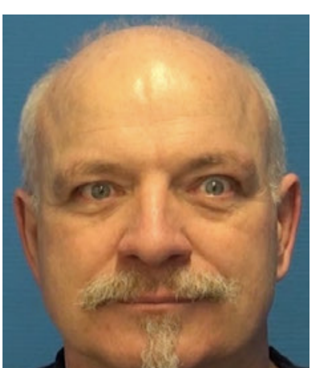
Stimulus j)



Stimulus k)



Stimulus l)



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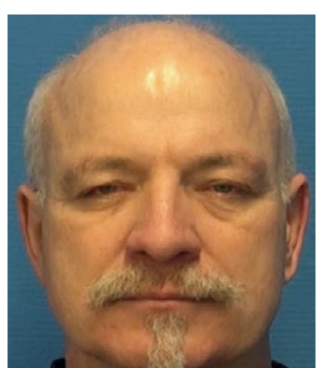

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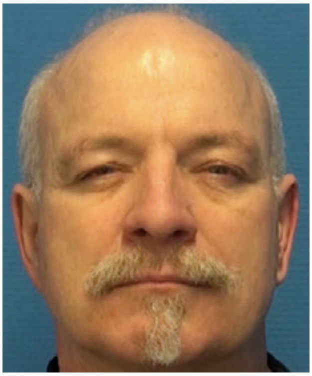
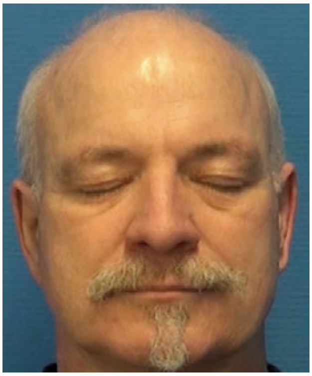
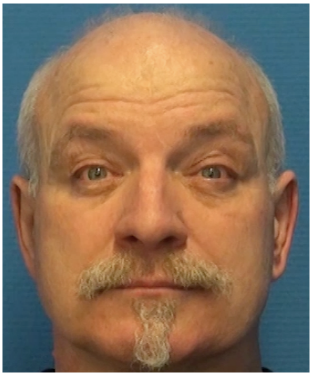


Stimulus o)

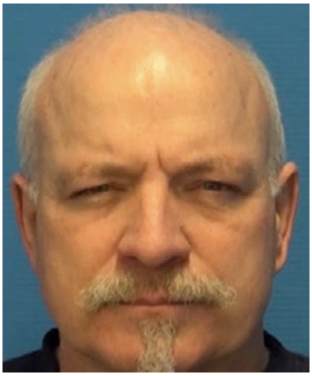


Stimulus p)

Stimulus q)

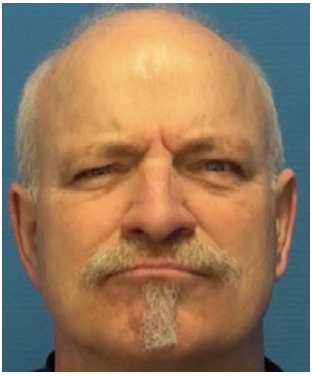


Stimulus r)



Stimulus s)

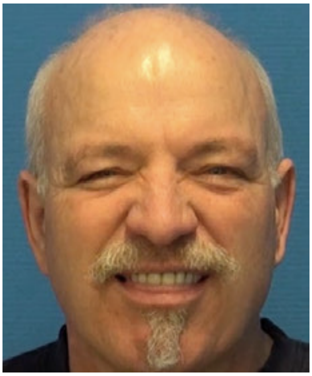
Stimulus t)



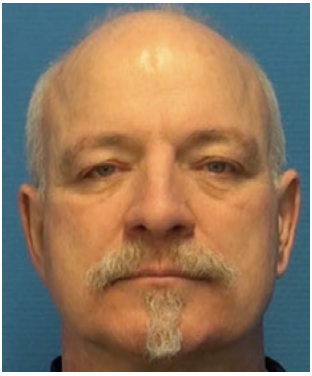
Stimulus u)

Stimulus v)

Stimulus w)



Stimulus x)



Neutral

F Meaning Attribution (MeaAtt) categories in Study III

MeaAtt categories
A
affection
amusement
anger
arrogance
awareness
B
be quiet
boredom
C
calming
cleverness
closeness
concentration
consent
contempt
continuation
contradiction
courage
D
decision
description
despair
direction
disappointment
disgust
disinterest
dislike
E
ease
effort
emotionless
emphasis
envy
expectation
F
fake
fear

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MeaAtt categories
H
happiness
I
ignorance
indecision
innocence
interest
interjection
interrogative (wh or y/n)
irrelevance
irony
K
kiss
L
lack of knowledge
low accessibility
M
mockery
moderate
morpheme
N
neutral
no response
P
pain
patience
provoking
Q
questioning
R
reflection
relaxation
relief
S
satisfaction
scepticism
severity
shock
sign
stupidity
surprise
T
tiredness
tasty
W
warning

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