Lexically bound mouth actions in Sign Language of the Netherlands

A comparison between different registers and age groups

Inge van de Sande and Onno Crasborn
Radboud University Nijmegen

1. Introduction

There is intensive language contact between signed languages and the surrounding spoken languages in all deaf communities we know of. This holds especially for the Western world, where for many generations the education of deaf children has focused exclusively on the use of spoken language. Hearing teachers invested endless time and effort in spoken language acquisition through lip reading and the articulation of speech sounds with dedicated speech therapy methods. Only since the 1980s has sign language slowly made its way into official education, notwithstanding previous individual efforts of teachers to adapt to the sign language that the children often used among themselves. From the 1990s onwards, the Dutch schools for the deaf have adopted a true bilingual education policy, whereby sign language and spoken language are used in parallel in the classroom by deaf and hearing teachers, respectively. The question arises which impact this environment has had on the communication of deaf people. Studies on various Western signed languages have taken two different perspectives on this question, either considering the use of mouth actions derived from the spoken language as a result of code mixing by the signer, or seeing these mouth actions as borrowed items that have made their way into the lexicon and grammar of signed languages. The present study contributes to this debate by investigating the influence of age of sign language acquisition and the register used on the frequency and behaviour of mouth actions in Sign Language of the Netherlands (NGT, Nederlandse Gebarentaal). It is the largest empirical study of mouth actions to date, being based on twelve signers in the *Corpus NGT*, an online open access corpus of sign language dialogues that was published at the end of 2008 (Crasborn et al. 2008; Crasborn & Zwitserlood, in prep.).

2. Mouth actions

As the mouth is able to function as an independent articulator parallel to the hands, different types of linguistic information can be simultaneously expressed in sign languages. For example, a mouth action consisting of stretched-down and somewhat protruded lips accompanying the manual sign GEBAREN ('signing') adds the meaning that the subject referred to was chatting *at ease*. Crasborn et al. (2008) proposed a typology containing five separate types of mouth actions after analysing fable stories of six signers in three different sign languages (explicated in Table 1):

Table 1. Types of mouth actions in sign languages

Mouth action type	Explanation
E-type	Semantically **e**mpty mouth actions, i.e. mouth actions which accompany manual signs but do not carry an additional or independent meaning.
A-type	**A**dverbial mouth actions: mouth actions specifying adjectival and adverbial information in addition to information specified by the manual part of the sign.
W-type	**W**hole face–mouth actions: actions in which the mouth appears to be part of a global facial expression, often with an affective meaning.
4-type	Mouth-**for**-mouth: the mouth performs a non-linguistic action, such as chewing, biting or screaming.
M-type	Mouthings (as detailed in the next paragraph)

Mouthings are movements of the lips or mouth, derived from lexical items of the surrounding spoken language (Boyes Braem & Sutton-Spence 2001; Crasborn et al. 2008; Schermer 1990). They are borrowed from the spoken language and are in some way lexically associated with the manual component of the sign. They could be considered a phonological component of signs, on a par with handshape or location, for example. An example of a mouthing is the articulated word 'wolf' while signing the manual sign WOLF in NGT.

2.1 The linguistic status of mouthings

There is no consensus on the lexical status of these 'oral words in sign languages'. According to some authors, mouthings are merely coincidental to sign languages (e.g. Hohenberger & Happ 2001). They argue that mouthings are examples of on-line code mixing rather than part of the lexicon itself and thus do not form an integrated part of any sign language. Sign languages indeed have always been in

contact with spoken languages, up to the point of being overtly oppressed in education (Fisher 1978; Lucas & Valli 1989; Schermer 1990; Woodward 1973). The extent of using mouthings is claimed to depend on sociolinguistic factors, especially on the amount of oral education (Hohenberger & Happ 2001; Sutton-Spence & Day 2001). In countries with a dominant oral educational system, like Germany, mouthings would be more frequent than in countries where other educational methods for deaf pupils are accepted (Hohenberger & Happ 2001; Keller 2001).

The way deaf pupils are taught in the Netherlands has changed dramatically since the 1980s (Kolen 2009; Tellings 1995). Earlier, use of signs by deaf pupils was strictly prohibited. Children were allowed to use an oral mode (speaking and lipreading) only. From 1980 onwards, sign languages have gradually become more accepted in the educational systems for the deaf.

Other researchers agree that mouthings stem from spoken languages, but argue that these have been incorporated in sign languages to such an extent that they are integrated into their lexical or even morpho-syntactic structures (e.g. Ajello, Mazzoni & Nicolai 2001; Boyes Braem 2001; Rainò 2001; Sutton-Spence & Day 2001; Vogt-Svendsen 2001; Woll 2001). There are several arguments suggesting spoken words have integrated into sign languages. Mouthings play a phonologically distinctive role in disambiguating between two signs with an identical manual part. A frequently cited example in NGT is the minimal pair BROER ('brother') and ZUS ('sister'). The manual part of these pairs is identical; they are only differentiated by mouthings of the words 'broer' versus 'zus'. However, the sign does not occur *without* a mouthing, with the hypothetical meaning 'sibling'. Further, mouthings are also used to add information to the manual part of the sign. For example, the manual NGT sign PLAATSEN ('places') accompanied by the mouthing 'verschil' ('difference') forms the complex meaning 'different places'. Another argument concerns the observation that in many Deaf cultures mouthings are used in all sign language interactions, regardless of whether hearing people are present (Crasborn 2006).

Another argument for why mouthings in sign languages are not just effects of code mixing concerns their phonological behaviour. The time slots available for mouth actions are usually provided by the signs, underlining the notion that "the hands are the head of the mouth" (Van der Hulst 1996). Thus, the manual and oral movements are synchronised in that they have a similar start and end time. However, processes have been observed in several sign languages in which mouthings spread across more than one manual sign (e.g. Boyes Braem 2001, on Swiss-German Sign Language; Crasborn et al. 2008, on British Sign Language, NGT and Swedish Sign Language; Hohenberger & Happ 2001, on German Sign Language; Sandler 1999, on Israeli Sign Language; Sutton-Spence & Day 2001, on British Sign Language; Vogt-Svendsen 2001, on Norwegian Sign Language). For

example, during the articulation of the mouthing 'leren' ('learn'), two manual signs can be articulated: LEREN ('learn') and GEBAREN ('sign'). A considerable percentage (20%) of all mouthings of the NGT signers studied in Crasborn et al. (2008) spread across at least 50% of another sign. In these cases, then, there is an asynchrony between the start and end of signs and mouth actions. Several authors have argued that these asynchronies are markers of prosodic domains (Crasborn et al. 2008; Sandler 1999).

2.2 The function of spread mouthings

There is an agreement in the literature that spreading of mouthings functions as a conjunction of manual components, probably on the prosodic level (Boyes Braem 2001; Boyes Braem & Sutton-Spence 2001). Nespor & Sandler (1999) have shown that spread mouthings in Israeli Sign Language marked phonological groups such as the prosodic word and phonological phrase.

2.3 Variables affecting the occurrence of mouth actions

The use of mouth actions is not identical for all signers. Boyes Braem (2001) has shown that the age of sign language acquisition influences mouth activity. She investigated the use of the mouth in six Deaf signers of Swiss German Sign Language, three early learners and three late learners. Although the proportion of mouthings appeared to be comparable between the two groups, the form and functions of the mouthings were different. For the late learners, mouthings seemed to have a primarily lexical function, often represented by a code-switch to the oral language. The early learners also used mouthings for this purpose, but in this group mouthings were also used for grammatical, stylistic and prosodic purposes (Boyes Braem 2001). Spreading of mouthings was used far more frequently by the early learners (49% of their total mouthings) than by the late learners (25% of their total mouthings).

The present study builds on that of Boyes Braem by comparing two groups of signers. As was noted above, the language used in the Dutch educational system for the deaf has changed dramatically since 1980. Because of this, most deaf children born some years after 1980 have been exposed to signs from a younger age onwards than children who were born earlier. The latter have almost exclusively been in contact with spoken Dutch during the first years of their lives. We were curious whether this difference still has an impact on the use of sign language by these children, including the use of mouth actions.

In addition to interpersonal variation, there appears to be variation in the use of mouth actions within a single signer, for example in different registers. A

'Register' can be defined as a way of speaking, linked to a situational type or genre (Coupland 2007). A study on the use of mouth actions in British Sign Language by Sutton-Spence & Day (2001) showed considerable differences between registers. The signers used a mean of 77% mouthings in an information-giving register and only a mean of 50% in a narrative register. The study of Crasborn et al. (2008) investigated the use of mouth actions in a narrative register, finding 26% signs accompanied by mouthings for NGT, 51% for Swedish Sign Language, and 36% for British Sign Language. It is possible that the proportions of the several subtypes of mouth actions are different if another register is studied.

In addition to studying differences in the use of mouth actions between age groups, the second question this study aims to answer is whether register differences in the use of mouthings can be found in NGT as well.

3.   Research questions and hypotheses

In an attempt to deepen our understanding of the role of mouth actions in signed languages, we tried to answer the following three questions.

i.   *Do deaf signers of different ages use other proportions of the five subtypes of mouth actions in different registers?*
As stated before, several researchers have observed that the use of mouthings crucially depends on the amount of oral education (Hohenberger & Happ 2001; Keller 2001; Sutton-Spence & Day 2001): signers who have been predominantly in contact with an oral language appear to use more mouthings than signers who have been surrounded by sign language. As the late learners had been exposed to spoken Dutch in their youth to a larger extent than the early learners, we expected the former to use more mouthings than the latter.

The present study compared mouth actions in a narrative register (retold fables) with an interactive register (discussions). As Ebbinghaus & Heßmann (2001) note, mouthings occur most often when a signer refers to objects, events or abstract concepts. The use of spoken words is inhibited when actions, expressive behaviour and relationships between objects are expressed. In fables these expressive and interactive elements are highlighted. Given that the actions of animals and people in fables are expressed by W, A, and 4 mouth actions in particular, we expected larger proportions of these types in fables (narrative register) than in discussions (interactive register). In discussions, on the other hand, objects and concepts are more prominent. Hence, signers were expected to use more mouthings and fewer other types.

ii. *Are there differences in the occurrence of spreading of mouthings in signers of different ages and in different registers?*

As the function of spread mouth actions is at present unclear, it was difficult to formulate a hypothesis about the influence of the signers' age difference on the use of spread mouthings. As yet, the only study that has addressed this issue is Boyes Braem (2001) (see Section 2.3). The early learners in this study displayed far more spreading (49% of their total mouthings) than the late learners (25%). We anticipated that our study would yield similar results.

As mentioned earlier, Crasborn et al. (2008) observed percentages of c. 20% spread lexically bound mouth actions in NGT storytelling. If the spreading of mouth actions serves to mark of prosodic domains, no large differences of spread lexically bound mouth actions were expected between registers, since we do not know of any prosodic differences between sign language registers.

iii. *In which direction do lexically bound mouth actions spread, and across which domains?*

Crasborn et al. (2008) found spreading to occur from content words to function words (i.e. from nouns, verbs, adverbs and adjectives to pointing signs indices, possessive pronouns, classifiers, palm-up gestures and prepositions). This is in line with the results in Boyes Braem (2001), Rainò (2001) and Sandler (1999). In addition, in NGT the direction of spreading is mostly progressive: only one of 67 cases that were observed involved regressive spreading. Since no other studies on spreading in NGT have been carried out to date, we expected the present study to yield similar results.

4. Methodology

4.1 Materials and subjects

The data for this study originate from the Corpus NGT (http://www.ru.nl/corpusngt). Deaf people who have used sign language from childhood onwards were invited in pairs to participate in several communicative situations. These situations were filmed, resulting in 2375 movie segments (PAL MPEG-1, with a resolution of 352x288 pixels and a frequency of 25Hz). Two movies were available for each signer, one containing the whole upper body and one containing the face only. Some of the clips were already annotated with Dutch glosses. Materials originating from two different registers were used:

– a narrative condition, consisting of a fable story: one of the participants viewed a video of a native signer retelling one of Aesop's fables. Afterwards, the participant retold the story in his / her own words to the other signer present (to

create a more natural communicative situation). The latter was instructed not to interrupt the story in order to prevent the situation from turning into a conversation.

– a more interactive condition in which both Deaf signers discussed subjects that are relevant to Deaf culture (such as the use of cochlear implants in deaf children). The subjects were unprepared, resulting in an informal, free style of conversation.

Twelve adult signers were selected from the corpus of 92 signers: six early NGT learners and six late learners. All signers were born profoundly deaf, considered NGT to be their main language, characterised themselves as members of the Deaf community, and had given permission to use their data. The early learners were aged 40 or less. NGT was their first language; they had learned NGT from birth onwards from their parents (among others). Therefore, the participants had all received NGT input from their first year of life onwards. The late learners however, had learned NGT postlingually[1] (mean age: 4 ½). They had not learned NGT from their parents, but in contact with other deaf pupils at school (typically against the school rules). At the time of the recording the signers in this group had a minimum age of 50.

Tables 2 and 3 list the demographic data of the early signers. The signer codes correspond with the numbers in the corpus on the Internet. As stated earlier, many factors influence the use of the mouth. We have tried to control the most important ones (age, register, amount of hearing experience, age of acquisition of NGT and persons they learned NGT from).

Table 2. Demographic data of the early acquirers

Code	Age	Gender	Age of onset of deafness	Started to learn NGT aged	Educational background
S022	18	m	0	0	bilingual
S021	24	f	0	0	oral + TC[2] + bilingual
S026	28	m	0	0	TC
S008	29	f	0	0	oral
S011	37	m	0	0	bilingual
S012	39	m	0	0	oral
Mean	**29;2**		**0**	**0**	

Table 3. Demographic data of the late acquirers

Code	Age	Gender	Age of onset of deafness	Started to learn NGT aged	Educational background
S048	50	f	0	5	oral
S047	59	f	0	4	oral
S016	66	m	0	5	oral
S017	68	m	0	3	oral
S002	81	f	0	2;6	oral
S018	82	f	0;6	5	TC
Mean	**67;7**		**0**	**4;4**	

4.2 Transcription and analysis

All utterances were transcribed for activity of the left and the right hand (cf. the *Corpus NGT* baseline annotation). In addition, the activity of the mouth was transcribed as a separate layer of information. The mouth actions were categorized in the five previously mentioned subtypes (see Table 1). Two extra categories were used to cover mouth actions that were not visible (e.g. when the hand of the subject was located before the mouth) and for mouth actions that were hard to categorise; these were indicated with a question mark. Table 4 provides an overview of the data used.

Table 4. Overview of the data

Signer Group[a]	Register	Number of R-hand glosses	Number of mouth actions
Young	narrative	956	716
	interactive	1429	1035
Old	narrative	638	538
	interactive	889	789
Total		**3912**	**3078**

[a] n = 6 signers per group

Differences in the numbers of the five subtypes of mouth actions could not all be analysed statistically. As the mouth can perform only one mouth action at a time, the five subtypes of mouth actions are connected; for example, a greater number of mouthings implies a smaller number of the other four kinds of mouth actions. Therefore, differences in the proportion of subtypes of mouth actions, depending on either the type of register being used (formal versus informal) or the user age group, could be statistically analysed for one subtype only. Since influences of

register and age group were expected to be most prominent in the mouthings, we studied the differences in the proportions of this subtype by means of a repeated measures ANOVA using a split-plot design. The same design was used to analyse the differences in percentages of spread mouthings. Holme's procedure was used as an adjustment for the multiple outcomes.

5. Results

5.1 Proportions of mouth actions

The mean proportions of all five subtypes of mouth actions for all signers in both registers are given in Table 5.

Table 5. Mouth actions in the two registers

Mouth action type[a]	Narrative register		Interactive register	
	Percentages	absolute numbers	Percentages	absolute numbers
M-type	47	598	78	1445
W-type	31	390	12	219
A-type	9	109	4	75
?	6	74	3	56
4-type	4	53	1	9
E-type	2	30	1	20
not visible	1	9	1	19
Total	100	1263	100%	1843

[a] The subtypes are explicated in Table 1

The mean percentage of mouthings as a proportion of the total number of mouth actions for each signer in each register turned out to be 49.29% (SD 7.08) in the narrative register and 77.41% (SD 8.70) in the interactive register for the early learners. For the late learners the mean percentage of mouthings was 52.25% (SD 15.78) in the narrative register and 84.22% (SD 5.51) in the interactive register.

The proportions of mouthings were analysed with the GLM Repeated Measures procedure of SPSS. The factor 'Register' appeared to be significant at the 5% level: $F(1,10) = 75.60$ ($p = .000$; $p = .000$ after correction with the Holm procedure), $MSE = 71.64$, η^2-partial $= 0.883$. The factor 'Age group' and the interaction 'Register' * 'Age group' were both not significant at the 5% level ($F < 1$; power: .158, $p = .320$; $F < 1$; power: .08, $p = .590$). Thus, the proportion of mouthings appeared to be different in the two registers, but there was no evidence for differences between the two age groups.

When looking at the data pooled for age group in Table 5, we see that the larger proportion of mouthings in the interactive register is balanced primarily by the use of relatively more 'whole face actions' in the narrative register, and to some extent by the difference in the 'A' and '4' category. As was indicated above, we have not yet found a suitable statistical procedure to test these relative differences in proportions. Nevertheless, the sizeable differences in proportions between M-types and W-types may be taken as an indication for the different role of the mouth in the two registers.

5.2 Spread mouthings

The mean percentage of spread mouthings in the youngest group appeared to be 12.93% (SD 4.27) in the narrative register and 14.36% (SD 4.76) in the interactive register. For the late learners, the mean percentage of mouthings was 12.73% (SD 11.61) in the narrative register and 9.84% (SD 5.36) in the interactive register.

No significant differences between percentages of spread mouthings in different registers and groups could be demonstrated: for all factors, $F < 1$. The observed power was low: 5.8% for the factor 'Register'; 10.2% for the factor 'Age group' and 11.8% for the interaction 'Register' * 'Age group'. The data showed no tendencies towards more spreading in one of the groups or registers.

5.3 Qualitative analysis of spreading

Finally, the cases of spreading were analysed in more detail to answer the question on the direction and domain of spreading. In both registers the vast majority of spreading cases involved a noun (42%), an adverb or adjective (29%) or a verb (23%) as trigger. These are prosodically strong content words from a fixed part of the lexicon.[3] Most targets of spreading in both registers consisted of indexical signs (38%). Most mouth actions (roughly 60%) spread somewhere between half a sign and a complete sign. Only 10% spread across two signs or more. 85% of the mouthings spread progressively, 7.8% regressively and 5.9% in both directions; the other spread mouthings spread across synonyms.

It is clear that substantial further analysis will be necessary to determine the precise prosodic domains that were marked by the asynchrony in mouth actions and manual signs. We leave this for future research.

6.   Discussion

This study has provided a considerable amount of new information on the role of the mouth in NGT. First, significantly larger proportions of mouthings were demonstrated in the interactive register than in the narrative one. The data show that there are higher proportions of W, A and 4 types in fables than in discussions, in line with our expectations. This suggests that the effect of register is highly relevant for the study of mouth actions. Late learners showed a tendency towards a more frequent use of mouthings than early learners, although this difference was not significant. This might be due to the small sample size.

We also observed a considerable number of spread mouth actions in both registers and in both age groups: 12% of all lexically bound mouthings spread across at least 50% of a neighbouring sign. It is unlikely that all of these cases were due to mispronunciations. In comparison, Crasborn et al. (2008) found 20% spread mouth actions, combining mouthings (M) and mouth gestures (E).

No significant differences were found in the amount of spreading, neither with respect to register nor age group. The fact that the percentages of spread mouth actions are similar indicates that spreading is by and large independent of register and the age at which NGT is acquired. The results of the present study suggest that spreading of mouth actions serves to mark a relationship between two or more signs, usually a content word and a function word. More research is needed to establish the precise phonological nature of the prosodic spreading domains.

7.   Conclusion

The most important contribution of this study is the finding that there is no difference in the prominence of Dutch-derived mouth actions between younger early learners and older late learners of NGT. Early acquisition of NGT as a native language does not appear to lead to a reduced role of mouthings in signers' communication.

The frequent occurrence of spreading of mouth actions in our data suggests that the mouth components play an important role in the phonology of NGT. For this reason, it seems justified to claim that many mouth actions in NGT, even those which are derived from spoken Dutch, form part of the NGT lexicon.

Our preliminary analysis of spreading cases showed that lexically bound mouth actions typically spread from content words (verbs, nouns, adjectives) to other lexical items — often indexical signs. We expect that detailed future analysis will shed more light on the precise nature of the prosodic domains involved. These could be phonological words (cf. Sandler's (1999) analysis of Israeli Sign

Language), although we also found cases where a single mouthing covered as many as three signs. Moreover, cases where spreading goes from one content word to another suggest that mouthings in NGT may also be used to mark larger domains, such as the phonological phrase.

This study, then, has created a pathway for further investigation of the domain of spreading in different registers of NGT. Future studies will have to establish whether our results can be maintained in the face of larger numbers of subjects with less variation between them, although such variation will always be present given the wide range of factors influencing the use of the mouth.

Notes

1. Postlingual speakers learned a (sign) language from the age of 3 onwards (Lenden & Flipsen 2007); one of the signers in this group learned to sign from the age of 2½ onwards.

2. TC is short for 'Total Communication'.

3. Prosodically strong signs are signs that tend not to adapt their movement or handshape to another sign.

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Authors' addresses

Inge van de Sande
Jozef Israëlsstraat 11
6521 MS Nijmegen
The Netherlands

i_vdsande@hotmail.com

Onno Crasborn
Radboud University Nijmegen
Department of Linguistics
P.O Box 9103
6500 HD Nijmegen
The Netherlands

o.crasborn@let.ru.nl