Morphological reduplication in Sign Language of the Netherlands

A typological and theoretical perspective

The topic of this dissertation is morphological reduplication in Sign Language of the Netherlands (*Nederlandse Gebarentaal*, NGT). Under reduplication, (part of) a word or sign is repeated, in order to yield a systematic change in meaning. The present study focuses on three of its functions: nominal pluralization, aspect marking, and reciprocal marking. Analysis of naturalistic corpus data is combined with data elicitation.

The findings reveal that, for all three investigated functions, different types of reduplication alternate with zero marking, and that the choice between strategies is influenced by the phonological make-up of the base sign. Moreover, for both aspect and reciprocals, meaning differences are expressed by different reduplication types. Finally, morphosyntactic verb type plays a role in the choice of reciprocal marking strategy. Interestingly, reduplication appears to be optional across functions.

Beyond offering a description of NGT reduplication, this book presents a typological perspective on the phenomenon. A comparison of the present results to findings from previous research on other signed and spoken languages reveals cross-linguistic patterns as well as variation. Moreover, the study shows, once more, that reduplication comes with a modality-specific flavor.

Finally, the dissertation presents a theoretical perspective by offering a formalization of the results in stochastic Optimality Theory (OT). Again, modality of signal transmission turns out to play a role. Given that universality is a hallmark of OT-constraints, we aim to employ modality-independent constraint types. Still, some constraints necessarily refer to modality-specific phonological features. This raises the question to what extent OT-constraints can be truly universal.

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Cindy van Boven

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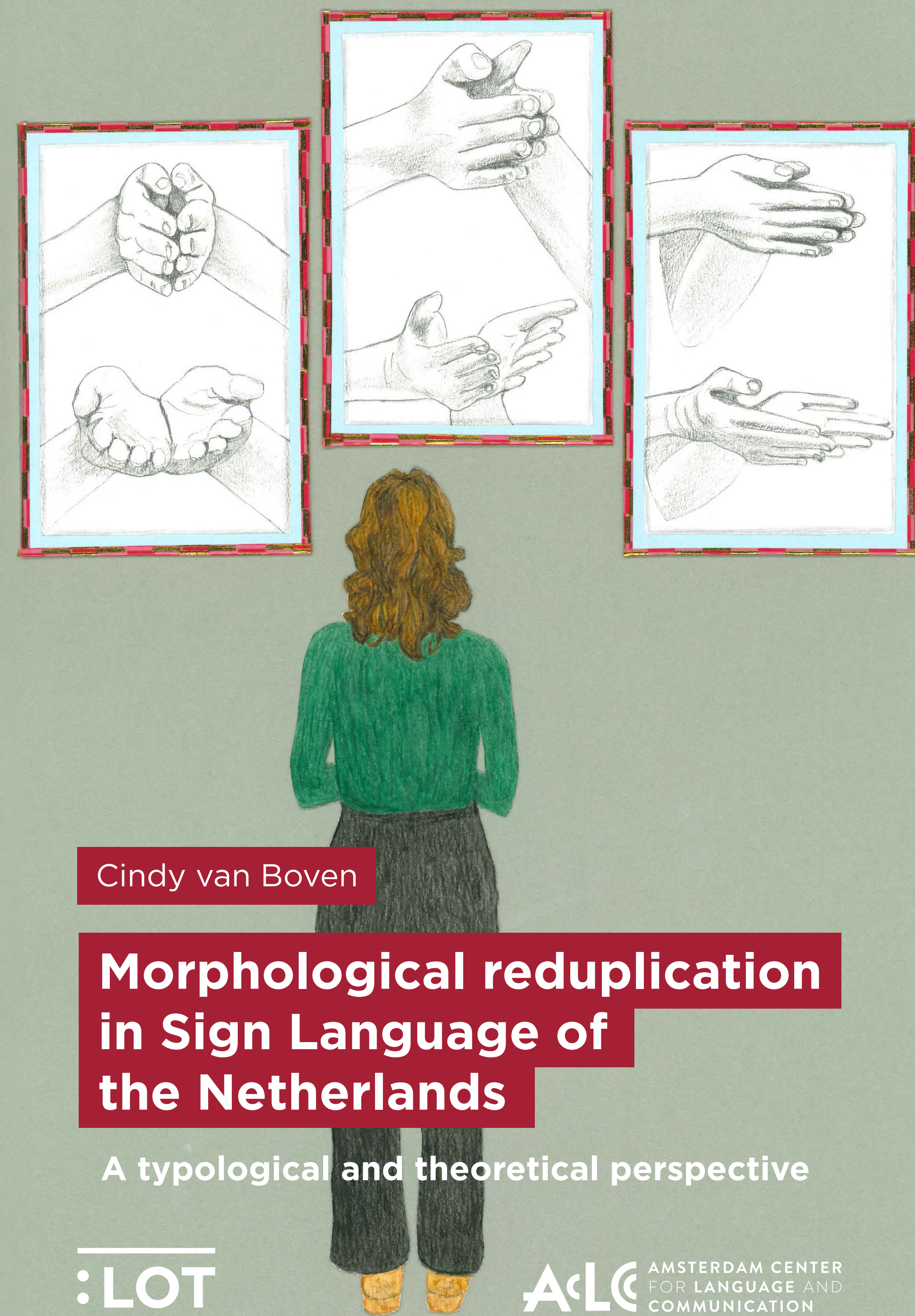

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Dankwoord (acknowledgements)

Dit dankwoord schrijf ik in de laatste weken van december 2023. In de aanloop naar een nieuw jaar reflecteer ik altijd graag op de gebeurtenissen van de afgelopen tijd. Dit jaar geldt dat nog een beetje extra: nu mijn proefschrift bijna af is, sta ik stil bij alle mensen die mij, op veel verschillende manieren, hebben geholpen.

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Author contributions

This work has received funding from the research programme PhDs in the Humanities, project number PGW19.003, funded by the Dutch Research Council (NWO). Cindy van Boven (CvB) wrote the proposal for the project, in collaboration with Roland Pfau (RP) and Silke Hamann (SH). Adjustments were made based on the feedback from the Faculty of Humanities Grant Team of the University of Amsterdam.

Chapters 1 and 7 were written by CvB, and adapted on the basis of feedback from RP and SH.

Chapter 2 is a slightly modified version of the published article:

> van Boven, Cindy. 2021. Phonological restrictions on nominal pluralization in Sign Language of the Netherlands: Evidence from corpus and elicited data. *Folia Linguistica* 55(2): 313–359. DOI: 10.1515/flin-2021-2039.

The text in this chapter was adapted on the basis of reviewers' comments.

Chapter 3 is a slightly modified version of a manuscript accepted for publication:

> van Boven, Cindy. Reduplication as an aspect marker in Sign Language of the Netherlands: Reconsidering phonological constraints and aspectual distinctions. Accepted for *Linguistics: An Interdisciplinary Journal of the Language Sciences*.

The corpus data for habitual aspect reported on in this chapter were collected and annotated in collaboration with Marloes Oomen, as described in van Boven & Oomen (2021). Further, some of the items in the elicitation task for this study were based on the TMA-questionnaire originally developed by Dahl (1985), and adapted for NGT by Oomen (2016); specifically, the items targeting the continuative and habitual aspect for SLEEP, HUG, TALK, and CLEAN. The text in this chapter was adapted on the basis of reviewers' comments.

Chapter 4 is a slightly modified version of a manuscript under review:

> van Boven, Cindy. Reciprocal marking in Sign Language of the Netherlands: Phonological, morphosyntactic and semantic restrictions. Under review at *Morphology*.

The corpus data in this study were collected and annotated by CvB and RP.

In addition, for all three studies reported on in **Chapters 2–4**, CvB was responsible for the design of the research, the data collection, annotation, and analysis, as well as writing the text. RP and SH provided feedback at all these stages of the three studies. Marijke Scheffener provided feedback regarding the grammaticality of the NGT-stimuli in the three elicitation tasks described in these chapters.

Chapter 5 is a slightly modified version of the published article:

> van Boven, Cindy, Silke Hamann & Roland Pfau. 2023. Nominal plurals in Sign Language of the Netherlands: Accounting for allomorphy and variation. *Glossa: A Journal of General Linguistics* 8(1). DOI: 10.16995/glossa.9686.

The data collection and analysis underlying the formalization presented in this chapter was done by CvB (as reported on in Chapter 2). All three authors contributed to the formalization of the data, i.e., the formulation of the constraints. SH performed the simulations acquiring the ranking values of the constraints. The text was written by CvB, SH, and RP jointly, with CvB taking the lead. The text was adapted on the basis of reviewers' comments.

The formalization presented in **Chapter 6** was proposed by CvB, and adapted based on feedback from SH and RP. CvB performed the simulations acquiring the ranking values of the constraints, with help and feedback from SH. The text was written by CvB, and adapted based on feedback by RP and SH.

Availability of data, analyses, and methods

For the study on nominal plural reduplication (reported on in Chapter 2), all data annotations of the two data sets, the statistical analyses, and an English translation of the complete elicitation task, including the instructions, are publicly available:

> van Boven, Cindy. 2023a. Annotations of plural reduplication in NGT (corpus & elicited data). University of Amsterdam / Amsterdam University of Applied Sciences. DOI: 10.21942/uva.23260814.

For the study on aspectual reduplication (reported on in Chapter 3), all data annotations of the two data sets, the statistical analyses, and an English translation of the complete elicitation task, including the instructions, are publicly available:

> van Boven, Cindy. 2023b. Annotations & analyses of aspectual reduplication in NGT (corpus & elicited data). University of Amsterdam / Amsterdam University of Applied Sciences. DOI: 10.21942/uva.24182760.

For the study on reciprocal reduplication (reported on in Chapter 4), all data annotations of the two data sets and the statistical analyses are publicly available:

> van Boven, Cindy. 2023c. Annotations & analyses of reciprocal reduplication in NGT (corpus & elicited data). University of Amsterdam / Amsterdam University of Applied Sciences. DOI: 10.21942/uva.24525256.

Additionally, for the study on reciprocal reduplication, an English translation of the complete elicitation task, including the instructions, as well as the video stimuli used in the task are publicly available:

> van Boven, Cindy. 2023d. Elicitation task: Reciprocal reduplication in NGT. University of Amsterdam / Amsterdam University of Applied Sciences. DOI: 10.21942/uva.24610164.

The video data gathered by means of the three elicitation tasks cannot be shared publicly, in order to ensure the anonymity of participants. They are stored under a permanent embargo:

> van Boven, Cindy. 2023e. Elicited video data: Morphological reduplication in NGT. University of Amsterdam / Amsterdam University of Applied Sciences. DOI: 10.21942/uva.24746199.

Finally, the complete Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008), including elicitation materials and metadata, is available online:

> Crasborn, Onno, Inge Zwitserlood, Johan Ros & Annemieke van Kampen. 2006 – 2017. Collection "Corpus NGT". The Language Archive, https://hdl.handle.net/1839/8e5a77a3-8d1a-492a-bc86-9a3398b0809c.

Notation conventions for glossed sign language examples

SIGN	The gloss of one single sign, represented by an English word that is an approximation of the sign's meaning
SIGN.SIGN	Multiple words form the gloss of one single sign
SIGN-1, -2, -3, etc.	Different variants of a single sign; the number indicates the variant
SIGN+	Simple reduplication of a sign; number of pluses indicates number of repetitions
SIGN>+	Sideward reduplication of a sign; number of pluses indicates number of repetitions
SIGN_{sim}	Simultaneous articulation of a sign, i.e., articulating a sign that is one-handed in its base form with both hands
$\text{SIGN+}_{\text{seq/back}}$	Sequential backward reduplication of a sign; number of pluses indicates number of repetitions
$\text{SIGN+}_{\text{sim/back}}$	Simultaneous backward reduplication of a sign; number of pluses indicates number of repetitions
$\text{SIGN}_{\text{2H/alt}}$	One-handed base sign articulated by two hands moving in alternation
S-I-G-N	Fingerspelling (e.g., for proper names)
SIGN--------	A sign is held (usually while the other hand continues to sign)
$\text{SIGN}_{1,\,2,\,3a,\,3b}$	A sign is localized; subscript numbers refer to locations (1=close to the signer; 2=close to the interlocutor; 3a, 3b, 3c, etc.=locations in the signing space)
POSS_1	Possessive pronoun, first person
$_{x}\text{VERB}_{y}$	A verb moves from location x to location y (which can be analyzed as agreement marking) – for possible locations, see $\text{SIGN}_{1,\,2,\,3a,\,3b}$
INDEX_x	Pointing sign with a linguistic function (pronoun); subscript number refers to locations in the signing space – for possible locations, see $\text{SIGN}_{1,\,2,\,3a,\,3b}$
$\text{INDEX}_{\text{arc}}$	An arc-shaped pointing sign with a linguistic function (pronoun)

DUAL.PRO-1, -2, -3	A sign which functions as a dual pronoun and possibly as a reciprocal marker; the number indicates the variant
PALMS.UP	Multifunctional, mostly clause-final particle
CL	Classifier sign
AUX.OP	Auxiliary (with mouthing 'op'; see Bos 1994)
___/…./	Mouthing (phonological form); line indicates the scope
___word	Mouthing (orthographic form); line indicates the scope
____xxx	Non-manual marker; line indicates the scope
[CNGTx; Sx; x:x]	Code for examples from Corpus NGT: Corpus file number; signer number; begin time (m:s.ms)
[p0x]	Participant number in elicited data

Chapter 1 | Introduction

Reduplication is a morphological process whereby (part of) a word or sign is repeated, in order to yield a systematic change in meaning. Reduplication is common across both signed and spoken languages, and it has similar functions in both modalities, i.e., the oral-aural modality of spoken languages and the visual-spatial modality of sign languages. Yet, it comes with a modality-specific flavor, as previous research on a variety of languages has demonstrated.

This dissertation focuses on one sign language in which reduplication has been found to be a productive morphological process: Sign Language of the Netherlands (*Nederlandse Gebarentaal*, NGT).[1] The linguistic study of NGT dates back to the 1950s, Tervoort (1953) being the first one to describe NGT as a natural language. Over the years, many aspects of the grammar of NGT – its phonology, morphology, and syntax – have been described (see Klomp's 2021 descriptive grammar of NGT for an overview of this research). Yet, while a handful of studies have shown reduplication to be a productive process in NGT, up until now, no study has systematically investigated and compared its different functions in the language.

The present study, therefore, aims to provide a comprehensive description of reduplication in NGT, specifically focusing on three of its functions: nominal pluralization, aspectual marking, and reciprocal marking. The findings are compared to previous studies on reduplication in both spoken and signed languages. Further, the findings are formalized within Optimality Theory, a framework that has often been used to account for spoken language reduplication.

This first chapter lays out the groundwork for the rest of the dissertation. First, some essential background on sign language structure is provided in Section 1.1, discussing general aspects of sign language phonology and morphology that turn out to be relevant throughout the thesis. Then, Section 1.2 focuses on the main topic of this dissertation, reduplication, and presents findings from previous studies on this morphological process in spoken and signed languages. Section 1.3 briefly introduces Optimality Theory, the framework used to formalize the findings, and it highlights the importance of formalizing NGT data in this framework. Section 1.4 more elaborately addresses the goals of the present study. Finally, Section 1.5 provides an overview of the rest of the thesis.

[1] NGT has been legally recognized as a minority language in the Netherlands since 2020 (see Cokart et al. 2019; and see Klomp 2021 for a socio-historical background of the language).

1.1 Sign language structure

The topic of the current dissertation is positioned at the interface between phonology and morphology. Throughout the thesis, several aspects of the phonological and morphological structure of sign languages turn out to play a pivotal role in reduplication. These aspects of phonology (Section 1.1.1) and morphology (Section 1.1.2) are highlighted here.

1.1.1 Phonology

While 'phonology' traditionally refers to systems of speech sounds, by now it is widely accepted that sign languages have phonological structure, too. Of course, in the case of sign languages, phonology does not refer to sounds. More generally, we can define phonology in a modality-independent way as "the abstract grammatical component where primitive structural units are combined to create an infinite number of meaningful utterances" (Brentari et al. 2018: 1). Focusing first on the manual part, the sublexical building blocks that have been identified for sign languages are the handshape, the place of articulation, and the movement of the sign (Stokoe 1960; Sandler 1989).[2] These building blocks are contrastive, that is, two signs may differ only in terms of, for instance, their handshape.

The visual-spatial modality offers an increased potential for signs to be iconic, i.e., the (combination of) building blocks may reflect semantic properties of the referent (e.g., van der Kooij 2002). Take, for example, the NGT sign BOOK in Figure 1.1, where the handshapes and their opening movement clearly represent the entity 'book' in an iconic way. The handshape, movement and place of articulation are not iconic in all signs, however – for instance, the building blocks of the NGT sign WATER in Figure 1.2 do not have a clear iconic motivation (see *Notation conventions for glossed sign language examples* for the glossing conventions used in this dissertation).

[2] Traditionally, orientation has also been considered to be one of the major building blocks – specifically orientation as "the absolute direction or the palm and/or the fingers", while later, it was redefined in relative terms, i.e., "the part of the hand that points in the direction of the end of the movement […] or toward the specified location" (van der Hulst & van der Kooij 2021: 7–8), and it has been proposed to group orientation under handshape (Sandler 1989).

Figure 1.1. The iconic sign BOOK in NGT.

Figure 1.2. The arbitrary sign WATER in NGT.

Several phonological models of the structure of signs have been proposed (see, e.g., Liddell & Johnson 1989; Sandler 1989; Brentari 1998; van der Kooij 2002; van der Hulst & van der Kooij 2021), and they have demonstrated that the building blocks are not holistic units, but rather can be further broken down into distinctive features, comparable to vowels and consonants in spoken languages. While I do not elaborately discuss the phonological models here, I briefly go into the internal structure of each building block.

First, the handshape of a sign can be further decomposed into the selected fingers (i.e., the most salient, or in the words of Mandel (1981: 82) the “foregrounded”, fingers) and the finger position: the fingers may, for example, be closed, extended, or curved (Mandel 1981). Both can be described in terms of distinctive features (see, e.g., the models in Sandler 1989; van der Kooij 2002). In the NGT sign BOOK (Figure 1.1), all fingers are selected, and they are in an open, extended position. For WATER (Figure 1.2), the middle finger is selected and bent. In CHAIR in Figure 1.3, all fingers are in a closed position. It has been observed that within a morpheme, the finger position may change, but the selected fingers do not (Mandel 1981) – in the NGT sign TALK in Figure 1.4, the position of the finger (repeatedly) changes from open to closed, but the selected fingers remain constant.

Figure 1.3. The sign CHAIR in NGT.

Figure 1.4. The sign TALK in NGT.

Second, the place of articulation of a sign can be subdivided into the sign's major location (such as the head, arm, body, neck, hand, and neutral space) and its setting, i.e., sublocation, within that major area (cf. Battison 1978). The major location of the NGT sign WATER (Figure 1.2) is the head; its setting is contact with the lateral side, specifically on the lower part of the cheek. Other signs with the head as their major location may have a different setting, such as the forehead or the chin (see van der Kooij 2002; Klomp 2021 for the phonologically distinctive locations and settings in NGT, and see, e.g., Sandler 1989; Brentari 1998 for different representations of location, both distinguishing features for major location on the one hand, and for setting on the other).

Third, for movement, we can distinguish path movement from internal movement (Sandler 1989; Brentari 1998). A path movement is characterized by a change in setting; e.g., in the sign CHAIR in Figure 1.3, which has the major location [neutral space], the setting changes from [high] to [low]. Furthermore, a path movement may be characterized by different manners: it may, for instance, be straight (as in Figure 1.3), arc-shaped, and/or involve repetition (for an example of the latter, see Figure 1.8 below). Internal movement, on the other hand, involves a change of handshape (or, more specifically, of finger position, as noted above – see TALK in Figure 1.4) or orientation (see BOOK in Figure 1.1, where there is a change in palm orientation). For representations of movement, see for instance Sandler (1989), who represents internal movement by a branching structure at the finger position node, while the manner of path movements is specified by specific features, and Brentari (1998), who subsumes both internal and path movement under a prosodic features structure, as opposed to an inherent features structure, which involves handshape and place of articulation.

Turning away from the three sublexical building blocks, I will discuss two more relevant factors: (i) the fact that signs may be one- or two-handed, and (ii) non-manual phonological components.

First, the fact that sign languages use different articulators than spoken languages has direct consequences for several aspects of the language (see, for example, Bellugi & Fischer 1972 for differences between spoken and signed language in terms of production rate; and Wilson & Emmorey 1997 for effects on working memory). A consequence that will turn out to be relevant for reduplication processes is the fact that, given that two manual articulators are available, signs may be one- or two-handed. Battison (1978) proposed that there are three different types of two-handed signs: (i) both hands are active and perform the same movement (which may be alternating); (ii) one hand is active, one is passive (i.e., serves as place of articulation), and both hands have the same handshape; (iii) one hand is active, one is passive, and the hands have a different handshape. Moreover, Battison specified two restrictions on two-handed signs. First, the *symmetry condition*: if both hands move independently, their location, movement and handshape should be the same, and their orientation should be symmetrical or identical. Second, the *dominance condition*: if the two hands do not have the same handshape, then one hand should be passive, and the possible handshapes of that passive hand are restricted to a small set. Following Battison's seminal analysis, these conditions were shown to hold for many different sign languages, including NGT (see, e.g., Crasborn 2011 for an overview). For a more recent account of these conditions, I refer to Eccarius & Brentari (2007), who slightly revise them by basing the conditions on phonological feature structures rather than the whole handshape.

Second, apart from the manual phonological components, non-manual components have also been considered part of the phonological structure of a sign. Signs may be lexically specified for facial expressions, head and body movements (see, e.g., Pendzich 2020 for a discussion of lexical non-manuals). For instance, Pfau & Quer (2010) point out that in many sign languages, the sign for SLEEP is lexically specified for a head tilt towards the palm of the hand. Signs may also be specified for mouth configurations, which come in two types: (i) mouth gestures, i.e., mouth movements or articulations which are not related to the surrounding spoken language, for instance in the NGT signs BE-PRESENT, where [ʃ:]-sound is the mouth gesture accompanying the sign; and (ii) mouthings, which involve the silent articulation of (a part of) a word from the surrounding spoken language, as in the NGT sign FLOWER, which is accompanied by the Dutch mouthing *bloem* [blum] ‘flower’ (see Boyes Braem & Sutton Spence 2001 for this distinction, and see also Pfau & Quer 2010, who present the same NGT examples; further, for NGT mouthing, see Schermer 2001; Bank 2015).

Having discussed some aspects of the phonological structure of sign languages, I now turn to the next level of structure: morphology.

1.1.2 Morphology

Morphologically complex signs have been found in most of the sign languages studied to date. Morphological modifications in sign languages mostly apply stem-internally, i.e., simultaneously rather than sequentially (e.g., Aronoff, Meir & Sandler 2005; Sandler & Lillo-Martin 2006; Sandler 2021; Pfau & Steinbach 2023). In fact, each of the (manual and non-manual) phonological building blocks introduced in the previous section may be affected by such stem-internal changes. Numerous simultaneous inflectional and derivational morphological processes have been identified. To give a few examples:

- Marking aspectual distinctions commonly involves the superimposition of specific movement features on the verb sign – e.g., Sutton-Spence & Woll (1999) on British Sign Language (BSL); Zeshan (2000) for Indo-Pakistani Sign Language (IPSL); Rathmann (2005) on American Sign Language (ASL);
- The handshape of certain verbs of motion or location (e.g., MOVE, GIVE) can be modified to classify one of their arguments (these have been analyzed as morphemic handshapes) – e.g., Supalla (1986) on ASL; Glück & Pfau (1998) on German Sign Language (DGS); Zwitserlood (2003) on NGT;
- The diminutive and augmentative may be marked non-manually, for instance, by blowing the cheeks while signing a noun to express the augmentative – see Pfau & Quer (2010) for examples from DGS; further, see Fornasiero (2020) for a detailed discussion of non-manual evaluative morphology in Italian Sign Language (LIS).

Verbal agreement also applies stem-internally. In many sign languages, the movement and/or orientation of a subset of verbs (often called agreeing verbs or indicating verbs) can be modified to express agreement (Padden 1988).[3] Specifically, agreeing verbs usually move from the locus associated with the subject to the locus associated with the object – for instance, between the signer and the interlocutor, or between two locations in space associated with third-person referents. Compare the two inflected forms of the NGT verb ANSWER in Figure 1.5: in Figure 1.5a, the verb moves between the signer (locus 1) and a third person (locus

[3] I neglect many complexities regarding agreement here, but see, e.g., Mathur & Rathmann (2012) for an overview. Further, there has been a lively debate as to whether this type of spatial modification should actually be considered an instantiation of agreement (see Pfau et al. 2018 for an overview of this debate). This is beyond the scope of the current dissertation.

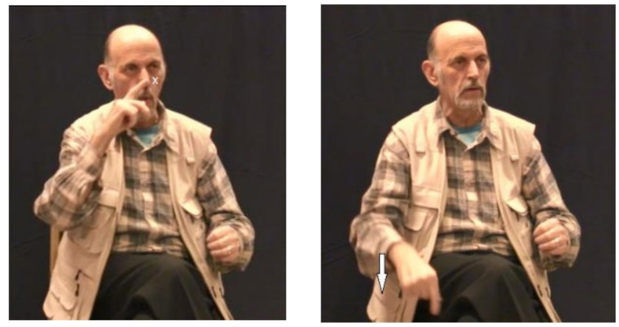
3a), while in Figure 1.5b, it moves in the opposite direction. Interestingly, a characteristic of sign languages is that not all verbs can undergo this modification: so-called plain verbs cannot be modified for agreement, often because they are body-anchored or do not have a path movement.

a. $_{1}$ANSWER$_{3a}$ 'I answer him/her/them.'

b. $_{3a}$ANSWER$_{1}$ 'He/she/they answer(s) me.'

Figure 1.5. Agreement of the verb ANSWER in NGT (Figures, glosses and translations from Klomp 2021: 201; © Ulrika Klomp, reprinted with permission).

Sign languages exhibit sequential morphological structures, too. A (mostly) sequential morphological process in sign languages is compounding, whereby two stems can be combined sequentially. In the process, the two signs may undergo phonological changes, such as movement reduction and/or assimilation (for descriptions and accounts of sign language compounds, see, e.g., Klima & Bellugi 1979; Liddell & Johnson 1986; Meir 2012; Vercellotti & Mortensen 2012; Santoro 2018). Further, sequential affixation exists in the visual-spatial modality, but it appears to be very rare. Still, a few examples have been attested. An agentive suffix attaching to verbs, grammaticalized from the noun PERSON, has been identified for ASL (Aronoff, Meir & Sandler 2005). For NGT, Klomp (2021) has described a negative prefix and a negative suffix, although the latter is not productive (both are loans from Dutch; the prefix is illustrated in Figure 1.6).



UN DEEP

Figure 1.6. Derived sign UN.DEEP 'shallow' (from Klomp 2021: 186; reprinted with permission; original source CNGT1516; S063; 00:28.050).

Thus, while sequential morphology does exist in the visual-spatial modality, it is much more common for morphological processes to apply stem-internally. Aronoff, Meir & Sandler (2005) observe, based on ASL and Israeli Sign Language, that simultaneous morphology is very similar across sign languages, and is mostly inflectional. They further note that the two sign languages differ more from each other when it comes to sequential morphology, which is derivational.

Much attention has been paid to the modality-specific characteristics of sign language morphology. Yet, Pfau & Steinbach (2023) argue that this modality-specificity does not stem from the simultaneous realization of morphemes. After all, in spoken languages, too, morphological changes may apply simultaneously – think, for instance, of pluralization through umlaut in German or tone changes marking morphological processes in tone languages. What is modality-specific, according to Pfau & Steinbach (2023), is the potential to simultaneously realize multiple morphemes at the same time. They show that in NGT three morphological modifications may be realized simultaneously by adapting the location (agreement) and handshape (classification) of a verb, while at the same time adding non-manual marking (adverbial modifier). As Pfau & Steinbach point out, parallel structures are not attested in spoken languages. We are thus dealing with a quantitative rather than a qualitative difference (cf. also Schuit 2013, who proposes an 'index of simultaneity' as an addition to Comrie's 1989 indexes of synthesis and fusion).

Interestingly, there is a morphological process that does not apply stem-internally, yet is very common across sign languages: reduplication. Given that the focus of the present study will be on reduplication, the next section further discusses reduplication as a morphological process in signed and spoken languages.

1.2 Reduplication as a morphological process

Reduplication is a cross-linguistically widespread morphological process. I start by illustrating its different forms and functions in spoken languages, and then turn to sign language reduplication.

Different types of reduplication have been identified in spoken languages. In its simplest form, reduplication involves the repetition of an entire word, stem, or root, as in the Mandarin example (1a); this type has been labeled full reduplication. In contrast, in partial reduplication (see, e.g., Rubino 2013), only part of a base is repeated, as in (1b), an example from Pima, where the reduplication involves only a single consonant. Languages may use these different types to make grammatical and semantic distinctions (Moravcsick 1978; see also Rubino 2013). According to Rubino (2013), partial reduplicants often occur at the beginning of a base, as in the Pangasinan example (1c), but medial (1b) and final positions are also attested. For all examples in (1) and (2), the form as presented in the original source is given.

(1) a. *hóng* → *hónghóng*
‘red’ ‘bright red’
[Mandarin Chinese; Finegan 2014: 47]

b. *mavit* → *ma-m-vit*
‘lion’ ‘lions’
[Pima; Riggle 2006: 858]

c. *toó* → *totoó*
‘man’ ‘people’
[Pangasinan; Rubino 2001: 540, as presented in Rubino 2013]

Further, we can distinguish simple from complex reduplication. In simple reduplication, the base and reduplicant are identical (as in (1a-c)), while in complex reduplication, base and reduplicant are non-identical, as vowels or consonants can be changed or added, or the phoneme order can be reversed (Rubino 2005, 2013). To give some examples, (2a) shows complex reduplication in Indonesian, where we observe a vowel change in the reduplicant, and (2b) illustrates a construction in Mangarayi (Australian), where the reduplicant copies the onset of the second syllable of the base and the rhyme of the first syllable of the base – in this case, the resulting reduplicant is [gim].[4]

[4] But see Kurisu & Sanders (1999) for an alternative analysis of Magarayi reduplication.

(2) a. *desus* → *desasdesus*
‘rumor’ ‘rumors, whispering’
[Indonesian; MacDonald & Soenjono 1967: 54]

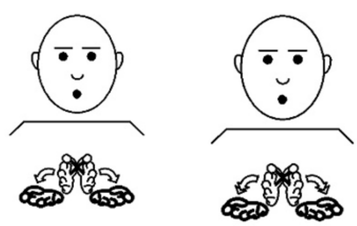
b. *ɟimgan* → *ɟimgimgan*
‘knowledgeable person’ ‘knowledgeable people’
[Mangarayi; Rubino 2005: 15]

Rubino (2013) reports, based on a sample of 368 languages, that 278 languages employ both full and partial reduplication, while 35 employ only full reduplication. The remaining 55 languages are reported not to have reduplication as a productive process. He indicates that, while reduplication is not common in Western Europe, it is widespread in Austronesia, South Asia, Australia, the Caucasus, Amazonia and Africa. Some language families in the Western hemisphere are also reported to have reduplication (for instance, Yuman and Salishan, a.o.).

Reduplication may have a variety of different functions, as is evident from the list of functions that Rubino (2013) presents for verbs and adjectives: “With verbs (and adjectives), reduplication may be used to denote a variety of things, such as number (plurality, distribution, collectivity), distribution of an argument, tense, aspect (continued or repeated occurrence; completion; inchoativity), attenuation, intensity, transitivity (valence, object defocusing), or reciprocity”. For nominal reduplication, Rubino (2013) also presents a list with a myriad of functions: “With nouns, reduplicative morphemes have been known to denote concepts such as number […], case, distributivity, indefiniteness, reciprocity, size (diminutive or augmentative), and associative qualities”. Other identified functions of reduplication include word class change and forming multiplicatives and limitatives (see Rubino 2013 for an overview).

Reduplication is often considered to be an iconic process, i.e., “more of the same form stands for more of the same meaning” (the “Iconicity Principle”; Kouwenberg & LaCharité 2015: 971; see also Lakoff & Johnson 1980: 128; Downing & Stiebels 2012; Börstell to appear; and see Lǐ & Ponsford 2018, who identify different iconic aspects of reduplication, presenting a more gradual view on the phenomenon). Indeed, the examples in (1) and (2) above neatly illustrate this point, as reduplication encodes plurality (‘more of entity x’) or intensification (‘more of property x’). Counterexamples also exist, however. Downing & Stiebels (2012: 396) point out that reduplication does not always express meanings related to repetition, and they offer as examples “inchoative, singular absolutive, reflexive, [and] causative” meaning (functions also listed in Rubino 2005). In this regard, they also note that reduplication sometimes serves prosodic purposes, and in those cases does not have any meaning. Still, they do conclude that “the correlation between repeated form and increased quantity (and related concepts) is common enough that reduplication often satisfies the Iconic Principle" (p. 397) (for a related discussion, see Kouwenberg & LaCharité 2015 on iconicity in reduplication in Caribbean Creole languages).

Given the mostly iconic nature of the process, it is not surprising that reduplication commonly occurs in sign languages, too. To illustrate reduplication in a sign language, an example of plural reduplication of the DGS sign BOOK is given in Figure 1.7. Figure 1.7a shows the singular form of the sign BOOK in DGS, where the hands articulate one opening movement (indicated by one arrow for each hand in the figure), while Figure 1.7b shows the plural form of the same sign, where the opening movement of the hand is repeated two times (indicated by a repetition of the arrows for each hand in the figure).



a. BOOK b. BOOK++

Figure 1.7. Plural reduplication in DGS ('book' (a) – 'books' (b); Pfau & Steinbach 2005a; image from Pfau 2016: 216; © John Benjamins, reprinted with permission).

Before continuing our discussion of reduplication in sign languages, a note on inherent repetition and doubling is in place. First, as already noted in Section 1.1.1, some signs are inherently specified for a repeated path movement, which may be alternating and/or circular, the former being true for the NGT sign CAR (Figure 1.8). If a sign is lexically specified for such a repeated movement, i.e., if the base form of the sign contains movement repetition, I refer to this as 'inherent repetition', in order to distinguish it from the morphological process of reduplication (cf. Pfau & Steinbach 2005a, who name inherent repetition combined with an alternating or circular movement 'complex movement' – a term that I also adopt later on in the thesis).

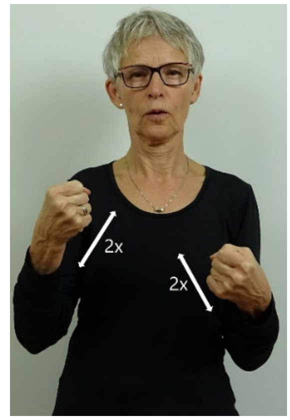


Figure 1.8. NGT sign CAR, with an inherently repeated and alternating movement.

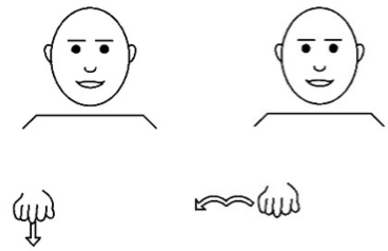
Second, reduplication should also be distinguished from doubling, which is, like in spoken languages, also attested in a variety of sign languages (see, e.g., Kimmelman 2013 and references therein; Kimmelman 2018). Doubling is illustrated in (3) for NGT, where the predicate BRING is doubled. Often, doubling in sign languages is said to fulfill pragmatic functions (e.g., emphasis), and Kimmelman (2018) takes this pragmatic function as an argument against analyzing doubling as a type of reduplication, next to the fact that usually material intervenes between doubled elements, while reduplicants are normally assumed to be adjacent to the base (but Kimmelman also refers to Inkelas & Zoll 2005, for whom adjacency is not a requirement for reduplication). Here, I distinguish doubling from reduplication, and assume that in the latter, base and reduplicant are adjacent and that it has a morphological rather than a pragmatic function.

(3) ONE BRING SCHOOL BRING.
‘At one I brought her back to school.’
[NGT; adapted from Kimmelman 2013: 106]

Cross-linguistically, sign language reduplication has been found to express a wide variety of meanings, such as plurality (e.g., Pfau & Steinbach 2005a for DGS), distributivity (e.g., Börstell 2011 for Swedish Sign Language), pluractionality (Kuhn & Aristodemo 2017 for French Sign Language (LSF); Quer 2019 for Catalan Sign Language (LSC)), reciprocity (e.g., Pfau & Steinbach 2003 for DGS), word-class change (e.g., Supalla & Newport 1978; Abner 2017 for ASL), aspect (e.g., Rathmann 2005 for ASL), and paucity (Veiga Busto 2021 for LSC). These functions clearly overlap with those of spoken language reduplication, and in most of them, reduplication is iconic. It has been shown that this iconicity of reduplication facilitates second language learning in both modalities (Carroll & Widjaja 2013 on the acquisition of number in Indonesian; Boers-Visker 2023 on the acquisition of plurality in NGT). Moreover, as illustrated in the example in Figure 1.9, sign language reduplication often actually involves triplication (see, e.g., Pfau & Steinbach 2006).

While reduplication as a morphological process is common in both modalities, it comes with a modality-specific flavor. As introduced earlier in this section, in spoken languages, there is a clear distinction between partial and full reduplication. In contrast, in sign languages, it has been noted that only full reduplication is a productive process (Wilbur 2009) – although a few later studies did observe some potential instances of partial reduplication (Kimmelman 2018 on Russian Sign Language (RSL); Pfau & Steinbach 2021 on DGS; Veiga Busto 2021 on LSC). Even if partial reduplication is not widespread, a wide variety of reduplication types has been described for sign languages. One type of reduplication that is clearly modality-specific is simultaneous reduplication, whereby the reduplicant of a one-handed sign is articulated simultaneously by the non-dominant hand. For instance, in RSL, this type of reduplication has been described to express nominal plurality, the derivation of indefinite pronouns from question words, and intensity when applied to adjectives (Kimmelman 2018, based on Burkova & Filimonova 2014).

A distinction that is typical for sign language reduplication is that between simple reduplication and reduplication with a displacement in space. The first involves the repetition of a sign at one location (as in Figure 1.7 above), while in the latter, the repetition of a sign involves an additional movement. For example, in many investigated sign languages, nominal pluralization involves not only simple reduplication, but also so-called sideward reduplication, where the noun is repeated while the hands move sideward; see Figure 1.9 for an example from DGS (and see, e.g., Pizzuto & Corazza 1996 for LIS; Sutton-Spence & Woll 1999 for BSL; Pfau & Steinbach 2005a, 2006 for DGS; for LSC, Veiga Busto 2021 shows that nouns can be pluralized by displacement alone, i.e., by modification of the sign's path movement, without repetition). Sideward reduplication can be considered a case of complex reduplication, given the phonological change in the reduplicants. In the case of CHILD, the location feature is changed in each reduplicant, due to the sideward movement.



a. CHILD b. CHILD>+>+

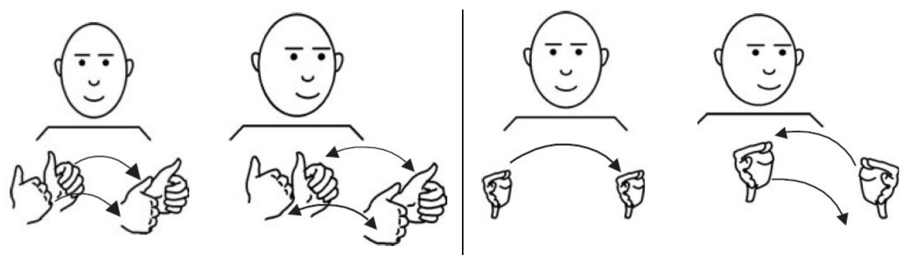
Figure 1.9. Sideward reduplication in DGS ('child'(a) – 'children' (b); Pfau & Steinbach 2005a; images from Pfau 2016: 216; © John Benjamins, reprinted with permission).

Crucially, in these cases, the sideward movement is not (necessarily) semantically motivated, i.e., it does not reflect the spatial locations of the referents (Pfau & Steinbach 2005a). Still, the visual-spatial modality does offer the unique possibility to articulate referents at different locations in the signing space so that these locations do reflect real-life spatial locations – for instance, classifier handshapes representing objects can be reduplicated such that the location of each repetition in the signing space reflects the real-life spatial arrangement of the referents (see, e.g., Zwitserlood & Nijhof 1999 for NGT; and see also Klomp 2021 for the localization of plural nouns in the signing space in NGT). Indeed, Schlenker & Lamberton (2019) argue that in ASL, plurals formed by repetitions at different locations in the signing space do have an iconic motivation.[5]

Other modality-specific reduplication types are attested in the aspectual and reciprocal reduplication of verbs. Aspectual inflection of sign language verbs often involves reduplication in combination with simultaneous modulations of the rate and rhythm of the movement – for instance, in ASL, habitual and iterative aspect are both marked by reduplication of the verb, but the habitual involves shorter and quicker movement cycles than the iterative (Rathmann 2005; see also Fischer 1973; Klima & Bellugi 1979). For reciprocal marking in DGS, Pfau & Steinbach (2003, 2005b, 2016) note that it involves so-called 'backward reduplication' of the verb – under this reduplication type, the verb is repeated, but its movement is reversed.

[5] Specifically, Schlenker & Lamberton (2019) distinguish punctuated repetition ("the discrete, clearly separable iteration of the same nominal sign in different parts of the signing space", p. 46) from unpunctuated repetition ("iterations with shorter and less distinct breaks between them", p. 46). According to the authors, when there is unpunctuated repetition of a noun in ASL, "the geometric arrangement of the repeated occurrences provides information about the arrangement of the denoted plurality" (p. 46). They extend this analysis to punctuated repetitions, too (see Schlenker & Lamberton 2019 for the full analysis).

Backward reduplication may apply sequentially (see Figure 1.10a) or be performed simultaneously by the non-dominant hand (see Figure 1.10b). Such a movement reversal in the reduplicant has also been described for other sign languages, such as LIS, LSC, and Austrian, Brazilian, Catalan, and Irish Sign Language (Pfau & Steinbach 2016).



a. HELP HELP+$_{seq/back}$ b. GIVE GIVE+$_{sim/back}$

Figure 1.10. Reciprocal marking by means of (a) sequential backward reduplication of DGS HELP and (b) simultaneous backward reduplication of DGS GIVE (Pfau & Steinbach 2003: 12-18; © John Benjamins; reprinted with permission).

Crucially, it has been observed that sign language reduplication in some cases interacts with, or is constrained by, phonological properties of the base sign. For instance, in DGS, nouns that are body-anchored (i.e., have a location on or close to the body) and nouns that have an inherently repeated movement (cf. Section 1.1.1 and Figure 1.8) cannot be pluralized by means of reduplication. In the same language, nouns that are specified for a location on the lateral side of the signing space can only undergo sideward reduplication, not simple reduplication (cf. Figure 1.9) (Pfau & Steinbach 2005a, 2006). Further, reciprocal reduplication in DGS also interacts with base verb properties – not only phonological, but also morphosyntactic properties are of importance here. Plain verbs cannot undergo reciprocal reduplication and remain zero-marked. In contrast, agreeing verbs undergo backward reduplication, which is realized simultaneously (by the non-dominant hand) for one-handed agreeing verbs (Figure 1.10b), but sequentially for two-handed agreeing verbs (Figure 1.10a) (Pfau & Steinbach 2003). Such phonological and morpho-syntactic restrictions on reduplication have been analyzed by Pfau & Steinbach (2005b, 2006) as cases of allomorphy.[6] Similar restrictions have also been observed for other sign languages, although there are cross-linguistic differences in terms of the exact restrictions (for instance, for nominal plurals: Pizzuto & Corazza 1996 for LIS; Sutton-Spence & Woll 1999 for BSL; Veiga Busto

[6] However, see van der Hulst & van der Kooij (2021) for the opposite viewpoint that sign languages lack grammatical phonological rules that regulate allomorphy.

2021 for CSL, for reciprocals: Zeshan & Panda 2011 for IPSL; Kubus & Hohenberger 2013 for Turkish Sign Language; Pfau & Steinbach 2016 for five different sign languages).

1.3 Optimality Theory

The theoretical model used to formalize the findings of the current study is Optimality Theory (OT; Prince & Smolensky 1993 [2004]). Briefly put, OT does away with grammatical rules and proposes that grammars are made up of violable constraints. Importantly, the violable constraints are universal, while their ranking is language-specific. Thus, grammars are the result of language-specific rankings of universal constraints. The constraints can be divided into two types: faithfulness and markedness constraints. I do not introduce all workings of OT here, but instead assume some basic knowledge of the model (see, e.g., Archangeli 1997 for an introductory overview of the theory).

For the present dissertation, two issues related to OT are of importance. First, the formalization of sign language data within OT, and the potential consequences for the claims the theory makes about the universality of constraints. Second, the formalization of variation within a language. I address both these issues in turn.

1.3.1 The universality of OT-constraints

First, there is the issue of adding sign language data to the available OT formalizations. OT has been used to account for different, mostly phonological, phenomena in spoken languages in numerous studies – and this is especially true for reduplication (see Downing & Inkelas 2015 for an overview; and see Rawski et al. 2023 for a discussion of several morphological theories of reduplication and their generative capacity). Clearly, pivotal for OT is the universality of the constraints. Still, to date, only a few studies have taken sign language data into account when proposing such constraints (e.g., Brentari 1998; Ann & Peng 2000; Kimmelman 2009; Eccarius & Brentari 2010). For sign language reduplication specifically, a few OT accounts are available (see Pfau & Steinbach 2003, 2005a for OT formalizations of reciprocal and plural reduplication in DGS, respectively).

Important in OT analyses of spoken language reduplication is to compare the phonological form of the reduplicant to the form of the base (McCarthy & Prince 1986/96 et seq.) – when base and reduplicant are non-identical, i.e., in complex reduplication, the similarity between the base form and its reduplicant is evaluated in OT with so-called Base-Reduplicant Faithfulness Constraints (McCarthy &

Prince 1999; henceforth: BR-FAITH). However, previous OT-accounts of DGS reduplication (Pfau & Steinbach 2003, 2005a) do not consider BR-FAITH, even though base and reduplicant are not always identical in sign language reduplication either (recall for instance sideward reduplication, where the base and the reduplicant(s) differ in terms of their location features; see Section 1.2).

Further, as we have seen in Section 1.2, reduplication is influenced by the modality of signal transmission, resulting in modality-specific reduplication types (recall, again, sideward reduplication, as well as simultaneous and backward reduplication). Such modality-specific patterns likely will have consequences for OT-formalizations. To give an example, consider ALIGNMENT constraints proposed for spoken languages (see McCarthy & Prince 1993a). Riggle (2006: 872) puts forward such a constraint for reduplication in Pima, where the reduplicant is an infix (see example (1b) above). The constraint stipulates that the left edge of the reduplicant should occur as close as possible to the left edge of the word. Clearly, "as close as possible" has different connotations depending on the modality: recall from Section 1.2 that in sign languages, it is possible to completely align the reduplicant and the base, and this actually happens in at least some of the investigated sign languages, when there is simultaneous reduplication (as in, e.g., Figure 1.10b) – something which is excluded in principle in a spoken language (ALIGNMENT has been included in accounts of sign languages: see Brentari 1998 for ALIGNMENT in the Prosodic Model of sign language phonology, and see Geraci 2009, who adopts this constraint in his account of movement epenthesis in LIS). A related matter concerns the fact that constraints are not always phrased in a modality-independent way. For instance, for nominal plurals in DGS, Pfau & Steinbach (2005a: 133) propose a constraint *MOVE, according to which "sequential movements must not be added to the input" – this is clearly a highly modality-specific constraint.

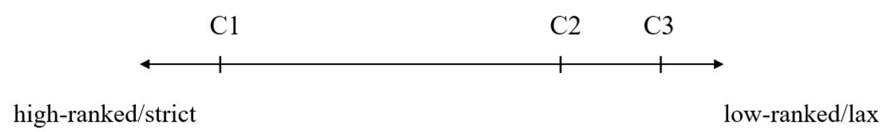
The ALIGNMENT and *MOVE constraints are just two cases in point that illustrate the bigger question to what extent we can propose OT-constraints that are actually universal, and whether this universality implies modality-independence. Given the fact that reduplication is common in both modalities, and that many OT-accounts of spoken language reduplication are already available, the phenomenon is thus an ideal starting point towards answering this question.

1.3.2 The formalization of variation

The second relevant issue that I would like to introduce here relates to variation within a language, and the formalization of this variation. By now it is well-known that sign languages often display free variation, not only lexically, but also in several domains of grammar (e.g., Oomen & Pfau 2017 for negation in NGT; Fenlon et al. 2018 for verb modification in BSL; Palfreyman 2019 for aspect and negation in the urban sign language varieties of Solo and Makassar (Indonesia), among many others). Such variation and optionality is, of course, also attested in spoken languages. Within-language variation may form a challenge if we assume that each language has one, fixed ranking of OT-constraints.

Within-language variation has been formalized successfully, however, within the framework of stochastic OT (Boersma 1997; Boersma & Hayes 2001), where constraints are ranked on a continuous ranking scale rather than categorically. Higher values indicate higher-ranked constraints, as in (3) below (based on Boersma & Hayes 2001: 47).

(3)



The distance differences between the constraints on the scale are meaningful – the smaller distance between C2 and C3 indicates that the ranking of these constraints is less fixed than the ranking of C1 above C2. Boersma & Hayes (2001) suggest that at evaluation time, i.e., when the output candidates are evaluated, a small evaluation noise value is added to the ranking values of the constraints – the result is the selection point of the constraint. Constraints are thus not associated with a single point in the ranking, but rather with a range of values. If the ranges of two constraints do not overlap (as would be the case for C1 and C2 above), there is a categorical ranking of C1 over C2: at evaluation time, the selection point of C1 will always be above C2. If the ranges of two constraints do overlap, however (as would be possible for C2 and C3 above), their relative ranking varies at different evaluation times, that is, C3 may sometimes end up outranking C2. If the different rankings result in different winning candidates, there will be multiple output forms for one underlying form over multiple evaluations, i.e., variation within a language. The selection points are assumed to be distributed normally in natural language, with the same standard deviation for each constraint, arbitrarily set at 2.0, such that the behavior of constraints depends only on their ranking values.

The ranking values of the constraints can be obtained using the Gradual Learning Algorithm (Boersma & Hayes 2001), based on distributions in language data. The constraints start out with ranking values set up by the researcher (which may be the same for each constraint, or not, when it is possible to propose preliminary rankings based on existing knowledge). The algorithm is then presented with pairs of underlying and surface forms (Boersma & Hayes refer to Tesar & Smolensky 1996, 2000 for more discussion of accessing underlying forms). Since the algorithm is error-driven, it first generates an output form, setting selection points for the constraints at this specific evaluation by taking a random noise value and adding it to the current ranking value of each constraint. If the form corresponds to the surface form the algorithm was presented with in the first place, nothing happens. If the forms do not correspond, however, the algorithm compares the constraint violations of the output currently generated by the grammar to those of the candidate that should have won, and adjusts the ranking values of the constraints (see Boersma & Hayes 2000 for more details). These steps are repeated as there is more exposure to the learning data. The acquisition process described can be simulated using OTMulti grammar in Praat (Boersma & Weenink 2020, 2023). Boersma & Hayes (2001) show that the Gradual Learning Algorithm successfully learns patterns of free variation and optionality – most relevant to the present discussion, the algorithm successfully deals with variation in the form of reduplicants in Ilokano.

Given the ubiquity of variation in the grammars of sign languages, both the framework of stochastic OT and the Gradual Learning Algorithm offer promising possibilities for the formalization of sign language data. However, to date, no study has attempted to formalize sign language data within this framework.[7]

Both of the issues introduced above – related to modality-(in)dependence and variation – illustrate the importance of adding sign language data to OT-formalizations. I address each of them further later on in the thesis.

1.4 Goals of the dissertation

The present study focuses on reduplication in NGT. As will become clear in the next chapters of this dissertation, a few previous studies have addressed reduplication in the language (for instance, Zwitserlood & Nijhof 1999; Hoiting & Slobin 2001; Oomen 2016; Klomp 2021), suggesting that it has several functions. However, while research on other sign languages has shown that not all signs can be reduplicated (see Section 1.2), not much is known about restrictions on NGT reduplication.

[7] However, the work by Eccarius & Brentari (2010) does illustrate the relevance of assuming varying constraint rankings within one sign language. Their OT-formalization focuses on the handshape feature [stacked] in ASL, which has different statuses in the lexical subcomponents they distinguish (foreign, spatial, and core); the formalization shows that the role of an iconic faithfulness constraint is slightly different across the lexical subcomponents. Specifically, this faithfulness constraint is re-ranked to explain the different behaviors of the different subcomponents. With this, they demonstrate that the interaction between iconicity and other pressures is not constant across the lexicon (see also Brentari & Padden 2001). Further, see Brentari et al. (2021) for an analysis of verb phrases in four sign languages in the spirit of probabilistic OT.

Previous studies have not systematically addressed this topic, or do not agree whether there are restrictions (cf. Hoiting & Slobin 2001; Oomen 2016). The first goal of the current study is, therefore, to provide a comprehensive description of reduplication in NGT, focusing on three of its functions: (i) nominal pluralization, (ii) aspectual marking, and (iii) reciprocal marking. The first function involves reduplication of nouns, while the second and third functions involve reduplication of predicates. The description sets out to uncover potential restrictions on NGT reduplication.

The second goal of the present study is to offer a typological perspective on NGT reduplication. Indeed, while the morphological process is common across sign languages, there are cross-linguistic differences, e.g., in terms of the specific constraints on reduplication (cf. Section 1.2). In order to further contribute to the cross-linguistic picture of sign language reduplication, the NGT data are compared to previous findings for other sign languages. Additionally, Section 1.2 showed that reduplication comes with a modality-specific flavor. The patterns attested in NGT are, therefore, also compared to previous findings on reduplication in spoken languages.

The final and third goal is of a theoretical nature: the findings are formalized within OT. As mentioned in Section 1.3, this framework has often been used to account for spoken language reduplication, while sign language data have been considered in only a few studies. No OT-formalization of NGT reduplication is currently available; the present study is the first to offer one. The formalization of sign language data allows me to address the consequences for the universality of OT-constraints, as well as to test to what extent stochastic OT and the Gradual Learning Algorithm (see Section 1.3) can be used to formalize variation in a sign language.

1.5 Overview of the thesis

The next three chapters of this dissertation serve the descriptive and typological goals of the study, as each of them describes one function of reduplication and compares the outcomes to previous studies on spoken and signed languages. First, reduplication of NGT nouns is addressed in **Chapter 2**, which focuses on nominal pluralization. Then, reduplication of predicates is addressed in Chapters 3 and 4. **Chapter 3** describes NGT aspect marking, more specifically, the marking of three types of grammatical aspect, namely the habitual, iterative, and continuative. In **Chapter 4**, NGT reciprocal marking is discussed, focusing mostly on reciprocity between two participants. Apart from reduplication, the results uncover some alternative strategies to express each meaning, which are also described in the three chapters.

Moreover, there are a few other topics to which I keep coming back throughout these three chapters. The first is of a methodological nature, since for all three reduplicative functions, two types of methods are combined: (i) searches were conducted on the translation and gloss tiers in the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008), and (ii) three novel, completely visual elicitation tasks were developed (one for each function, as discussed in the respective chapters). Throughout the dissertation, I discuss some advantages and consequences of the combination of these two methods. Further, a second important thread running through all three chapters relates to the potential restrictions on NGT reduplication. Each chapter addresses which signs are reduplicated in the data and which signs are not, and analyses which potential base sign features (phonological, morphological, or other) may block reduplication. Yet, offering such explanations is not always straightforward, leading to the third and final topic that is woven throughout the three chapters: variation and optionality in NGT reduplication.

Then, the next two chapters serve the theoretical goal of the thesis, as they introduce the OT-formalization of the data presented in Chapters 2–4. **Chapter 5** offers a formalization of NGT plural reduplication, adopting constraint types that have previously been proposed in formalizations of spoken language reduplication. The variation in the data is formalized by employing stochastic OT and the Gradual Learning Algorithm (Boersma 1997; Boersma & Hayes 2001). **Chapter 6** presents a formalization of aspectual reduplication, again applying the Gradual Learning Algorithm to account for the attested variation. The formalization is compared to and combined with that of nominal plurals. The chapter also touches upon how the presented OT-formalizations could be extended to the patterns and variation observed for NGT reciprocal reduplication.

The final chapter, **Chapter 7**, brings together the findings for all three investigated reduplicative functions. After offering a summary of the main results, the chapter presents a general overview of the typological contributions of the study, by discussing how NGT reduplication can be situated with respect to the same process in other spoken and signed languages. Then, the theoretical contributions of the thesis are discussed, and I argue that the formalization of NGT reduplication reveals that there are some inevitable consequences of the modality of signal transmission for such formalizations. Finally, the chapter concludes with some suggestions for future work.

Chapter 2 | Phonological restrictions on nominal pluralization in Sign Language of the Netherlands: Evidence from corpus and elicited data*

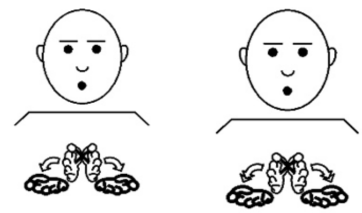
2.1 Introduction

Previous research has shown that sign languages display strong cross-linguistic similarities in their morphological structures. Morphologically complex forms display modality-specific properties since sign languages rarely employ sequential affixation of morphemes; rather, their morphology is largely simultaneous, that is, inflectional and derivational processes often occur stem-internally. Sequential morphological processes do occur, albeit less frequently, and they show less complexity than the simultaneous processes. This division within one language is unique for sign languages (Aronoff, Meir & Sandler 2005).

Given the modality-specific properties of sign language morphology, it is striking that one morphological process is common in both modalities, namely reduplication, i.e., the repetition of (part of) a stem. Interestingly, reduplication is not stem-internal. It has similar functions in spoken and signed languages – for instance, forming the plural of a noun, modifying the verb for aspectual distinctions, or deriving the reciprocal form of the verb. Often – but not always – reduplication is iconic, in that there is a form-meaning correspondence. An example of plural reduplication is given in (1) for Warlpiri, an Australian language (Nash 1980: 130), and in Figure 2.1 for German Sign Language (DGS) (Pfau & Steinbach 2005a; image from Pfau 2016: 216) (see *Notation conventions for glossed sign language examples* for the conventions used in this dissertation).

(1)	*kurdu*	→	*kurdu-kurdu*	
	'child'		'children'	[Warlpiri; Nash 1980: 130]

* This chapter is a slightly modified version of the published article:
van Boven, Cindy. 2021. Phonological restrictions on nominal pluralization in Sign Language of the Netherlands: Evidence from corpus and elicited data. *Folia Linguistica* 55(2): 313–359. DOI: 10.1515/flin-2021-2039.



BOOK – BOOK++

Figure 2.1. Reduplication in DGS (Pfau & Steinbach 2005a; image from Pfau 2016: 216; © John Benjamins, reprinted with permission).

Reduplication is commonly found as a pluralization strategy across sign languages. Yet, previous research suggests that not all nouns can undergo reduplication: phonological features of the base noun have been found to constrain reduplication, and these constraints differ per sign language (Pizzuto & Corazza 1996 for Italian Sign Language (LIS); Sutton-Spence & Woll 1999 for British Sign Language (BSL); Pfau & Steinbach 2005a for DGS).

The present study focuses on reduplication of nouns as a pluralization strategy in Sign Language of the Netherlands (*Nederlandse Gebarentaal*, NGT). Some previous studies have addressed pluralization in this language (Zwitserlood & Nijhof 1999; Harder et al. 2003), and yielded interesting results. However, to date, no comprehensive description of nominal pluralization in NGT is available. Moreover, the studies contradict each other on the role of reduplication: while Zwitserlood & Nijhof suggest that reduplication of the noun sign is not a systematic means to form the plural in NGT, Harder et al. find that it actually is. Therefore, this study aims to offer a comprehensive description of pluralization in NGT, based on both corpus data and elicited data, taking into account potential phonological restrictions.

Section 2.2 provides some background on the phonological structure of signs in general, and on nominal plurals in sign languages specifically. The section concludes with the present study's aims and predictions. Section 2.3 goes into the methodology used, first providing more details on the corpus data set, next describing the data elicitation procedure, as well as the data analysis. Section 2.4 provides an overview of results, while Section 2.5 addresses the variation found, showing how the results complement previous findings on NGT and other sign languages. Finally, Section 2.6 draws some conclusions.

2.2 Nominal plurals in sign languages

While the pluralization of nouns is often mentioned in textbooks and grammatical sketches of sign languages, to date detailed investigations on nominal plurals are only available for a handful of sign languages. Before reporting findings from these studies in Section 2.2.2, in Section 2.2.1, I first introduce basics of the phonological structure of signs that will turn out to be relevant to the discussion of pluralization strategies found across sign languages. Section 2.2.3 then describes how certain phonological properties of the base noun may affect the choice of pluralization strategy. Section 2.2.4 addresses previous research on Sign Language of the Netherlands, the focus of this study. Finally, Section 2.2.5 introduces the main aims and predictions of this study.

2.2.1 Phonological structure of signs

In sign languages, multiple articulators are available, i.e., the two hands. Thus, signs may be one- or two-handed, and they have phonological structure at the manual level. Sublexical building blocks (sometimes called 'parameters') that have been identified are the handshape (hand configuration), place of articulation, and movement (Stokoe 1960; Sandler 1989; for an overview, see Fenlon et al. 2017). These building blocks can be contrastive: for instance, two signs may differ in terms of their handshape alone. Sign languages being visual languages, there is an increased potential for iconicity, that is, the building blocks of a sign may reflect semantic properties of the referent (e.g., Mandel 1977; van der Kooij 2002). This is clear in Figure 2.1 above, which illustrates the iconic sign BOOK in DGS.

It has further been proposed that each of the building blocks can be described in terms of distinctive features, which are organized in feature hierarchies. Various phonological models have been put forward, which differ in feature (under)specification and relationships among features, but details of the models are beyond the scope of this chapter (see, e.g., Liddell & Johnson 1989; van der Hulst 1993; Brentari 1998). In the context of the present discussion, only certain movement and location features will be of relevance.

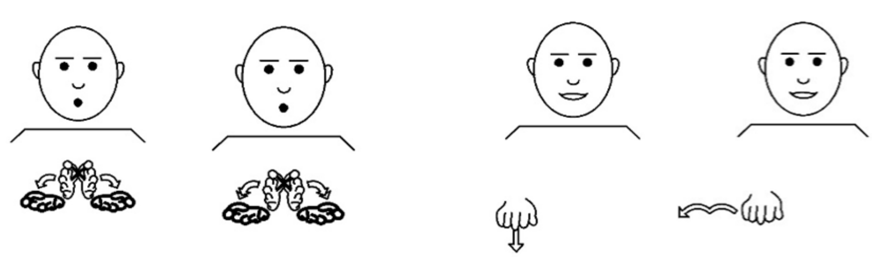
Apart from the manual building blocks, signs are often accompanied by linguistic elements expressed on the body and/or the face, so-called non-manual markers. These non-manual markers may fulfill functions at various grammatical levels (Pfau & Quer 2010). For instance, they have a morphological function when a sign is accompanied by blown cheeks to yield augmentative meaning, or a syntactic function when a headshake accompanies a negated sentence. Relevant to the present discussion is the fact that signs are sometimes accompanied by a mouthing (Boyes

Braem & Sutton-Spence 2001; Bank 2015): a (silent) articulation of a (part of a) spoken language word, as in (2), where the NGT signs BOOK and READ are accompanied by articulations of the Dutch spoken words *boek* ‘book’ /buk/ and *lees* ‘read’ /le:s/, respectively. Note that while in this case the whole words are pronounced, sometimes only part of the corresponding word in spoken language is articulated.

/buk/ /le:s/
(2) […] BOOK READ […].
‘[…] read a book [....].’ [NGT; CNGT0170; S010; 02:46.080]

2.2.2 Plural marking on the noun: manual and non-manual strategies

Across sign languages, different nominal pluralization strategies have been found, which overlap with those identified in spoken languages (for an overview, see for instance Pfau & Steinbach 2006; Steinbach 2012; also see Section 2.2.4 for a summary of previous findings on NGT). First, pluralization by means of reduplication has been described for many sign languages (for instance, Pizzuto & Corazza 1996 for LIS; Sutton-Spence & Woll 1999 for BSL; Pfau & Steinbach 2005a, 2006 for DGS). Noun reduplication comes in two types: simple and sideward. Under simple reduplication, the movement of the noun is repeated at the same location, while sideward reduplication implies that the repetition is combined with a sideward movement, both illustrated in Figure 2.2 with signs from DGS: (a) the noun BOOK undergoes simple reduplication (already illustrated in Figure 2.1 above, but repeated here as Figure 2.2a), while (b) the noun CHILD is pluralized by means of sideward reduplication (Pfau & Steinbach 2005a; images from Pfau 2016: 216).



a. BOOK – BOOK++ b. CHILD – CHILD>+>+

Figure 2.2. Simple (a) and sideward (b) reduplication in DGS (Pfau & Steinbach 2005a; images from Pfau 2016: 216; © John Benjamins, reprinted with permission).

The displacement in sideward reduplication does not add to the meaning; thus, the meaning of the plural form in Figure 2.2b, for instance, is 'children', not '(three) children next to each other'. Moreover, under both types of reduplication, the stem may be repeated more than once – in the DGS examples above, we actually observe triplication rather than duplication. Yet, there is variation among signers in the number of repetitions (e.g., Pfau & Steinbach 2005a, 2006).

The above processes are sequential in nature.[1] However, given the availability of two articulators (the two hands), some sign languages display simultaneous reduplication, where a one-handed noun is articulated with two hands. For instance, in American Sign Language (ASL), one-handed nouns articulated on the face are generally pluralized by repeating the sign alternately with both hands (Wilbur 1987).

Another plural strategy attested in sign languages (as in spoken languages) is zero marking. Some sign languages do not distinguish between the plural and singular form. For instance, Indo-Pakistani Sign Language is reported to usually not distinguish between singular and plural, and plurality thus has to be inferred from the context or is marked by numerals or quantifiers (Zeshan 2000). In other languages, such as DGS, zero marking occurs when there is a numeral or quantifier within the determiner phrase (DP), that is, nominal pluralization is blocked by the presence of a numeral or quantifier (Pfau & Steinbach 2005a).

Apart from manual marking, mouthings may also play a role in pluralization. For instance, for Norwegian Sign Language (NSL), Halvorsen et al. (2014, in Quer et al. 2017) describe that a mouthing accompanying a reduplicated noun may be lengthened, as for example the mouthed Norwegian word *garn* 'skein' /gɑːɳ/ in (3a). While changes in the mouthing thus may go hand in hand with reduplication, they may also be the sole marker of plurality: a zero-marked noun may be accompanied by a mouthing of the plural Norwegian word as in (3b), where GUTT 'boy' is not reduplicated, but accompanied by the plural form of the Norwegian noun, i.e., *gutter* 'boys' /gʉtər/ (Halvorsen et al. 2014, in Quer et al. 2017: 246–247).

[1] A simultaneous pluralization strategy that is not discussed here is numeral incorporation, under which specific nouns (e.g., DAY, WEEK in NGT, or POUND in BSL) take on the handshape of a numeral (see, e.g., Sutton-Spence & Woll 1999; Jones 2013; Ktejik 2013).

(3) a.
/gɑːɳ/ → /gɑ:::ɳ/
GARN → GARN++
'skein' → 'skein(PL)'
[NSL; Halvorsen et al. 2014, in Quer et al. 2017: 246]

b.
/gʉt/ → /gʉtər/
GUTT → GUTT
'boy' → 'boys'
[NSL; Halvorsen et al. 2014, in Quer et al. 2017: 247]

2.2.3 Phonologically triggered allomorphy

As described above, several pluralization strategies have been found across sign languages. Often, one sign language has multiple pluralization strategies at its disposal. Two of the phonological building blocks, i.e., place of articulation and movement type, have been shown to influence the choice of pluralization strategy in several sign languages. This phonologically triggered allomorphy is the focus of this section. First, the different phonological noun types that have been found to undergo different pluralization strategies will be introduced.

Phonologically triggered allomorphy was first described for DGS by Pfau & Steinbach (2005a, 2006), who distinguish four different phonological noun types and show that different noun types undergo different pluralization strategies – as will become clear, these phonological constraints differ per sign language. While adopting the basic phonological noun types distinguished by Pfau & Steinbach, I also make more fine-grained distinctions in terms of phonological features. An overview of the distinctions made here is provided in Figure 2.3. Note that Pfau & Steinbach (2005a) use slightly different abbreviations for the different noun types, i.e., B-, L-, M-, and C-nouns; for readability, I adopt the more transparent abbreviations body-, lat-, mid-, and comp-nouns.

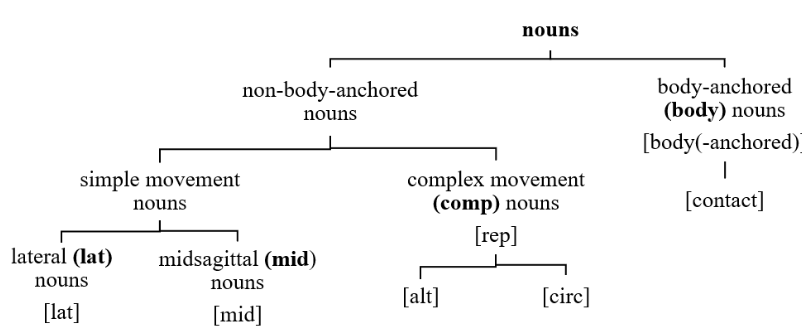
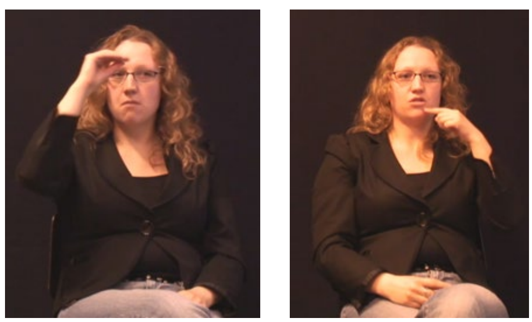


Figure 2.3. Noun types distinguished in the present study (based on Pfau & Steinbach 2005a: 118).

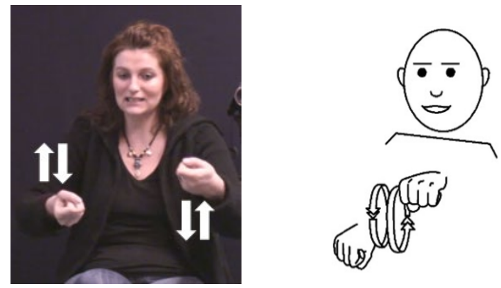
First, I follow Pfau & Steinbach in making a distinction based on place of articulation, that is between nouns that are body-anchored (body), and those that are not. All nouns that have a feature [body(-anchored)] are subsumed under body-nouns. 'Body-anchored' does not necessarily imply that the articulation of the noun involves contact with the body; rather, it concerns nouns that are not articulated in neutral space, but which have a place of articulation which is clearly related to the body, as the NGT signs in Figure 2.4. While MAN does not contact the body (a), MOTHER contacts the chin (b). Within the class of body-nouns, I therefore make a distinction between nouns that have a feature [contact], and nouns that are not specified for that feature.



a. MAN b. MOTHER

Figure 2.4. Body-anchored (body) nouns in NGT: (a) without body contact [CNGT0124; S008; 00:15.520] and (b) with body contact [CNGT0138; S008; 01:10.760].

Next, there are nouns that are not body-anchored. For these, I follow Pfau & Steinbach in distinguishing between two types, based on their movement specification: nouns with complex movement and nouns with simple movement. All complex movement (comp) nouns have a repeated movement, i.e., a [rep] feature. Additionally, they may have a circular [circ] and/or an alternating [alt] movement. Two examples are provided in Figure 2.5, where CAR involves a repeated and alternating movement (a), and BICYCLE is repeated, alternating and circular (b).



a. CAR b. BICYCLE

Figure 2.5. Complex movement (comp) nouns in NGT,[2] involving repeated and alternating (a) [CNGT0171; S010; 04:10.4] or circulating (b) movement (Pfau 2016: 217; © John Benjamins, reprinted with permission).

On the other hand, simple movement nouns are not specified for repetition in their base form. Like Pfau & Steinbach, I make a further distinction within the group of simple movement nouns by distinguishing midsagittal (mid) nouns from lateral (lat) nouns, the difference being their place of articulation. While both are articulated in the neutral signing space in front of the signer's body, mid-nouns "are specified for a particular relation to the midsagittal plane", while lat-nouns "are signed on the lateral side of the signing space, which, of course, is dependent on the handedness of the signer" (Pfau & Steinbach 2005a: 118). Thus, the place of articulation of lat-nouns is lateral, i.e., they have a [lat] feature, while mid-nouns are midsagittal, i.e., [mid]. Examples of both noun types from DGS were already given in Figure 2.2, namely the mid-noun BOOK and the lat-noun CHILD. In NGT, the signs BOOK and CHILD have the exact same form as in DGS, and thus NGT BOOK is a mid-noun, while NGT CHILD is a lat-noun.

Pfau & Steinbach (2005a, 2006) show for DGS that the noun type influences the choice of pluralization strategy. First, lat-nouns undergo sideward reduplication, as was already illustrated for the lat-noun CHILD in Figure 2.2b above; other pluralization strategies, such as simple reduplication, are ungrammatical for lat-nouns in DGS. For mid-nouns, on the other hand, Pfau & Steinbach show that sideward reduplication is ungrammatical. Instead, mid-nouns are pluralized by means of simple reduplication as already shown for the mid-noun BOOK in Figure 2.2a above. Finally, both comp-nouns and body-nouns do not undergo any type of reduplication and thus are zero-marked: for both noun types, the plural is not formally distinguished from the singular. Note that zero marking is claimed to be

[2] Note that in Pfau (2016), Figure 2.5b is actually given as an example from DGS. However, since the noun BICYCLE has the exact same form in NGT as in DGS, I use it as an NGT example here.

ungrammatical for mid- and lat-nouns in DGS – they necessarily undergo simple or sideward reduplication, respectively.

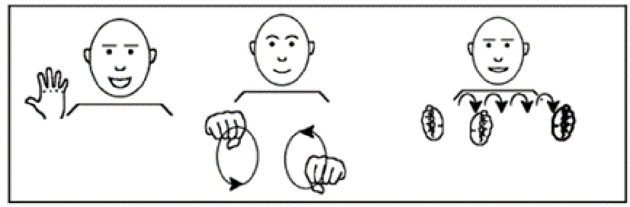
It turns out that these phonological constraints on pluralization differ per sign language (see, e.g., Wilbur 1987 for ASL; Pizzuto & Corazza 1996 for LIS; Sutton-Spence & Woll 1999 for BSL). I will come back to the cross-linguistic differences regarding constraints on reduplication in Section 2.5.3.

2.2.4 Previous studies on NGT: disentangling pluralization and spatial distribution

We now turn to pluralization in NGT, the language under investigation. Zwitserlood & Nijhof (1999) previously investigated nominal pluralization in this language by eliciting singular and plural forms of several nouns from four NGT signers. Participants were presented with pictures of singular and plural objects and were instructed to explain what was in the picture. Strikingly, the authors did not find reduplication of the noun itself to be a systematic pluralization process. Instead, they found that plurality was commonly marked by means of localization. When localizing entities in the signing space, signers associate a certain point in space with a specific entity – a strategy that is found to be ubiquitous in sign languages, independent of number marking. Localizing entities in space can be done by means of, for instance, pointing (index) or classifier signs.

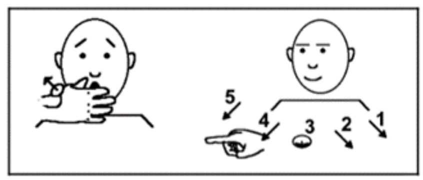
I illustrate the localization strategy found by Zwitserlood & Nijhof by means of two examples. First, in their data, the noun was often followed by a contour sign or a classifier, articulated at different locations. These locations indicate the spatial arrangement of the plural objects. In Figure 2.6a, the noun BICYCLE is followed by a classifier handshape that is localized at several locations next to each other in the signing space, indicating that there are five bicycles in a row (Zwitserlood & Nijhof 1999: 69). Similarly, nouns were sometimes also followed by indexes pointing at different locations, again localizing the plural referents in space. This is illustrated in Figure 2.6b, where the noun APPLE is followed by five index signs, indicating the locations of the apples (Zwitserlood & Nijhof 1999: 70). These processes were not found to be obligatory.

a.



FIVE BICYCLE CL$_{\text{BICYCLE}}$.AT.SEVERAL.LOCATIONS

b.



APPLE INDEX$_{3a,3b,3c,3d,3e}$

Figure 2.6. Pluralization of the NGT noun BICYCLE by means of localizing classifiers (a), the translation is: 'There are five bicycles (in a row).'; and pluralization of the NGT noun APPLE by means of localizing index signs (b), the translation is: 'There are several apples.' (adapted from Zwitserlood & Nijhof 1999: 69–70; © Inge Zwitserlood, reprinted with permission).

It is not surprising that Zwitserlood & Nijhof found this type of pluralization by means of localization. As the authors note, the elicitation pictures showed objects in a certain spatial arrangement; consequently, signers expressed these spatial arrangements in their signed productions. Thus, the localization of contour signs, classifiers, and index signs actually does not express a 'pure' plural but adds spatial meaning to the signers' productions. Moreover, the authors did not take into account potential phonological restrictions. Still, they also found cases of simple reduplication of the noun. Two explanations are offered: (i) the signer repeated the noun sign while thinking about how to tell what was on the picture, or (ii) the number of syllables in the mouthing of the Dutch plural word influenced the number of movements in the sign – indeed, previous studies have described a tendency for hand and mouth movement to be synchronized (Sandler 1999; Boyes Braem 2001).

However, the possibility that nominal reduplication plays a role in NGT pluralization should not be excluded since another study on the topic by Harder et al. (2003) actually found reduplication of the noun sign. Their data set consisted of material for students of NGT at the *Nederlands Gebarencentrum* (Dutch Sign Centre). While Harder et al., too, describe localization of classifiers and index signs to be one strategy, nominal reduplication is also mentioned. They even identify some phonological restrictions: reduplication was found to be ungrammatical for signs with a complex movement in their base form as well as for signs articulated on or above the crown. Also, while the plural of body-anchored signs was formed by simple reduplication, the plural of signs articulated in neutral space was usually formed by sideward reduplication. Moreover, they found that one-handed base signs were sometimes articulated with two hands in order to indicate plurality. Unlike in DGS, Harder et al. also describe that reduplication is not blocked by numerals/quantifiers in NGT. Notably, these findings differ from what has been reported by Zwitserlood & Nijhof (1999). Harder et al. offer the possible explanation that more different signs were included in the data set, and that phonological properties were taken into account in this study, but not in the study by Zwitserlood & Nijhof.

While these two studies certainly paint a first picture of the pluralization strategies in NGT, no comprehensive and systematic description of the 'pure' plural form of NGT nouns, taking into account the different noun types, has been offered so far. The studies contradict each other on the role of reduplication, and it remains unclear what the plural form looks like when it is completely disentangled from localizing plural referents in space.

2.2.5 The present study

The aim of the present study is to systematically describe the nominal pluralization strategies in NGT, completely disentangling pluralization from localization. Thus, it focuses on those strategies which convey plural meaning without a specific spatial arrangement. It also describes the potential phonological restrictions on these pluralization strategies, based on the phonological noun types introduced in Section 2.2.3. Finally, it compares the findings to other sign languages.

Based on the previous literature, several factors are investigated. The first concerns the relation between noun type and pluralization strategy. Given that reduplication is a common pluralization strategy in sign languages and because it was found for NGT by Harder et al. (2003), reduplication is expected to be one of the main pluralization strategies. Moreover, reduplication is expected to be constrained by phonological properties of the base noun. Following Harder et al. (2003), body-nouns are expected to undergo simple reduplication, while mid-nouns may undergo sideward reduplication. Comp-nouns are expected to be zero-marked. For lat-nouns, no predictions can be formulated based on Harder et al. (2003) – possibly, they undergo sideward reduplication as they do in DGS.

Second, this study also investigates the relation between the pluralization strategy and presence of numerals/quantifiers. In DGS, numerals/quantifiers were found to block reduplication (Pfau & Steinbach 2005a, 2006), while Harder et al. (2003) describe that this is not the case in NGT. Finally, the number of repetitions in reduplication is looked into. It is expected that there is individual variation as Pfau & Steinbach (2005a, 2006) also found for DGS. Possibly, there is a relation between mouth movement and number of repetitions as suggested by Zwitserlood & Nijhof (1999) for NGT.

2.3 Method

This study combines two methodologies: corpus analysis and data elicitation. The starting point is a corpus search in the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008), which should provide us with a first idea of what pluralization looks like in this language, and which potential restrictions can be identified. However, a well-known caveat in using corpus data is that there is no guarantee that these searches will yield the specific noun types that are required for generalizations. Therefore, the corpus data are supplemented with data elicitation in order to make sure that all relevant noun types are included in the analysis.

2.3.1 Corpus data collection

The Corpus NGT consists of recordings of 92 deaf NGT signers (age 17–84 years) and contains over 70 hours of video data. Participants were asked to perform several tasks, resulting in both monologues and dialogues. For instance, signers were asked to discuss issues related to Deafness, to retell video clips (i.e., narratives), and to tell stories about past experiences. Moreover, participants also spontaneously talked about topics of their choice; the data are thus partly elicited, and partly (semi-)spontaneous.[3] Part of these video data has been transcribed using the annotation tool ELAN (Crasborn & Sloetjes 2008), on several tiers.[4] Three tiers are of importance here. First, annotations on the Gloss tiers show the Dutch glosses of the NGT signs; separate tiers are created for the dominant and non-dominant hand. Moreover, there are annotations on the Translation tier, which show translated sentences in Dutch, and the Mouth tier, on which mouth actions are annotated (Crasborn et al. 2015).

The annotated part of the corpus was searched for plural nouns. According to the Corpus NGT Annotation Conventions, "although many NGT signs do not have a plural form, other signs do. These forms […] are annotated with the gloss for

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[3] The complete Corpus NGT, including elicitation materials and metadata, is available online at: https://archive.mpi.nl/tla/islandora/object/tla:1839_00_0000_0000_0004_DF8E_6?asOfDateTime=2018-03-02T11:00:00.000Z (Crasborn et al. 2006–2017).

[4] See the Annotation Conventions of the Corpus NGT, Version 3: https://doi.org/10.13140/RG.2.1.1779.4649 (Crasborn et al. 2015).

the singular form with an added '.PL' (and not with the plural form of the Dutch gloss)" (Crasborn et al. 2015: 15). I therefore searched for '.pl' on the Gloss tier to find nouns that are overtly marked for plurality. In total, this yielded 284 search hits. Note that two-handed nouns are glossed for .PL twice, namely on the Gloss tier for the dominant hand, and on the Gloss tier for the non-dominant hand. After excluding these double appearances, 221 tokens remained. Subsequently, four tokens were excluded: one because the noun actually referred to a singular referent, one because the video file did not work, and two because the signs were not nouns, but rather a point to the hand and the name of a city. This left 217 tokens for analysis.

However, it was suspected – based on previous research – that certain signs *cannot* undergo plural reduplication. I also searched − in order to find out whether specific phonological properties could be held responsible for this − for signs that appear in a 'plural context' but are not glossed for .PL, indicating that it is likely that they are not overtly marked for plurality. For this, I searched on the Translation tier for the plural of 12 frequent Dutch nouns, which were taken from a list of the 5,000 most frequent words in the *Corpus Gesproken Nederlands* ('Corpus Spoken Dutch'; Dutch Language Institute 2014). From this list, the most frequent nouns were selected that were not yet included in the .PL annotations (i.e., *huizen* 'houses', *dagen* 'days', *weken* 'weeks', *scholen* 'schools', *vrouwen* 'women', *mannen* 'men', *boeken* 'books', *moeders* 'mothers', *vaders* 'fathers', *problemen* 'problems', *treinen* 'trains', and *cafés* 'cafés'). It is important to include these nouns since they receive a plural interpretation (and thus translation), even though they are not morphologically marked for plurality – at least according to their glosses. Searching for these nouns yielded 114 search hits. After excluding tokens that involved spatial distribution and tokens in which the NGT noun actually referred to a singular entity, 80 tokens remained for analysis. Thus, in total, 297 plural noun tokens (22 types) from the corpus were analyzed.

2.3.2 Data elicitation

2.3.2.1 Participants

In addition to the corpus data, data were elicited from five deaf participants, who grew up with NGT (one male, four female, age range 25–62, mean age 38.4) from varying sign language regions in the Netherlands.[5] Three participants come from a hearing family, while the other two participants have deaf family members. All participants signed informed-consent forms, allowing me to use the data gathered.

[5] There is regional lexical variation in NGT between the north, the south, and the west of the Netherlands (Schermer 2004), which should be kept in mind since participants identified themselves with various regions.

However, two of them did not grant permission to have their faces shown on figures. In the following, participants will be referred to as p01–p05.

2.3.2.2 Stimuli

For the purpose of this study, i.e., eliciting plural nouns without localization, a gap-filling task was designed: participants were presented with signed (carrier) sentences in which the plural noun was omitted and replaced by a question mark sign, as shown in Figure 2.7. Participants were asked to repeat the sentence and fill in the gap, based on a picture that shows the targeted plural noun. The picture was shown during the entire carrier sentence. Crucially, spatial configuration is not relevant in the signed contexts, such that only plurality would be expressed by the participants. Participants were explicitly instructed in NGT to only fill in the gap without changing the sentence, such that plurality would indeed be marked on the noun and not on, for instance, the verb. A more elaborate overview of the task and its advantages and disadvantages is provided in van Boven (2020), and an English translation of the elicitation task, including instructions, is publicly available (van Boven 2023a).

INDEX$_1$ BABYSITTER.

OFTEN QUESTION.MARK PLAY.

Figure 2.7. Elicitation clip from the gap-filling task (targeted answer: INDEX$_1$ BABYSITTER. OFTEN **CHILD(+>+>)** PLAY 'I'm a babysitter, I often play with children.').[6]

[6] Stimulus picture 'children' from Dreamstime.com, Image ID: 5937013, Copyright Monkey Business Images, https://www.dreamstime.com/monkeybusinessimages_info.

The task aimed at eliciting eight noun (sub)types, following the phonological distinctions discussed in Section 2.2.3, and shown in Figure 2.3. Plural nouns were targeted for each (sub)type.[7] An overview of the targeted nouns is given in Table 2.1.

Table 2.1. Targeted nouns in the gap-filling task, by noun type (N = 21).

Noun type	Phonological features	Gloss
body-nouns	[body], [contact]	FARMER, HUMAN, LAMP, SHOP, HOTEL
	[body]	GLASSES,[8] WOMAN, MAN, MOVIE
lat-nouns	[lat]	CHILD, DOLL, WINE.BOTTLE
mid-nouns	[mid]	BOOK, CHAIR, TROUSERS
comp-nouns	[rep]	PILLOW, BABY, MOUSE
	[rep], [circ]	TRAIN
	[rep], [alt]	CAR
	[rep], [circ], [alt]	BICYCLE

All 21 nouns were targeted twice: once in a sentence without a numeral/quantifier, and once preceded by a numeral/quantifier.[9] This resulted in a total of 42 carrier sentences for plural nouns.

Moreover, 11 sentences which elicit singular nouns were added. The function of these was twofold: first, they ensured that participants did not simply reduplicate all signs because they realized that the task is targeting plurals. Second, they elicited the singular forms of those nouns that, according to the NGT dictionary, have an inherent repetition in their citation form, as well as of nouns that were suspected to involve an inherent repetition for at least some signers,[10] such that the number of repetitions in singulars and plurals could be compared within signers.

[7] The nouns were categorized based on their citation form in the NGT dictionary (https://www.gebarencentrum.nl/Gebarenwoordenboek). There may be variation in how participants actually articulate the nouns, leading to a different categorization – see Section 2.3.3 for further discussion. Moreover, for some nouns, I suspected that they contain an inherent repetition for some signers but not for others – for these I also elicited the base form, see below.

[8] Note that the English glosses TROUSERS and GLASSES are underlyingly plural, but the same is not true for the corresponding Dutch words/glosses *broek* and *bril*, or the NGT signs.

[9] The task contains the following numerals and quantifiers: TWO, THREE, FOUR, FIVE, THREE OR FOUR, TEN; (MANY) DIFFERENT, SEVERAL, FEW, MOST, MANY.

[10] Consequently, there are eleven sentences which elicit singular forms with an inherent repetition, while only six comp-nouns are included in Table 2.1. The reason is that some body-nouns also involve inherent repetition, e.g., MOVIE. I also suspected that some nouns I

The 53 elicitation clips were presented by a deaf signer in a semi-randomized order, the same one for all participants. Participants never saw more than four consecutive clips eliciting plural nouns without a clip eliciting a singular noun in between, never more than two carrier sentences with a numeral/quantifier in a row, never the same target noun twice in a row, and never more than two nouns of the same type in a row.

2.3.2.3 Pilot study

Before conducting the gap-filling task, it was piloted with one signer – the results of this signer are not taken into consideration below. The pilot only served to make sure the task works and indeed elicits plural nouns without localization. To this end, I also discussed the task and possible responses with this signer after she had finished the test, and she offered her advice on how the test could be improved.

The pilot study showed that, indeed, the carrier sentences elicit plurals without spatial distribution – the participant signed only the 'pure' plural forms. Nevertheless, five elicitation clips were changed for the final version of the task. First, one elicitation clip elicited the singular rather than the plural noun (i.e., for the body-noun LAMP), and therefore a different carrier sentence − which more likely would elicit a plural − was recorded. Second, the two sentences that were meant to elicit the lat-noun PERSON elicited HUMAN instead (a body-noun that was already elicited by other sentences). After consulting another deaf signer, it was clear that eliciting PERSON and not HUMAN would be rather difficult, if not impossible. Therefore, the two sentences meant to elicit PERSON were replaced by two sentences that aimed at eliciting WINE.BOTTLE, another lat-noun. Finally, one of the elicitation clips that was meant to elicit the plural of the mid-noun BOOK elicited the singular instead. Apparently, the picture did not clearly indicate that multiple books were aimed at, and therefore it was replaced by a clearer picture. For consistency, the picture for the other clip eliciting the plural of BOOK was also replaced.[11]

initially categorized as simple movement nouns, may sometimes also involve an inherent repetition in their citation form, e.g., DOLL. However, as the results for the singular carrier sentences showed that DOLL can actually be analyzed as a lat-noun – as I initially categorized it – rather than a comp-noun, I included it as a lat-noun in Table 2.1.

[11] Note that although, at this point, it was unclear what the plural form would look like exactly, from the mouthings, the context, and discussions following the test, it became clear in which cases the participant meant the singular rather than the plural form. This also became clear from a comparison to the sentences with quantifiers, where the signer did sign plural forms of LAMP and BOOK because both signs were reduplicated.

2.3.2.4 Procedure

After the pilot, five other participants participated in the actual task. They first answered a background questionnaire (on their age, sex, sign region, the hearing status of their family members, and the languages they know). Then they were presented with a clip that showed the instructions for the task in NGT, signed by a deaf signer. Participants were told that the researchers are interested in different nouns, signed in specific contexts. It was explained that signers will see sentences with one noun being omitted, and that the missing sign is shown to them on a picture. They were further asked to *exactly* repeat the sentence, only replacing the question mark by an actual sign, based on the picture. Next participants were shown an example sentence and the relevant answer. The example elicited a singular noun so as not to influence participants' plural marking strategies. Moreover, the target noun in this carrier sentence (BREAD) was not used in the actual task.

The stimuli were presented in one long video on a computer screen in front of the participant. After each elicitation clip, participants paused the video before responding and pressed 'Play' again after responding, such that there was no time pressure. Four participants were tested in a recording studio, with one researcher present, whom they could ask questions if necessary. One participant did the test at home without a researcher present but with clear instructions in NGT regarding the procedure. Since she went through the test in the same manner as the other participants, her results are included below. In total, 189 plurals nouns were elicited.

2.3.3 Analysis of both data sets

Both data sets were annotated in ELAN (Crasborn & Sloetjes 2008), and statistical analyses were conducted using R (R Development Core Team 2008). This section first goes into the data annotation, and then introduces the statistical analyses.

2.3.3.1 Data annotation

For both data sets, only nouns referring to plural referents without spatial configuration were included in the analysis – this was decided mainly based on context. For the annotations, several tiers were created (see Figure 2.8).

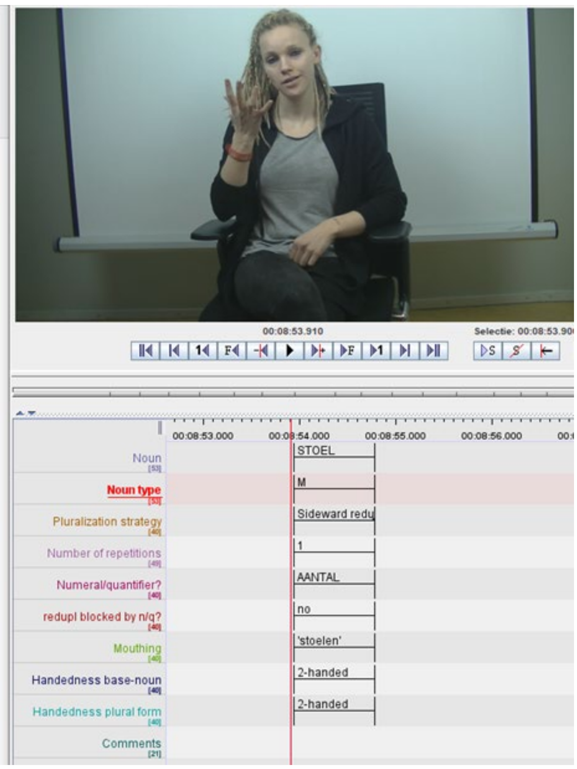


Figure 2.8. Screenshot from ELAN (Crasborn & Sloetjes 2008), showing the tiers and annotations created for analysis of plural nouns in both data sets.

Figure 2.8 shows that the plural nouns were annotated for the following characteristics:

(i) *phonological properties of the base noun.* The data were categorized into noun types based on the phonological properties discussed in Section 2.2.3. Nouns were categorized based on how they were actually articulated – for this reason, one and the same noun can be categorized differently for different signers. For instance, in the data elicitation, some participants made body contact while signing GLASSES, while others did not – as a consequence, this noun was sometimes annotated as body-noun with [contact], and sometimes as body-noun without [contact]. Related to this, even though the elicitation task aimed at eliciting all different noun types, sometimes the clips elicited noun types that were not the target. This has several reasons: (i) some clips elicited a noun that was not the target, and therefore of a different type (e.g., FRIEND instead of HUMAN, where FRIEND was still included in the analysis even though it has phonological properties different from the target); (ii) some clips elicited a different variant of the target noun, which belongs to a different type (e.g., for HOTEL, there was a body-noun and a mid-noun variant); and (iii) in some cases, participants did not repeat the sentence exactly but adapted the elicitation contexts such that a singular rather than a plural noun was articulated.

(ii) *pluralization strategy.* In the analysis, three possible pluralization strategies were anticipated. First, I annotated 'simple reduplication' when the movement of produced nouns is repeated in comparison to the base noun, which, here, is taken to be the citation form of the respective noun.[12] However, for nouns with inherent repetition (comp-nouns and some body-nouns), there may be individual variation in the number of repetitions in the base noun (as Zwitserlood & Nijhof 1999 also found). Therefore, I compared the elicited plural forms of these nouns to the elicited singular forms; these were within-participant comparisons. Hence, if for instance, a participant articulated the singular comp-noun BICYCLE with two circular movements, the same noun in the plural context was analyzed as reduplicated if it involved more than two circular movements (i.e., three or more). Second, 'sideward reduplication' was annotated when the noun was not only repeated but when a sideward movement was also involved. Third, I annotated 'zero marking' when the referent of the noun clearly was a plural entity (based on context), yet no manual marking on the noun could be identified. Of course, it is possible that NGT displays additional pluralization strategies, and thus any other formal adaptation of the noun that possibly indicates plurality was also annotated (such as adding the non-dominant hand, i.e., simultaneous reduplication). Finally, it should be noted that during data elicitation participants sometimes articulated the same noun twice within one sentence; in those cases, only one instance was included in the data analysis. If only one of the two instances was pluralized while the other was not, the pluralized noun was included.

(iii) *number of repetitions.* If the noun was annotated for (simple or sideward) reduplication, I counted how often the base noun was repeated. For elicited nouns with inherent repetition, this, again, involved within-participant comparison to the singular forms. Thus, if a participant articulated the singular comp-noun BICYCLE with two circular movements, for example, one repetition was counted if the *entire* noun was repeated, that is, in this case if four circular movements were articulated. In some cases, the reduplicated comp-noun was articulated with more movement repetitions than the singular form, yet not twice as many. In this particular example, if the plural form of BICYCLE involves three circular movements, this was annotated as 'less than one repetition' since it does not involve a complete repetition of the entire base noun.

(iv) *presence of a numeral and/or quantifier.* It was analyzed whether the plural noun was accompanied by a numeral and/or a quantifier. This was done not

[12] Based on the NGT dictionary: https://www.gebarencentrum.nl/Gebarenwoordenboek.

only for the corpus data, but also for the elicited data since participants sometimes omitted numerals/quantifiers that were present in the elicitation sentences but also sometimes added numerals/quantifiers when the elicitation context did not contain one. For the corpus data, whenever a numeral/quantifier was present, it was only annotated which numeral/quantifier this was. The elicited sentences containing a numeral/quantifier, however, were also compared to the sentences without a numeral/quantifier but with the same plural noun (because all plural nouns were elicited in both contexts). This provided insight into whether or not the numeral/quantifier blocked pluralization: if the noun was pluralized by the same participant in the sentence without numeral/quantifier but not in the sentence with numeral/quantifier, then it was annotated that pluralization was blocked.

(v) *mouthings.* Another factor of interest was potential non-manual marking of plurals, specifically mouthings, and their relation with number of repetitions. For both data sets, I annotated which Dutch word (or part of word) was mouthed. If there was no mouthing or if the mouthing was not clearly visible, this was also annotated. A deaf signer checked a representative sample of these annotations. I showed her 16 signs from the data set (eight from the corpus and eight from the elicited data), and asked her to write down the mouthings accompanying these signs. For 13 of those, she noted the same mouthing as I did (81.2%). The agreement between raters was measured using the irr package (Gamer et al. 2019). The agreement was substantial (Cohen's Kappa = 0.76) and greater than would be expected by chance ($z = 5.69$, $p < 0.001$). Moreover, I also showed her some nouns where the mouthing was deemed unclear. For some of those, the signer could discern a mouthing, while for others the mouthing was not clear to her either.

Note that 103 of the nouns extracted from the corpus (i.e., 34.7%) were already annotated for mouthings (on the Mouth tier); in those cases, the mouthings already annotated were adopted, and a deaf signer was not asked to check them (since the corpus annotators are fluent NGT signers).

(vi) *other factors.* Some additional tiers were created. First, it was annotated whether the base noun is one- or two-handed, and whether the plural form is one- or two-handed. Moreover, on a Comments tier, I noted anything else that might be relevant in the context of pluralization – most notably, for the elicited data, whenever the pluralization was not (only) marked on the noun but on another element, this was annotated. A complete list of annotation values per tier is given in Appendix 2-A. Moreover, all data annotations for both data sets are publicly available (van Boven 2023a).

2.3.3.2 Statistical analyses

To investigate the relevant factors introduced in Section 2.2.5, three statistical analyses were conducted. First, I analyzed statistically whether certain phonological properties block reduplication in NGT – specifically [body] and [rep] as was found for other sign languages. Second, I analyzed statistically whether numerals and quantifiers block reduplication in NGT. For both of these analyses, I fitted generalized linear mixed-effects models using the lme4 package (Bates et al. 2015). For each analysis, I built a model with zero marking as the dependent variable, which was converted into a binomial factor with two levels: 'yes' or 'no', since it was only relevant whether all types of reduplication were blocked for body- and comp-nouns and for sentences with a numeral/quantifier. For the first model, noun type and data type were included as fixed effects. For the second model, presence of numeral/quantifier and data type were included as fixed effects. Data type was included to check whether there were differences between the corpus and the elicited data. With the aim to fit a maximal model justified by the design (Barr et al. 2013), a random intercept for subject was also included in both models as well as a by-subject random slope for noun type in the first model and for presence of numeral/quantifier in the second.

For the first model, I used orthogonal sum-to-zero contrast coding for the noun-type variable. I set the following comparisons: a) body-, lat-, and mid-nouns against comp-nouns (contrast coded as -0.25, -0.25, -0.25, +0.75, respectively); b) lat- and mid-nouns against body- and comp-nouns (contrast coded as -0.25, -0.25, +0.25, +0.25, respectively); and c) comp-, lat-, and mid-nouns against body-nouns (contrast coded as -0.25, -0.25, -0.25, +0.75, respectively). I also used orthogonal sum-to-zero contrast coding for the data type variable. Corpus data was coded as -0.5 and elicited data as +0.5.

For the second model, I used orthogonal sum-to-zero contrast coding for the numeral/quantifier variable. No numeral/quantifier present was coded as -0.5 and numeral/quantifier present was coded as +0.5. I also used orthogonal sum-to-zero contrast coding for the data type variable. Corpus data was coded as -0.5 and elicited data as +0.5.

To avoid problems of model convergence in both models, the number of possible iterations of the BOBYQA optimizer was increased up to 1.000.000.

Finally, it was analyzed statistically whether there is a correlation between the number of syllables in the mouthing and the number of repetitions in the noun. First, the data were trimmed, i.e., I excluded (i) nouns for which the number of repetitions was unclear and (ii) unclear mouthings. I then applied a Pearson correlation test to the trimmed data to test the correlation between number of repetitions and the number of syllables in the accompanying mouthing.

The statistical analyses (a .Rmd-file and an html version) are publicly available (van Boven 2023a).

2.4 Results

2.4.1 Data overview

In total, 297 plural nouns were extracted from the Corpus NGT, and 189 plural nouns were elicited. For an overview of the nouns in both data sets, see Table 2.2.[13] Appendix 2-B shows the specific nouns that are included under each type.

Table 2.2. Plural nouns in the corpus and elicited data sets (tokens).

Noun type	Corpus	Elicited	***Total***
body-nouns	88	97	*185*
lat-nouns	194	30	*224*
mid-nouns	11	26	*37*
comp-nouns	4	36	*40*
Total	*297*	*189*	*486*

As mentioned in Section 2.3.3, some carrier sentences elicited nouns that were not targeted. These nouns were included in the analysis, and therefore, the elicited data are not equally distributed over the different noun types. Furthermore, as also mentioned, sometimes carrier sentences did not elicit plural nous as planned (but rather singulars), and therefore the total of elicited plurals does not add up to the expected 210 nouns (i.e., 42 plural elicitation contexts for five signers). The data are also not equally distributed over the different noun types for the corpus data set. Notably, comp- and mid-nouns are under-represented. Strikingly, comp-nouns occur much less frequently in the spontaneous corpus data than in the elicited data.[14]

[13] For the body-nouns, 53 corpus nouns and 60 elicited nouns are specified for [contact], while the other 35 corpus nouns and 37 elicited nouns are not. For the comp-nouns, one corpus noun and ten elicited nouns are specified for [alt], one corpus noun and ten elicited nouns are specified for [circ], and no corpus nouns but seven elicited nouns are both [circ] and [alt]. The other two corpus comp-nouns and nine elicited comp-nouns involved neither [circ] nor [alt], i.e.,they only contain a repeated movement.

[14] A reviewer pointed out that the rarity of comp-nouns in the naturalistic data – and by extension, in the language – might be associated with different patterns of pluralization. This was not systematically analyzed here, but as Table 2.4 shows, comp-nouns at least undergo simple reduplication, just as other noun types. It is striking, however, that a large percentage of comp-nouns is zero-marked. Possibly, this is related to the fact that comp-nouns occur less frequently than any other noun type in naturalistic language data.

Further, while all lat-nouns in the data are one-handed signs, the analyzed mid- and comp-nouns are all two-handed.[15] The class of body-nouns includes one- (N = 134 tokens) and two-handed (N = 51 tokens) signs. Moreover, while the classes of body- and lat-nouns include both animate and inanimate nouns, all mid-nouns refer to inanimate entities, and comp-nouns mostly refer to inanimate entities – BABY is the only exception (see Appendix 2-B).

The following sections discuss the relation between pluralization strategies and the different noun types (2.4.2), the relation between reduplication and the presence of a numeral or quantifier (2.4.3), as well as the number of repetitions in the nouns and its relation to mouth movement (2.4.4). The section concludes with a discussion of plural marking on elements other than the noun (2.4.5).

2.4.2 Noun types and pluralization strategies

Table 2.3 shows the distribution of pluralization strategies found in both data sets, irrespective of noun type. Table 2.4 shows the percentages of the pluralization strategies for the specific noun types in the corpus and elicited data.

Table 2.3. Distribution of pluralization strategies in the corpus and elicited data sets.

Strategy	*Total*	Corpus NGT	Elicited
Zero marking	*148*	76	72
Simple reduplication	*133*	62	71
Sideward reduplication	*197*	153	44
Others	*8*	6	2
	Total	*297*	*189*

[15] While one-handed comp-nouns exist in NGT (e.g., SIREN), but happened not to be included in the data set, I suspect that there are no one-handed mid-nouns in NGT. One-handed nouns articulated on the midsagittal plane are also body-anchored (e.g., APPLE), and are therefore specified as body-nouns in the present classification.

Table 2.4. Pluralization strategies per noun type in the corpus and elicited data (percentage); boldface indicates frequent strategies.

Noun type	***N (total)***	**Zero marking**	**Simple reduplication**	**Sideward reduplication**	**Others**
Body	*185*	**74 (40.2%)**	**103 (55.7%)**	6 (3.2%)	2 (1.1%)
Lat	*224*	**35 (15.6%)**	4 (1.8%)	**181 (80.8%)**	4 (1.8%)
Mid	*37*	**16 (43.2%)**	**11 (29.7%)**	**8 (21.6%)**	2 (5.4%)
Comp	*40*	**23 (57.5%)**	**15 (37.5%)**	2 (5%)	0 (0%)

The descriptive analyses show that zero marking occurs with all distinguished noun types, i.e., plural marking is clearly not obligatory in NGT. At the same time, Table 2.4 also makes clear that each noun type can undergo at least one type of reduplication – although a larger proportion of comp-nouns is zero-marked compared to the other noun types (see also footnote 14).

As described in Section 2.3.3.2, it was analyzed statistically whether comp- and body-nouns undergo zero marking more often than mid- and lat-nouns. Because the fixed-effect model matrix was rank deficient for the comparison of body-nouns against mid-, lat-, and comp-nouns (i.e., there was not enough data), I only report the comp-nouns against body-, lat-, and mid-nouns and the body- and comp-nouns against mid- and lat-nouns comparisons. No significant effect of data type ($p = 0.54$) nor a significant difference between comp-nouns and the other noun types ($p = 0.11$) were found. Yet, participants were ten times more likely to use zero marking with body- and comp-nouns than with lat- and mid-nouns (odds ratio = 10.24, $p < 0.001$, $z = 4.23$, 95 percent confidence interval from 3.49 to 30.06). An overview of all statistical data for the fixed effects is provided in Appendix 2-C, and see van Boven (2023a).

Thus, strikingly, I did not find a significant difference with respect to zero marking between comp-nouns and the other noun types, but when combining the body-nouns with the comp-nouns in the comparison, rather than with the mid- and lat-nouns, there was a significant effect. This suggests that the significant difference results from adding the body-nouns to the comp-nouns; however, I cannot check whether body-nouns alone also are more likely to undergo zero marking since that comparison was dropped. For now, the statistical analysis suggests that body- and comp-nouns are more likely to be zero-marked by the participants than mid- and lat-nouns.

Nevertheless, it cannot be concluded that [rep] and [body] block reduplication altogether: after all, 37.5% of comp-nouns and 55.7% of body-nouns undergo simple reduplication; sideward reduplication, however, is rare for these noun types. Indeed, when plural marking occurs, there are some patterns related to the phonological noun types. I only go into the frequent patterns here, marked in boldface in Table 2.4. These patterns are not categorical, and the variation found will be discussed in Section 2.5.2.

Body-nouns (with and without contact), comp-nouns (all movement types), and mid-nouns can undergo simple reduplication as exemplified[16] in Figures 2.9a–c. In these figures, the plural is formed by repeating the movement of the noun at the same location.

[16] For all examples from the corpus NGT, the Corpus NGT file number, signer number, and begin time (m:s.ms) are given between square brackets. For the glossed examples from the elicited data, participant number (p01-p05) is provided; cf. the *Notation conventions for glossed sign language examples*. For screenshots from the elicited data no participant code is provided (in order to ensure that participant code cannot be linked to individual participants).

a. 

CHAIR+

b. 

FARMER+

c. 

CAR+++

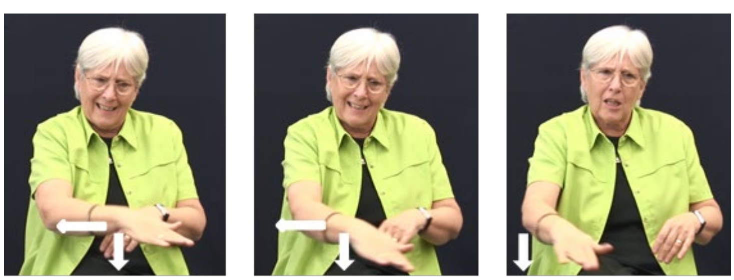
Figure 2.9. Pluralization by simple reduplication: (a) of mid-noun CHAIR (a downward movement is made twice at the same location); (b) of body-noun FARMER (thumb makes contact with the body twice while lower arm is rotated outward); (c) of comp-noun CAR (six alternating movements; the singular version by the same participant contains two alternating movements).

Strikingly, the elicited data suggest that mid-nouns actually cannot only undergo simple but also sideward reduplication – this is illustrated in Figure 2.10, where the noun CHAIR is not only repeated, but also displaced.

CHAIR>+

Figure 2.10. Pluralization by sideward reduplication of mid-noun CHAIR[17] (a downward movement is made twice while moving the hands sideward from left to right).

Sideward reduplication is also the main pluralization strategy for lat-nouns as exemplified in Figure 2.11: the lat-noun CHILD is not only repeated but a sideward movement from left to right is also added. For some lat-nouns, the sideward reduplication is executed with two hands, i.e., the non-dominant hand is added to the one-handed base noun and both hands then move to opposite sides.



CHILD>+>+

Figure 2.11. Pluralization of lat-noun CHILD by sideward reduplication (a short downward movement is made three times while moving the hand sideward from signer's left to right) [CNGT008; S003; 00:52.040].

More generally, it can be concluded that all non-body-anchored nouns with a simple movement (both lat and mid) can undergo sideward reduplication. On the

[17] Mid-noun CHAIR in Figure 2.10 has a slightly different form than in Figure 2.9a, as there is a difference in palm orientation.

other hand, body-nouns and comp-nouns cannot undergo sideward reduplication in NGT and they are statistically more likely to be zero-marked.

Finally, an alternative strategy that is observed for lat-nouns and one-handed body-nouns (subsumed under ‘others’ in Table 2.4), but only infrequently, is articulating the base noun simultaneously with two hands. This addition of the non-dominant hand could be labelled as ‘simultaneous reduplication’. This is exemplified in Figure 2.12, where the lat-noun CHILD, which is one-handed in its base form, is articulated with two hands to indicate plurality, without additional repetition.

CHILD$_{sim}$

Figure 2.12. Pluralization by articulating the one-handed base noun CHILD (lat-noun) with two hands without repetition and fully simultaneously [CNGT0099; S001; 00:42.960].

Note that some nouns occur with multiple strategies. For instance, CHILD is a lat-noun and is thus usually pluralized by means of sideward reduplication, as in Figure 2.11, but in some instances it occurs with zero marking, or it is articulated with two hands (Figure 2.12). At least in the elicited data, this type of variation is observed both within and across participants.

2.4.3 The presence of numerals and quantifiers

In a total of 47 of the analyzed corpus hits and 109[18] of the elicited sentences, the plural noun is accompanied by a numeral or a quantifier. With respect to zero marking, no significant difference was found between sentences with and without numerals/quantifiers (p = 0.83), and there was also no significant effect of data type (p = 0.14). Thus, the statistical analyses provide no evidence as to whether

[18] Despite the instructions, participants sometimes added numerals or quantifiers to their answers that were not in the carrier sentences, and sometimes they omitted or changed numerals/quantifiers that were in the carrier sentences. Therefore, the total number is 109 sentences, instead of 105, as would be expected, given that there were 105 carrier sentences (21 per participant) that contained numerals/quantifiers.

numerals/quantifiers would block plural marking in NGT. An overview of all statistical data for the fixed effects is provided in Appendix 2-C, and see van Boven (2023a).

Still, we can have a closer look at both data sets, where numerals/quantifiers sometimes co-occur with simple reduplication (N = 9 in the corpus data, N = 43 in the elicited data) and sometimes with sideward reduplication (N = 24 in the corpus data, N = 27 in the elicited data). For instance, in (4a), the lat-noun WEEK is reduplicated (sideward), even though preceded by a numeral, and in (4b), the body-noun HUMAN is reduplicated (simple), even though preceded by a quantifier.

(4) a. TWO WEEK>+>+.
‘Two weeks.’ [CNGT0049; S006; 04:25.440]

b. MANY HUMAN++ HANDICAPPED.
‘Many people are handicapped.’ [CNGT0171; S010; 04:04.915]

Thus, unlike in DGS (Pfau & Steinbach 2006) and some spoken languages such as Hungarian (e.g., Ortmann 2000), reduplication can co-occur with numerals/quantifiers. That is, NGT allows for NP-internal number agreement – at least optionally since in the remaining sentences the noun co-occurring with the numeral/quantifier is not marked for plurality (N = 14 in the corpus data, N = 39 in the elicited data). In (5a), the body-noun PROBLEM is zero-marked, and plurality is only indicated by means of the quantifier. In sentences without numerals/quantifiers, PROBLEM was sometimes reduplicated. However, it cannot be concluded that the quantifier blocked reduplication; no significant effect was found, and furthermore, some nouns are also zero-marked when they are *not* preceded by a numeral/quantifier, as shown in (5b), where the same noun is zero-marked in a sentence without a numeral/quantifier. There were no instances in which PROBLEM was reduplicated and co-occurred with a numeral/quantifier.

(5) a. FEW PROBLEM.
‘There are few problems.’ [CNGT1684; S069; 00:42.760]

b. […] INDEX$_{3a}$ SELF PSYCHOLOGY PROBLEM […].
‘[The child] could develop psychological problems […].’
[CNGT0132; S008; 03:06.040]

Moreover, for other nouns, such as the lat-noun WEEK, the numeral/quantifier sometimes occurs with zero marking, but not always; compare (6), where this noun is zero-marked and plurality is marked only by means of the numeral, to (4a), where plurality is marked both on the noun and by the numeral. Thus, there is variation in the corpus data that cannot be explained by the presence of numerals/quantifiers alone.

(6) ALSO ONE TIME GO.TO AMERICA TWO WEEK.
'One time, I also went to America for two weeks.'
[CNGT0386; S020; 02:13.600]

In fact, for only nine of the elicited sentences with a numeral/quantifier and zero marking, the noun was reduplicated by the same participant in the corresponding sentence without the numeral/quantifier. In those instances, the reduplication may have been blocked; this is illustrated in (7). In (7a), the participant reduplicates the comp-noun BABY; there is no numeral/quantifier in the sentence. Yet, in (7b), the same noun is preceded by the quantifier MANY, and the participant does not reduplicate BABY. Possibly, MANY blocked the reduplication because the plural is already marked by the quantifier, and thus pluralization of the noun is redundant (7b) even though in principle BABY can undergo reduplication (7a).

(7) a. ALSO PRESENT BABY+.
'Babies also come [to daycare].' [p03]

b. MANY BABY OFTEN CRY.
'Many babies cry often.' [p03]

2.4.4 Accounting for the number of repetitions

2.4.4.1 Individual variation

In total, 215 noun tokens extracted from the corpus and 115 elicited noun tokens were reduplicated. Recall that previous research has shown that the number of repetitions in sign language reduplication may be subject to individual variation and be influenced by various factors (e.g., Zwitserlood & Nijhof 1999; Pfau & Steinbach 2006). Moreover, Pfau & Steinbach (2006: 157) note that "triplication, while being rare across spoken languages, is a common feature in the morphosyntax of sign languages. Various types of aspectual modification, for instance, also involve triplication (or even more repetitions)". Therefore, the number of repetitions[19] in reduplicated NGT nouns was analyzed, as shown in Table 2.5.

[19] The base is not included in the number of repetitions, i.e., BASE-REDUPLICANT-REDUPLICANT is analyzed as two repetitions.

Table 2.5. Number of repetitions in reduplication in the corpus and elicited data.

		Number of repetitions					
	Total	**< One**	**One**	**Two**	**Three**	**Four**	**Unclear**
Simple reduplication	*133*	19	90	14	2	1	7
Sideward reduplication	*197*	1	78	44	4	1	69

The table reveals that although the number of repetitions varies, the majority of both reduplication types involves only one repetition. Thus, although triplication (i.e., two repetitions) does occur, duplication still occurs more frequently. Often, the movement repetitions are articulated in rapid succession. Especially in sideward reduplication, the movement is sometimes too reduced to actually count the number of repetitions: the base noun and the reduplicants are then fused into one extended, sideward, movement. In those cases, I annotated 'unclear' since the different reduplicants were not distinguishable. It is likely that the amplitude of movement reduces when number of repetitions increases, however, I leave this matter for future studies because this was not systematically annotated.

As the table shows, the number of repetitions is subject to (individual) variation, and, with few exceptions (eight in total), nouns are usually not repeated more than twice. The same variation is also attested in signs that are lexically specified for repetition. A possible explanation is that the number of (inherent) repetitions may vary depending on the position of the sign within a prosodic domain, as Nespor & Sandler (1999) found for Israeli Sign Language. Here, the potential impact of prosodic structure will not be further explored.

It should be noted that in both data sets, the number of repetitions does not usually reflect the exact number of referents. For example, in (8a), the signer repeats the lat-noun variant of LAMP only once even though the elicitation picture showed three lamps and the numeral THREE was present in the carrier sentence. Yet, there are also cases in which it seems that the number of repetitions mirrors the actual number of referents. For instance, in (8b), the same variant of LAMP is repeated twice, i.e., in total, three instances of LAMP were articulated, thus matching both the elicitation picture and the accompanying numeral. In cases like this, there appears to be an emphasis on 'not more or less than three' because each movement repetition is articulated with emphasis and the number of repetitions is not arbitrary.

(8) a. INDEX$_1$ BUY THREE NEW LAMP>+.
‘I buy three new lamps.’ [p05]

b. INDEX$_1$ THREE NEW LAMP>+>+ BUY.
‘I buy three new lamps.’ [p04]

2.4.4.2 The impact of mouthings

Next, it was considered whether there is a correlation between the number of repetitions and the number of syllables in the accompanying mouthing as had been suggested previously by Zwitserlood & Nijhof (1999) (see also Sandler 1999; Boyes Braem 2001). Indeed, a considerable number of nouns – 362 in total – from both data sets are accompanied by mouthings: 152 (80.4%) elicited nouns and 210 (70.7%) corpus nouns. This is not surprising given that previous research has shown that mouthings occur frequently in NGT since they make up the largest part of mouth actions in the language (Bank 2015). For the other 37 elicited noun tokens (19.6%) and 87 corpus noun tokens (29.3%), there is either no mouthing, or the mouthing is unclear or not completely visible.

There was a significant positive association between number of repetitions in the noun and the number of syllables in the accompanying mouthing ($r(361) = 0.2$, $p < 0.001$, 95 percent confidence interval from 0.1 to 0.29) (see also Appendix 2-C; van Boven 2023a). Thus, nouns that were accompanied by mouthings with more syllables were repeated more often.

For the most part, Dutch plurals contain more syllables than the corresponding singular noun, and this may be reflected in the mouthings accompanying nouns. Indeed, 85 elicited noun tokens and 69 noun tokens from the corpus are accompanied by an articulation of the corresponding Dutch noun in its plural form (44.9% and 23.26% respectively of nouns accompanied by mouthings in the data). In (9a), for instance, the lat-noun CHILD is not only reduplicated, but the plural Dutch word *kinderen* ‘children’ /kɪndərə/ is also mouthed – note that here, the mouthing has three syllables, and there are two repetitions (i.e., hand and mouth are synchronized). Still, on the other hand, in 63 elicited instances and 135 corpus instances (33.3% and 45.5% respectively of nouns accompanied by mouthings in the data), (a part of) the corresponding singular Dutch word is mouthed: in (9b), the body-noun variant of LAMP is reduplicated but is accompanied by the mono-syllabic Dutch singular word *lamp* ‘lamp’ /lɑmp/.

/kɪndərə/

(9) a. […] PLAY WITH CHILD>+>+.
'[…] Play with children. ' [p03]

/lɑmp/

b. IKEA HAVE PRETTY LAMP+ SELL+++.
'Ikea sells nice lamps.' [p02]

Strikingly, besides mouthing of the Dutch singular or plural word, another form of mouthings was found, albeit infrequently: three elicited noun tokens and two corpus noun tokens are accompanied by a reduplicated articulation of the Dutch singular noun, despite reduplication not being a productive morphological process in Dutch. This is illustrated in (10a), where the reduplicated body-noun HUMAN is accompanied by a repeated articulation of the Dutch singular *mens* 'human' /mɛns/ (thus, lit. 'human human'). Similarly, one elicited plural noun, the mid-noun TROUSERS, was accompanied by a reduplicated articulation of a verb (10b). First, the noun is articulated manually and is accompanied by the corresponding singular mouthing *broek* 'trousers(SG)' /bruk/. Subsequently, TROUSERS is reduplicated sidewards, and is accompanied by a repeated articulation of the Dutch verb *pas* /pɑs/ (infinitive *passen* 'to try on'). We are thus dealing with an instance of code-blending, that is, a simultaneous mixing of signed and spoken language (Emmorey et al. 2005). This exemplifies the tendency of hand and mouth movement to align, as described above, since in these reduplicated mouthings the number of non-manual repetitions (i.e., syllables) is synchronized with the number of movement repetitions (including the movement of the base). Finally, the remaining four corpus instances contain some other mouthing (e.g., an adjective).

/mɛns mɛns/

(10) a. CHILD HUMAN+ […].
'Children are human too […].' [CNGT0333; S015; 00:37.600]

/bruk/ /pɑs pɑs pɑs pɑs/

b. INDEX$_1$ YESTERDAY SHOP GO. TROUSERS TROUSERS>+>+>+.
'Yesterday I went shopping. I tried on (several pairs of) trousers.'
[p01]

Note that marking the plural only by means of a mouthing might be considered a separate pluralization strategy since in 18 of the elicited sentences and seven of the corpus sentences the noun is zero-marked yet accompanied by a plural mouthing, as in (11) where TROUSERS is not reduplicated yet accompanied by the Dutch plural *broeken* 'trousers(PL)' /brukə/.

/brukə/
(11) INDEX$_1$ TROUSERS TRY.ON.
'I tried on trousers.' [p03]

2.4.5 Other pluralization strategies

The elicited data make clear that plurality can also be marked on elements other than the noun – be it in combination with nominal reduplication or not. This section discusses the strategies that were identified, as one of the aims was to provide a comprehensive overview of pluralization strategies in NGT. First, some other element in the sentence may be reduplicated. This may be the verb, as observed in eleven sentences (in nine of these, there is zero marking on the noun; in the other two, the noun is also reduplicated). This is illustrated in (12) where the noun is zero-marked but the verb TRY.ON is reduplicated. Moreover, in four sentences, the sign INSIDE is modified by means of sideward reduplication, always combined with a zero-marked noun as illustrated in Figure 2.13; here, we see zero marking on the comp-noun SHOP, followed by sideward reduplication of INSIDE.

(12) INDEX$_1$ MANY TROUSERS TRY.ON+++.
'I tried on many [pairs of] trousers.' [p02]

SHOP INSIDE>+>+>+

Figure 2.13. Zero-marked comp-noun SHOP followed by several instances of INSIDE, executed with sideward movement; the translation is: 'in shops'.

Furthermore, six nouns are followed by a classifier which is reduplicated sideward (in only one case, the noun is also reduplicated): in Figure 2.14, the comp-noun CAR is zero-marked and is followed by a classifier indicating a small object, also reduplicated sideward. This classifier is used to indicate that the signer is referring to toys (i.e., small) cars, rather than real ones.

CAR $\text{CL}_{\text{SMALL.OBJECT}}$>+>+

Figure 2.14. Zero-marked comp-noun CAR followed by a classifier indicating a small object, executed with one, reduced sideward movement; the translation is: 'toy cars'.

Finally, for human (or, possibly, animate) referents, there appears to be an additional strategy to indicate plurality: in eight cases, when localizing a plural referent in signing space, this is not done by a 'regular' pointing sign in space (INDEX), but rather by an arc-shaped indexical sign. This strategy can be used in combination with both reduplicated (six cases) and zero-marked (two cases) nouns. In Figure 2.15, the body-noun WOMAN is reduplicated and then localized in space by means of an $\text{INDEX}_{\text{arc}}$.

WOMAN++ $\text{INDEX}_{\text{arc}}$

Figure 2.15. Pluralization by reduplication of body-noun WOMAN followed by arc-shaped INDEX; the translation is: 'women'.

2.5 Discussion

To summarize, the results suggest that the pure plural form in NGT can be marked by simple reduplication and sideward reduplication and that the phonological noun type influences the choice between the two. However, these processes are optional, and there is considerable variation in the data. Statistical analyses show that comp-and body-nouns are more likely to be zero-marked than mid- and lat-nouns, and that there is a positive correlation between the number of syllables in the mouthing and the number of repetitions.

These findings thus complement previous research on NGT by disentangling pluralization from spatial distribution, which is discussed in more detail in Section 2.5.1. The range and impact of the variation attested in the NGT data is the focus of Section 2.5.2. Finally, the phonological restrictions on reduplication found for NGT are compared to those described for other sign languages in Section 2.5.3.

2.5.1 Disentangling pluralization from spatial distribution

The novel gap-filling task succeeded in disentangling pluralization from localization and as such yielded valuable data that complement previous findings: it revealed that – in addition to the pluralization strategies previously described by Zwitserlood & Nijhof (1999) – nominal reduplication commonly occurs in NGT. The task offers an elegant alternative way to investigate plurality without the pitfalls of a picture description task. Similar gap-filling tasks could fruitfully be used in future research into different topics where the use of space needs to be controlled for. Of course, if the research topic involves spatial configuration, a picture description task is more useful.

Additional evidence that the task succeeded in disentangling pluralization from localization comes from the fact that the spatial arrangements of the objects shown on the picture stimuli did not influence the choice of pluralization strategy. If this were the case, we would expect referents presented in a neat row to be pluralized by means of sideward reduplication. However, since the spatial arrangements shown on the pictures were not relevant in the sentence contexts, this did not happen. To give an example, the lat-noun BOTTLE was pluralized by means of sideward reduplication even though the bottles on the picture were not presented in a neat row but rather were arranged randomly. Conversely, the body-noun WOMAN was pluralized by means of simple reduplication, even though the women on the picture were standing in a row. This suggests that while phonological characteristics of the base noun play a role in the choice of the pluralization strategies, the spatial arrangement of the referents does not.

One might hypothesize that the focus on pluralization in the experiment increased the frequency of use of plural marking in the elicited data. Yet, this was not the case: while 74.4% of the nouns in the corpus data undergo overt pluralization, this is the case for only 61.9% of the elicited nouns. Indeed, zero marking occurs more often in the elicited data, which suggests that the experiment did not enhance frequency of reduplication to a large extent. I further refer to van

Boven (2020) for an elaborate consideration of the advantages and disadvantages of such a gap-filling task.

A related point is that simple and sideward reduplication and zero marking are likely not to be the only ways to express 'pure' plurals in NGT. I also found some alternative strategies: (i) nominal strategies that occur only infrequently (simultaneous reduplication of the noun); (ii) non-manual strategies (mouthings); and (iii) strategies that do not affect the noun at all (reduplicating some other element; arc-shaped index). This suggests that NGT has many ways to mark pure plurals, which deserve further investigation. Particularly interesting is the example in Figure 2.14 above, which suggests that classifiers can also be used to express pure plurality without indicating the spatial distribution of the referents. The reduplicated classifier in this example is used to indicate the size of the cars but it does not represent the spatial distribution of the cars on the stimulus picture (they were presented in a half circle, not in a row). This is striking since the localization of classifiers is usually claimed to be a dedicated (iconic) strategy for indicating spatial relations, as also found for NGT by Zwitserlood & Nijhof (1999).

Interestingly, a similar use of classifier handshapes to mark 'pure' plurals has recently been described for DGS by Herbert (2018: 124). She describes a so-called "classifier-based plural morpheme" (CLP), which "takes the form of classifier handshapes available in the language, combined with sideward reduplication." Similar to the NGT example in Figure 2.14, Herbert (2018: 124) describes that the CLP is reduplicated by means of "one continuous, fluid movement, in contrast to the punctuated reduplication typical of a canonical classifier construction." And, likewise similar to what we observe for NGT, the interpretation of this form is the 'pure' plural, or, as Herbert calls it, the simple plural.

Notably, Herbert states that while canonical classifier constructions can be used with all different nouns, the CLP only combines with nouns that cannot fully realize the canonical plural, which is assumed to be sideward reduplication. If a similar CLP was attested in NGT, as the example in Figure 2.14 above suggests, we would expect this morpheme to combine with nouns that cannot undergo sideward reduplication, i.e., comp- and body-nouns. In the data elicited here, the potential CLP co-occurs with four comp-nouns, one body-noun, and one mid-noun. The co-occurrence with a mid-noun is unexpected based on Herbert (2018) because in principle this noun can undergo sideward reduplication; yet, mid-nouns sometimes also undergo simple reduplication, which may be an explanation. At least, just as in DGS, the potential CLP does not co-occur with lat-nouns in the data here. Future research into a CLP in NGT would certainly be worthwhile.

2.5.2 The range and impact of variation

Regarding reduplication, the discussion so far focused on the frequent patterns, marked in boldface in Table 2.4 – simple reduplication of comp-, body-, and mid-nouns, and sideward reduplication of mid- and lat-nouns. However, we should not neglect the fact that these patterns are not categorical: in a small number of cases, body- and comp-nouns undergo sideward reduplication, and lat-nouns undergo simple reduplication. Although not systematically investigated here, there seem to be explanations for at least some of these exceptions. For instance, some of the lat-nouns undergoing simple reduplication already have a sideward movement in their base form (e.g., SCHOOL). This may cancel out the spatial displacement that characterizes sideward reduplication. Moreover, many body-nouns undergoing sideward reduplication have a lateral location (e.g., one variant of DOLL), which may have influenced the pluralization strategy.

Nevertheless, there is considerable variation in the NGT data, and reduplication is clearly optional. This may raise questions on the grammatical status of reduplication as a pluralization strategy in NGT. Yet, it is important to note that variation in and optionality of morphosyntactic and syntactic marking is a characteristic of many investigated sign languages. Grammatical phenomena that have been shown to display optionality and/or to be subject to intra- and inter-signer variation include agreement marking (De Beuzeville et al. 2009 for Australian Sign Language; Legeland 2016 for NGT) and, in the domain of syntax, the position of negative markers (Oomen & Pfau 2017 for NGT) and wh-signs (Geraci et al. 2014 for LIS). Thus, the fact that we also find optionality and variation in NGT plural marking is perhaps not that surprising after all (see Section 2.5.3 for further discussion).

Interestingly, similar variation is also attested in some spoken languages. Specifically, for the domain of pluralization, Hayes & Abad (1989) describe variation in plural reduplication in Ilokano (a language of the Philippines). Usually, pluralization is realized by heavy reduplication, under which the initial consonant(s), a vowel, and the next consonant of the stem are copied – this is the pattern we observe in (13a). Yet, when the stem starts with a consonant plus glide cluster (as is true for *pjano*), two alternative options are available (Hayes & Abad 1989, summarized in Boersma & Hayes 2001). The second option is to copy the stem-initial consonant plus a long vowel as in (13b). The final option is to copy the first consonant plus a vowel and to create a heavy syllable by resyllabification, as in (13c) (Hayes & Abad 1989, in Boersma & Hayes 2001: 56). Crucially, these three options are in free variation.

(13) a. *pja.no* → *pjan.pja.no*
'piano' 'pianos'

b. *pja.no* → *pi:.pja.no*
'piano' 'pianos'

c. *pja.no* → *pip.ja.no*
'piano' 'pianos'

[Ilokano; Hayes & Abad 1989, in Boersma & Hayes 2001: 56]

Thus, variation in and optionality of morphological marking is common in sign languages, and variation in the realization of reduplication specifically is also attested in a spoken language. This suggests that the variation in the NGT data is not as exceptional as it may at first seem.

2.5.3 Language-specific constraints on reduplication

This study distinguished phonological noun types, which led to the conclusion that there is some systematicity within the variation. Indeed, the choice between simple and sideward reduplication in NGT largely depends on phonological properties of the base noun. Phonologically triggered allomorphy has previously been described for other sign languages. Recall the findings for DGS (Pfau & Steinbach 2005a, 2006), summarized in Section 2.2.3: comp-nouns and body-nouns cannot be reduplicated in this language. Similarly, in BSL, while sideward reduplication applies to lat-nouns and to (at least some) mid-nouns, both body-nouns and comp-nouns cannot undergo reduplication (Sutton-Spence & Woll 1999). For LIS, Pizzuto & Corazza (1996: 181) distinguish between "nouns articulated on the body" (i.e., body-nouns) and "neutral-space nouns". For the latter, they argue that nouns with simple movement can undergo sideward reduplication, while, again, comp-nouns and body-nouns apparently cannot be reduplicated. Finally, pluralization in ASL is somewhat less restricted since reduplication of some specific body- and comp-nouns is permitted (Wilbur 1987).

Thus, in most of the sign languages described to date, reduplication is blocked by certain phonological properties (body-anchoredness and complex movement). The findings here reveal that this is not the case for NGT: while indeed body- and comp-nouns rarely undergo sideward reduplication and are more likely to be zero-marked than mid- and lat-nouns, simple reduplication is not blocked altogether for these noun types. That is, reduplication in this language appears less constrained because all noun types can undergo at least one type of reduplication. NGT patterns with ASL in this respect although my data do not indicate that only specific body- and comp-nouns undergo reduplication; perhaps NGT pluralization is even less restricted than ASL pluralization. Moreover, Pfau & Steinbach (2005a) suggest that nouns that can be reduplicated in DGS are never zero-marked. Again, NGT behaves differently: zero marking occurs with all noun types.

Possibly, it is not (only) the phonological properties of the noun that block reduplication in NGT; perhaps we should attend to other properties to explain the occurrence of zero marking. Interestingly, a reviewer brings to my attention that in, for instance, BSL, iconicity constrains reduplication. More specifically, signs whose form bears a metonymic relationship with their referents have been reported to be blocked from undergoing reduplication; a case in point is the BSL sign CAR, which represents turning the steering wheel – similar to the NGT sign CAR (Figure 2.5a). Given this suggestion, I checked the data to scrutinize whether metonymy might also explain the occurrence of zero marking in NGT. The data set did not include many signs that are clearly motivated by metonymy. One clear case is the NGT sign CAR; as is already clear from Figure 2.9c, this sign can actually be reduplicated. Other, albeit less clear, examples are BIKE, GIRL and TRAIN – these, too, were found to undergo reduplication. This suggests that metonymy does not block reduplication in NGT, in contrast to BSL.

A potential explanation for the cross-linguistic differences was explored by looking at the historical links between the sign languages described above, as described by Power et al. (2020). On the one hand, restrictions on reduplication in NGT pattern with those described for ASL: both these languages are traceable to Old French Sign Language and are indeed classified in the French-origin group by Power et al., suggesting that this common link may explain why reduplication is less restricted than has been reported for other languages, for instance BSL, which is part of the British-origin group. On the other hand, body- and comp-nouns cannot be reduplicated in LIS, a language that can also be traced back to the French-origin group. Similarly, Power et al. note that contemporary DGS, originally classified in the Austrian-origin group, is now also found in the French-origin group. This suggests that historical links between sign languages alone cannot fully explain why NGT/ASL reduplication is less restricted. This matter should be investigated further by looking at phonological restrictions on nominal reduplication across the different sign language families.

Another potential explanation for cross-linguistic differences can be found in the methodology of the studies. Studies that report rather clear, categorical patterns, such as Pfau & Steinbach (2005a), often do not indicate how exactly their data were collected. Since the present study takes into account naturalistic corpus data, less clear patterns and more variation are to be expected because corpus data come closer to naturalistic language use than elicited data (other studies that report (morpho)syntactic variation and optionality in sign languages, mentioned above, also investigate corpus data, e.g., De Beuzeville et al. 2009; Oomen & Pfau 2017).

However, even in our elicited data, all noun types optionally undergo at least one type of reduplication. This suggests that these findings are persistent in NGT.

While all noun types in NGT can undergo at least one type of reduplication, it has to be emphasized that this does not mean that all strategies apply to all noun types: phonological properties of the base noun may not block reduplication but they do influence the reduplication type. The present study is thus an important contribution to the typology of reduplication in sign languages. Clearly, reduplication, despite being iconically motivated, is subject to language-specific grammatical constraints.

2.6 Conclusion

This study presented a description of nominal pluralization in NGT, taking into account potential phonological restrictions. First, analysis of corpus and elicited data revealed three main pluralization strategies: simple reduplication, sideward reduplication, and zero marking. Second, it turned out that phonological allomorphy plays an important role. While comp-nouns and body-nouns are more likely to be zero-marked than the other noun types, they can undergo simple reduplication, while lat-nouns undergo sideward reduplication. Finally, mid-nouns can undergo both simple and sideward reduplication. Reduplicating the noun is not obligatory since zero marking occurs quite often with all noun types.

Notably, reduplication is also found to be a common pluralization strategy in other sign languages, as it is in spoken languages. Yet, the results presented here show that nominal reduplication is subject to language-specific phonological constraints. While body-anchoredness and complex movement have been noted to block reduplication in other sign languages, this is not the case for NGT. Phonological properties of the base noun influence the type of reduplication (i.e., simple or sideward) but do not block it altogether. Moreover, the patterns in the NGT data are not as categorical as those reported for other sign languages because there is considerable variation for all noun types. Yet, variation in plural reduplication has also been attested in at least one spoken language (Ilokano; Hayes & Abad 1989).

Some issues regarding nominal pluralization in NGT are left for further research. First, the number of repetitions in reduplication varies greatly, and there is a positive correlation with the number of syllables in the mouthing. Future research could look into further (prosodic) factors that might play a role here. Moreover, the influence of numerals and quantifiers on marking the plural on the noun remains unclear; no statistical effect is found. Further investigation into DP-internal number agreement is necessary. Finally, it appears that the plural can also be marked on elements other than the noun – for instance, reduplication of the verb. Future research can look into these different strategies, and which strategy is preferred. That is, the present study focused on plural marking on the noun sign, but it is possible that when focusing on pluralization more broadly, the preferred strategy is on elements other than the noun.

To conclude, this study offers a description of new NGT data, complementing previous findings in important ways. A subsequent study, which is reported on in Chapter 5 of the present dissertation, aims to formalize these results in an Optimality-Theoretic framework, offering a constraint-based analysis of nominal reduplication in NGT (see also van Boven, Hamann & Pfau 2023).

Chapter 3 | Aspectual reduplication in Sign Language of the Netherlands: Reconsidering phonological constraints and aspectual distinctions[*]

3.1 Introduction

There is a long line of research on tense and aspect, investigating a vast variety of typologically diverse spoken languages. While tense has to do with time reference, aspect, which is the focus of the present study, relates to internal temporal structure (e.g., Comrie 1976; Bybee 1985; Dahl 1985; Smith 1997; Binnick 2012a). Both are traditionally considered grammatical categories of verbs: languages may reflect temporal and aspectual differences in the inflectional distinctions they make (compare, for instance, English present tense *walk* to past tense *walked*). Apart from that, periphrastic constructions may also play a role (e.g., the English progressive *he is walking*). Languages have been found to differ in the distinctions that are grammaticalized (see, e.g., Dahl & Velupillai 2013 for further details).

As for sign languages, they have been shown to display striking similarities when it comes to the encoding of aspect and tense. Sign language verbs usually do not inflect for tense (but see, for instance, Zucchi 2009). The most common strategy to express tense, i.e., to place an event on a timeline, is by means of adverbials, often using the signing space metaphorically (e.g., a backward movement in YESTERDAY versus a forward movement in TOMORROW; see Pfau et al. 2012 for an overview). In contrast, rich aspectual systems have been identified across sign languages (for an overview, see Pfau et al. 2012). A common way of encoding aspectual distinctions is by modulating the verb's movement component, be it by reduplicating the movement and/or by adapting its rate and rhythm (e.g., Klima & Bellugi 1979; Rathmann 2005). Interestingly, reduplication has also been found to commonly encode certain aspect types in spoken languages (e.g., Bybee 1985; Finegan 2014).

This study investigates reduplication of the predicate as a strategy to express grammatical aspect in Sign Language of the Netherlands (*Nederlandse Gebarentaal*, NGT). The focus will be on the habitual, continuative, and iterative – three aspect types that have been found to involve reduplication across sign languages (e.g., Zeshan 2000; Cabeza Pereiro & Fernández Soneira 2004; Rathmann

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2005; Pfau et al. 2012). A thorough investigation of NGT is worthwhile: while there are previous studies on this topic, many questions remain unanswered. On the one hand, Hoiting & Slobin (2001) found that habitual and continuative aspect in NGT are expressed by different types of repeated elliptical modulation of the verb sign, and identified phonological constraints on this inflection. Oomen (2016), on the other hand, also found that both these aspect types in NGT are expressed by reduplication, but she did not observe elliptical modulation or phonological constraints. The present study is the first to comprehensively investigate all three aspect types in NGT, attempting to explain the diverging findings of previous studies, and taking into account potential (phonological) restrictions on aspectual reduplication. The investigation is based on two types of data: semi-spontaneous data extracted from the Corpus NGT, and data elicited from six deaf NGT signers by means of a novel elicitation task.

Section 3.2 provides some background on aspect in spoken and signed languages, including previous studies on NGT specifically, and concludes with the present study's research questions. Section 3.3 details the method, addressing first the corpus, before detailing the elicitation task. This section also describes the data annotation and statistical analysis. Section 3.4 then provides an overview of the results, while Section 3.5 further discusses the phonological constraints on aspectual reduplication, takes a typological perspective on the aspectual distinctions NGT makes, and offers some methodological and sociolinguistic considerations. Section 3.6, finally, draws some conclusions.

3.2 Aspect in spoken and signed languages

3.2.1 General background

Previous work has shown that two types of aspect can be distinguished: lexical aspect and grammatical aspect. First, lexical aspect (also called "situation aspect" by Smith 1997) refers to inherent properties of the verb, or, in the words of Filip (2012: 721), it is "a semantic category that concerns properties of eventualities (in the sense of Bach, 1981) expressed by verbs". These "properties" generally refer to an end or boundary that is present in the lexical structure of some classes of verbs, but not in others, known as the basic distinction between telic verbs, which have a clear endpoint or goal, and atelic verbs, which do not (Filip 2012; and see Garey 1957 for the telic/atelic distinction). Two other fundamental concepts are change of state (i.e., whether there is a transition from one state to another) and temporal extent (i.e., whether the event is punctual or whether there is some temporal extent). Based on these three properties, verbs can be divided into different classes (for instance, states or processes) (Filip 2012, and references therein such as Vendler 1957; Comrie 1976; Dowty 1979; Bach 1986). The present study will not be concerned with lexical aspect, and solely focuses on grammatical aspect – although, of course, the two are closely related (see Binnick 2012a for more discussion).[1]

Second, grammatical or verbal aspect (also called "viewpoint aspect" by Smith 1997), is not an inherent lexical property of the verb, but can be described as "a sub-system belonging to the grammar of a particular language" (Binnick 2012b: 32). Comrie (1976: 3) defined it as "different ways of viewing the internal temporal constituency of a situation". Taking English as an example, de Swart (2012: 753) compares *When Bill came to the office, Sarah left through the back door* to *When Bill came to the office, Sarah was leaving through the back door* – the progressive verb form in the second sentence changes the interpretation of the sentence and is part of the English inflectional system: it functions as a grammatical aspect marker. It is this type of aspect, i.e., grammatical aspect, that this study focuses on – specifically, continuative, habitual, and iterative aspect.

Within the domain of grammatical aspect, a fundamental distinction is that between perfective and imperfective aspect. Perfective viewpoints focus on the situation in its entirety, looking at the situation from outside, while imperfective viewpoints focus on part of a situation and its internal structure (see, e.g., Comrie 1976; Smith 1997; Gvozdanović 2012). While this distinction is grammaticalized in some languages (e.g., Russian and Spanish), this is not the case for all languages (e.g., English) (Comrie 1976; see also Gvozdanović 2012). Still, it has been noted that the distinction between these two viewpoints by means of different verbal inflectional forms is "fairly stable across languages" (Deo 2012: 161). Many languages have a single category that expresses the imperfective. Bybee (1985), for instance, noted that the distinction between perfective and imperfective is the most common inflectional aspectual distinction made in her sample of fifty languages. However, as we will see in Section 3.2.2, languages may also have further formalized distinctions, such as habitual and continuous aspect, which are usually assumed to be subtypes of the imperfective (Comrie 1976: 25; see also, e.g., Carlson 2012 on habitual aspect; Mair 2012 on continuous aspect). The distinction between habitual/continuous is the second most common one in Bybee's (1985) sample.

[1] For sign languages, see also the Event Visibility Hypothesis (Wilbur 2003, 2008), which proposes that the phonological form of predicate signs reflects the semantics of the event structure, i.e., "predicate signs contain morphemes that reflect the event structure they represent. These morphemes have regular phonological forms by which they are recognized" (Wilbur 2008: 29). According to this hypothesis, the difference between telic and atelic verbs is thus marked at the morpho-phonological level of the predicate sign (see also, e.g., Strickland et al. 2015; Krebs et al. 2021; Krebs et al. 2023).

In the following, I first set the scene by describing previous studies on spoken languages, focusing on the three grammatical aspect types under investigation in the present research (Section 3.2.2). Then, I go into the two types of realization of grammatical aspect that have been identified for sign languages: modulating the verb sign (Section 3.2.3.1) and free functional elements (Section 3.2.3.2) (see also Pfau et al. 2012 for an overview). Finally, I turn to previous studies on NGT (Section 3.2.4), the language under investigation here.

3.2.2 Continuative, habitual and iterative aspect in spoken languages

The present study focuses on continuative, habitual, and iterative aspect. Here, I define each aspect type, and briefly discuss how they are commonly expressed in different spoken languages.

According to Comrie (1976), the imperfective aspect can be further divided into habitual and continuous aspect, as mentioned above. In turn, the continuous is further divided into progressive and nonprogressive, where the progressive has been described as "the idea that an event is progressing dynamically over a time frame opened up by an utterance" (Mair 2012: 803). This time frame has been defined by Klein (1994) as the "topic time", i.e., "the time span to which the speaker's claim on this occasion is confined" (Klein 1994: 4). "Nonprogressive" includes situations in progress or non-progressive states (see Mair 2012: 808, also for a critical evaluation of this distinction).

Here, I will generally focus on the continuous. Various languages have developed a grammatical category to express these semantics, which I will refer to as *continuative aspect* here.[2] An example is given in (1), which shows that continuative aspect is expressed by a prefix on the verb in Zapotec.

(1) ***ku***-*ka?a-beé*
CONT-write-3SG.HUMAN
'He is writing.' [Zapotec; Pickett 1953: 220/ Bybee 1985: 142]

Apart from marking on the verb, continuative aspect has also been found to be marked by periphrastic constructions or by adverbs or particles (see Mair 2012). For instance, in Russian the lexical adverb *dolgo* expresses 'for a long time' (Smith 1997: 251).

The other type of imperfective aspect concerns habituals, which "describe a situation that is characteristic of an extended period of time" (Comrie 1976: 28) –

[2] Note that I will use "continuous" and "continuative" interchangeably, as both terms have been used in previous studies.

they are imperfective, because the situation is characteristic of the whole period. In the Zapotec example (2a), the *habitual aspect* is marked on the verb by the bound morpheme *ru* – comparing (2a) to (1) illustrates that habitual and continuous meaning are contrasted inflectionally in Zapotec, i.e., by means of the bound morphemes *ru-* and *ku-*, respectively (Bybee 1985). Cross-linguistically it is common to express habituality with a verbal affix, but it may also take the form of for instance an auxiliary or a periphrastic construction (Carlson 2012).

Comrie (1976) notes that habituality should be distinguished from iterativity (the repetition of a situation), because repetition alone is not sufficient to use an imperfective or habitual form. He points out that, if a situation is repeated a few times, each repetition can be viewed as a single instance, i.e., a situation on its own, which can be referred to with the perfective form. Further, according to Comrie (1976), a habitual form can refer to situations without iterativity, as in (2b) , where English *used to* is considered a habitual marker (although note that Binnick 2005 actually argues against English *used to* as a habitual marker – I will not go into this discussion here). For further discussion of the difference between habitual and iterative aspect, see Bertinetto & Lenci (2012).

Bybee (1985) shows that some languages (15 out of 50 in her sample) employ a verbal marker to give iterative meaning to the verb, i.e., *iterative aspect*, as illustrated for Kiway in (2c), where the affix *-ti* expresses iterativity. Further, iterativity can be expressed by similar means as those mentioned above for the other two aspect types, for instance, adverbials (Bertinetto & Lenci 2012).

(2) a. ***ru***-*ka?a-beé*
HABIT-write-3SG.HUMAN
'He writes (regularly).'[3]
[Zapotec; adapted from Pickett 1953: 220/ Bybee 1985: 142]

b. *The Temple of Diana used to stand at Ephesus.* [Comrie 1976: 27]

c. *arigi* → *arigi-**ti***
scratch scratch-IT
'to scratch' 'to scratch repeatedly'
[Kiway; Ray 1933/Bybee 1985: 150]

[3] "Regularly" is not present in the translation in Bybee (1985: 142), but is added here to emphasize the habitual meaning.

Finally, a grammatical aspect marker that commonly occurs not only in spoken languages, but also in sign languages, is reduplication. A spoken language example is given in (3).

(3) *mahuta* → *mahutamahuta*
‘to sleep’ ‘to sleep constantly’ [Motu; Finegan 2014: 48]

The next section will illustrate the importance of reduplication for sign language aspect marking.

3.2.3 Aspect in sign languages

This section focuses on grammatical aspect in sign languages, which is mainly expressed by verbal inflection (specifically, reduplication) and free-standing markers. These will be discussed in turn in Sections 3.2.3.1 and 3.2.3.2, respectively. Section 3.2.4 outlines previous studies on aspect in NGT specifically, and finally, Section 3.2.5 details the research questions the present study addresses.

3.2.3.1 Modulating the verb sign

Across sign languages, it has been observed that grammatical aspectual distinctions can be encoded by modulating or inflecting[4] the verb sign, or, more specifically, modulating the verb’s movement. Klima & Bellugi (1979) (building on work by Fischer 1973) were the first to provide an extensive overview of 15 different aspect types in American Sign Language (ASL), which are distinguished by modulating the verb. Examples of such modulations include reduplication, changing the rate of signing, and/or adding pauses in between reduplication cycles – these modulations are argued to result from morphological processes applying to the verb sign.

The list of 15 ASL aspect types was later brought back to six aspect types by Rathmann (2005). This comprehensive study also provides evidence for the morphemic status of the distinguished aspect types in ASL. Five of these aspect types are encoded by modulating the verb sign, among which the continuative, iterative, and habitual aspect, which are defined in a similar way as introduced

[4] While modulating the verb sign to express aspectual distinctions has often been analyzed as an instantiation of inflection (e.g., Klima & Bellugi 1979; Rathmann 2005), Bergman & Dahl (1994) offer a different analysis for Swedish Sign Language (SSL). They argue that the reduplication system of SSL differs from inflectional processes in spoken languages (they mention obligatoriness and lexical generality as essential properties of inflection, lacking from the reduplication system in SSL), but rather shares many properties with ideophonic components in spoken languages. Here, I analyze verbal modulation as inflection, and refer to Bergman & Dahl (1994) for the alternative analysis.

above for spoken languages. While such inflections are typically subsumed under grammatical aspect (see, e.g., Quer et al. 2017), Rathmann (2005) argues that in ASL, four of them (continuative, iterative, habitual, and hold) belong to the situation type component rather than the perfective or imperfective viewpoint.[5] In the present study, however, I follow previous work (Comrie 1976 on spoken languages and Quer et al. 2017 on sign languages, among many others) in assuming that inflections expressing the habitual and continuative are generally instances of imperfective aspect, and that inflections expressing the iterative are generally instances of perfective aspect, and as such that they are grammatical aspect (but see Section 3.5.2 for further discussion).

Continuative aspect – which Rathmann (2005: 36) defines as "the temporal interval over which the eventuality unfolds is longer than usual and uninterrupted", as in (4a) – is expressed in ASL by extending the movement of the verb root for a longer time than in the citation form. Iterative aspect – which he defines as "multiple instances of the eventuality unfold in their own intervals" (p. 39), as in (4b) – is expressed by reduplication of the verb's movement. Finally, habitual aspect is defined as "there is a property that is characterized by a regular repetition of the eventualities and that holds over an interval of time" (p. 42), as in (4c). This is also expressed by reduplication of movement, but in shorter and quicker cycles than the iterative morpheme. In (4a–c), the subscript with the verb indicates the verb is inflected (i.e., modulated in the ways just described) for (a) continuative, (b) iterative, or (c) habitual aspect. Further, see *Notation conventions for glossed sign language examples* for the general conventions used in this dissertation.

(4) a. TODAY, MARY COOK, JOHN COOK$_{\text{continuative}}$.
'Today, Mary cooked, but John cooked even longer.'
[ASL; adapted from Rathmann 2005: 35]

b. JOHN COOK$_{\text{iterative}}$.
'John cooked repeatedly.'
[ASL; adapted from Rathmann 2005: 38]

c. JOHN GO$_{\text{habitual}}$ CHURCH.
'John goes to church (regularly).'
'John usually goes to church.'
[ASL; adapted from Rathmann 2005: 41]

[5] Rathmann (2005: 174) gives two reasons for this: (i) these aspectual morphemes can co-occur with perfective FINISH, and (ii) they are concerned with duration, telicity, and dynamism.

Apart from ASL, modulating the verb sign to encode aspectual distinctions has been observed for several other sign languages. For example, in British Sign Language (BSL), the continuative form of verbs without a path movement is expressed by an extended hold (Sutton-Spence & Woll 1999), and repetition of movement was found to encode iterative aspect in Indo-Pakistani Sign Language (IPSL) (Zeshan 2000) and habitual aspect in Spanish Sign Language (LSE) (Cabeza Pereiro & Fernández Soneira 2004), among others. Gray (2013), in his extensive corpus study on aspect in Australian Sign Language (Auslan), finds different types of reduplication (in a "fast, unmarked or slow manner", p. 142). However, unlike what has been described in the other studies mentioned here, Gray (2013: 159) notes that these different reduplication types "do not appear to form a clearly defined paradigm of discrete, categorical options". Rather, according to Gray, the specific meaning is determined by the context, and, for instance, whether the reduplication co-occurs with constructed action. He notes that the number of repetitions in reduplication varies, and a larger number may reflect a more frequent repetition of the event.[6]

The encoding of aspect in sign languages does not always involve marking on the predicate: free-standing markers are also attested, to which we turn now.

3.2.3.2 Free-standing aspectual markers

Rathmann (2005) notes that one of the six aspectual distinctions in ASL is encoded by a free-standing aspectual marker: a sign glossed as FINISH, which expresses that "the eventuality is bounded" (p. 48); i.e., perfective viewpoint. Cross-linguistically, such free-standing markers often indicate that an event is finished, i.e., perfective or completive aspect, as is true, for example, for ALREADY in Israeli Sign Language (ISL) in (5) (Meir 1999).

(5) INDEX$_1$ **ALREADY** WRITE LETTER SISTER POSS$_1$.
'I have written a letter to my sister.' [ISL; adapted from Meir 1999: 51]

Such markers have also been identified, for instance, for German Sign Language (Rathmann 2005), SSL (Bergman & Dahl 1994), ASL (Janzen 1995;

[6] Gray (2013) thus observes no fixed and predictable forms, and no completely consistent semantics in reduplication expressing aspectual meanings in Auslan. Reduplication is also not obligatory to describe repeated or continuing events. Given these – among other – observations, Gray (2013) argues against the existence of a set of aspectual morphemes with fixed forms, and against an analysis of Auslan aspect marking as an inflectional morphological system. Instead, Gray analyzes aspectual modification in Auslan as gestural modification of verbs (for details, I refer to Gray 2013).

Fischer & Gough 1999), Turkish Sign Language (Zeshan 2003a; Karabüklü & Wilbur 2021), and IPSL (Zeshan 2000), and Johnston et al. (2015) describe the ongoing grammaticalization of different signs glossed as FINISH in Auslan.

Manual perfective markers are sometimes accompanied by non-manual elements, that is, silent articulations by the mouth. For instance, for Kata Kolok (Bali), de Vos (2012a, 2012b) describes that the manual sign FINISH is often accompanied by a non-manual element 'pah'. She observes that the non-manual element can also attach to a lexical predicate to express the perfective, and in those cases, it occurs without FINISH. Similarly, for the urban sign language varieties of Solo and Makassar (Indonesia), Palfreyman (2013) finds that completive aspect can be encoded by at least four particles, which may co-occur with completive-marking mouthings. He observes that these mouthings may co-occur with the (manual) particle, but they, too, can also occur as the only completive marker in the sentence (see also Palfreyman 2015). For Turkish Sign Language, Karabüklü & Wilbur (2021) find that, apart from the manual marker BİT (which is similar to ASL FINISH), the non-manual marker 'bn' is a separate perfective morpheme.

Free-standing manual signs have been described for other types of aspect as well, albeit less frequently. For instance, in SSL, a habitual marker (which is not obligatory) has been identified; use of this marker, which is glossed as USUALLY, is illustrated in (6). Note that here, USUALLY co-occurs with reduplication of the verb.

(6) **USUALLY** SIT WRITE++ LETTER.
'He usually sits down and writes letters.'[7]
[SSL; Bergman & Dahl 1994: 402]

Free-standing aspect markers have also been identified for NGT (Hoiting & Slobin 2001; van Boven 2018; van Boven & Oomen 2021), as I will discuss in the following section.

3.2.4 Previous studies on aspect in NGT

The first to describe the encoding of aspectual distinctions in NGT were Hoiting & Slobin (2001), focusing on habitual and continuative aspect in this language. According to them, continuative aspect describes an action that is ongoing (e.g., "He's going on working [at the moment]", p. 128), and is marked on the verb sign by "three repetitions of an elliptical modulation accompanied by pursed lips and a slight blowing gesture" (p. 127). Habitual aspect, which they define as describing an

[7] This is a free translation, as Bergman & Dahl (1994) do not offer a translation for this example.

ongoing action that occurs habitually (e.g., “He always works on and on”, p. 128), is marked on the verb sign by “a slower elliptical modulation accompanied by gaze aversion, lax lips with protruding tongue, and slowly circling head movement” (p. 127). Note that both definitions are somewhat unconventional: in the definition of continuative aspect, there is no reference point (e.g., Klein’s (1994) “topic time”; see the definition given in Section 3.2.2), and in the definition of habitual aspect, there is a notion of continuity, implied by the word ‘ongoing’ – traditional definitions of habituality (and the one we adopt in the present study), however, do not include such a notion (see, again, Section 3.2.2). Hoiting & Slobin do not provide examples of the elliptical modulation. Yet, they do identify phonological constraints.

For the reader to appreciate these constraints, it is necessary to introduce the sublexical (i.e., phonological) building blocks of signs, which have been argued to function like segments in spoken languages (sometimes called “parameters”). Simplifying somewhat, the building blocks that have been identified are the handshape (hand configuration), place of articulation, and movement of the sign (Stokoe 1960; Sandler 1989; for an overview, see Fenlon et al. 2017). The latter comes in two types: path movement and hand-internal movement. If a sign has a path movement, the hands move from one location to another. Internal movement involves a change in handshape or in orientation. Another kind of internal movement is so-called secondary or trilled movement, which involves fast repetitions of orientation or handshape changes, or wiggling of the fingers. Internal movement and path movement may combine, or occur on their own (Wilbur 1987; Brentari 1990; Sandler & Lillo-Martin 2006). Evidence for the phonological significance of these building blocks comes from minimal pairs; for instance, two signs may differ in terms of their movement alone. Furthermore, just like segments in spoken languages, these building blocks can be described in terms of distinctive features, which are organized in feature hierarchies. Various phonological models have been put forward (e.g., Sandler 1989; Brentari 1998), to which I will come back in Section 3.5.1.

According to Hoiting & Slobin (2001), aspectual marking in NGT is phonologically constrained, the relevant building blocks being movement and place of articulation: verbs with internal movement and/or body contact cannot undergo the elliptical modulation. These verbs thus remain uninflected, but are followed by an aspectual particle which they gloss by means of the Dutch word DOOR (lit. ‘through’), which takes on the inflection instead. This particle is borrowed from spoken Dutch, where it can be used with a similar meaning with some verbs (e.g., *Hij loopt door* ‘He continues to walk’). The sign is illustrated in Figure 3.1. In the following, I will gloss this sign as CONT (since later studies have shown that this particle expresses continuity, but not habituality, as we will see below). An example where a verb with body contact (TRY, which contacts the nose) is combined with CONT, which then takes on the inflection, is given in (7).

Figure 3.1. CONT in NGT (van Boven 2018: 7), video still taken from the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008).

(7) INDEX$_{3a}$ TRY **CONT++**.
'He tried continuously.'
'He tried and tried and tried.'
[NGT; adapted from Hoiting & Slobin 2001: 129]

A few recent studies have called into question the analysis of continuative and habitual marking offered by Hoiting & Slobin. First, Oomen (2016) conducted an elicitation task with one deaf signer. This task followed the general format of Dahl's (1985) questionnaire, originally developed to elicit tense, mood, and aspect (TMA) in spoken languages, but which was later also used to investigate SSL (Bergman & Dahl 1994). This questionnaire consists of approximately 200 sentences preceded by a question or context sentence that is supposed to trigger specific TMA marking (if available in the language); the verbs in the target sentences are given in their infinitival forms as in (8). Sentences are presented in English and informants are asked to translate the sentences to a target language (Dahl 1985).

(8) Question: What your brother usually DO after breakfast?
Answer to be translated: He WRITE letters [Dahl 1985: 199]

Oomen (2016) used this questionnaire in slightly adapted form: she brought the number of sentences down to 66, translated the sentences into Dutch, and adapted the items to the purpose of her study, such that they would (i) trigger continuative and habitual aspect and (ii) target verbs that were selected based on their phonological specifications.

Oomen's results suggest that both aspect types are expressed in NGT by reduplication combined with non-manual markers. Specifically, continuative aspect was "consistently marked by means of a relatively slow reduplication of the verb's movement and a synchronous back-and-forth movement of the head or body" (Oomen 2016: 43), while habitual aspect involved reduplication and synchronous left-to-right head and body movements. Habitual marking only occurred in past contexts. Notably, CONT did not appear in the data at all: verbs with internal movement or body contact were inflected for continuative and habitual aspect in the same manner as those without these constraining features. Oomen offers regional variation as a potential explanation for the differences between these two studies: she reported on an informant from Amsterdam, while Hoiting & Slobin included informants from Groningen. It is well-known that there are lexical differences between the NGT dialects from these regions (Schermer 2004), but Oomen is the first to suggest a grammatical (i.e., inflectional) difference. It is also important to note that Oomen defined habituality in a more traditional way than Hoiting & Slobin, that is, excluding the notion of continuity.

In a subsequent study, van Boven (2018) presents a descriptive analysis of CONT based on naturalistic corpus data, searching for this sign (i.e., the gloss DOOR) in the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008). The results again challenge Hoiting & Slobin's description, as well as Oomen's observations: CONT does occur in the data, but it co-occurs with a wide variety of verbs, not only with those involving body contact or internal movement. It also appears in various syntactic positions, sometimes preceding rather than following the verb. CONT was mostly used to express continuative aspect.

Finally, habitual aspect in NGT was further investigated by van Boven & Oomen (2021). They, too, investigated naturalistic corpus data from the Corpus NGT. They searched for any sentence that refers to an event that is regularly repeated over an extended period of time. They conducted specific searches in the Dutch translations available in the corpus, searching for particles and adverbials that normally occur in Dutch habitual sentences (e.g., *regelmatig* 'regularly', *per week* 'a week', and *elke dag* 'every day'). In total, they included 106 sentences in their data set, which, according to them, have habitual meaning. They then analyzed how this habitual meaning is encoded in the sentence. Since the present study builds on their methodology, and actually includes these data, more details about the search procedure are given in Section 3.3.1.

While they could not identify clear non-manual markers, van Boven & Oomen found that habitual meaning can be realized by reduplicating the verb, as well as by several adverbials. These two types of manual markers sometimes occur together (26.4% of the 106 analyzed sentences), but also on their own (40.6% for adverbs; 19.8% for reduplication). Moreover, manual marking is not obligatory (13.2% of the sentences does not involve any manual marking). (9a) shows a sentence with both reduplication and the adverbial ALWAYS, while (9b) illustrates a sentence without any manual marking.

(9) a. INDEX$_{3a}$ **ALWAYS ONE TIME MONTH ANGRY++**.
'He always used to be angry once a month.'
[NGT; van Boven & Oomen 2021: 170]

b. SAY PAST INDEX$_1$ CERTAIN.
'I used to say "I'm certain [it will forever stay that way]".'
[NGT; van Boven & Oomen 2021: 169]

As for CONT, van Boven & Oomen (2021) argue that it does not express habitual meaning: it occurs in only two out of 106 sentences, and in both cases, it triggers an additional continuative reading. Therefore, they conclude that CONT actually encodes continuative rather than habitual aspect, which aligns with the fact that (i) Hoiting & Slobin (2001) maintained a definition of habituality that includes the notion of continuity, and (ii) van Boven (2018) found this sign to mostly express continuity.

In the corpus data, habitual marking occurs with verbs with a variety of phonological properties, as well as both in past and non-past contexts. Van Boven & Oomen offer a methodological explanation for the differences between their study and the previous studies on NGT: corpus data display more variation than elicited data.

3.2.5 The present study

Strategies for encoding habitual and continuative aspect in NGT have been investigated previously. From these studies, it seems clear that reduplication plays a role. Yet, many questions remain unanswered, since there is considerable variation in the results. Moreover, none of the previous studies takes into account iterative aspect, while in other sign languages, iterative aspect has often been found to be encoded by reduplication as well. The present study therefore aims at answering the following questions:

(I) Can reduplication of the predicate encode habitual, continuative and iterative aspect in NGT?

(II) Can different types of reduplication be distinguished for different types of aspect in NGT?

(III) Which restrictions on aspectual reduplication can be identified in NGT?
   a. Are there phonological restrictions (internal movement/body contact)?
   b. Is there a relation between CONT and reduplication for continuative aspect?
   c. Is there a relation between tense and reduplication for habitual aspect?

Previous studies on aspect in NGT included only one (Oomen 2016) or a few informants (Hoiting & Slobin 2001) from one sign region and focused only on elicited data that sometimes involved translations – and thus potential influence – from spoken Dutch (Oomen 2016). Some studies included naturalistic corpus data (van Boven 2018; van Boven & Oomen 2021), but none of the previous studies on NGT systematically analyzed all three aspect types that are potentially expressed by reduplication. Therefore, the current study is the first to comprehensively analyze and compare all three aspect types, combining naturalistic corpus data with data elicitation, in order to provide a comprehensive description of aspectual reduplication in the language.

3.3 Method

The method of this study is two-fold: first, building on van Boven & Oomen (2021), data were collected from the corpus NGT (Section 3.3.1), and second, data were elicited from deaf informants (Section 3.3.2). Both data sets were annotated and analyzed in a similar manner (Section 3.3.3).

3.3.1 Corpus search

The starting point of this study was a search in the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008), which contains recordings of 92 deaf NGT signers (age 17–84 years). The signers in the corpus performed several tasks, such as discussing certain topics and retelling video clips, resulting in semi-spontaneous monologues and dialogues.[8] The corpus contains over 70 hours of video data, and part of these data have been transcribed by fluent signers, using the annotation tool ELAN (Crasborn & Sloetjes 2008). The available transcriptions include annotations on gloss tiers, where signs are glossed on separate tiers for the dominant and non-dominant hand, and a translation tier, which includes Dutch translations (Crasborn et al. 2008).

The present study includes the corpus data collected for habitual aspect by van Boven & Oomen (2021), as reported above. In order to complement these data with constructions involving iterative and continuative aspect, I adopted the same strategy, i.e., I included sentences in my data set based on their meaning: The Corpus NGT is not annotated for aspectual distinctions or reduplication, and for this reason, searches had to be conducted on the translation tier, searching for particles and phrases that often occur in Dutch continuative and iterative sentences. Additionally, for continuative aspect, one specific gloss was searched for (HELE 'whole'), as this sign was expected to often occur in continuative sentences (e.g., in the context of the phrase HELE DAG 'the whole day'). Table 3.1 provides an overview of the specific search terms, and specifies how many search hits there were in total per aspect type,[9] and how many sentences were included in the end for each aspect type.

[8] For more information on the Corpus NGT, such as the elicitation materials, metadata and all public corpus files, see: https://archive.mpi.nl/tla/islandora/object/tla:1839_00_0000_0000_0004_DF8E_6?asOfDateTime=2018-03-02T11:00:00.000Z.

[9] Please note that these are not all unique hits, as some sentences in the corpus showed up for multiple search terms (e.g., a sentence that contains both *voortdurend* 'continuously' and *de hele dag* 'the whole day' would surface twice as a search hit).

Table 3.1. Search terms used to find different aspectual distinctions in the Corpus NGT. The searches were conducted on the translation tier, with one exception (HELE 'whole' on the gloss tier for the continuative).

Aspect type	Search terms	N (total hits)	N (hits included)
Habitual (see van Boven & Oomen 2021)	*regelmatig* ('regularly') *iedere/elke dag/week/jaar/maand* ('each day/week/year/month') *per week/jaar/maand/dag* ('per day/week/year/month') *altijd* ('always') *vaak* ('often') *elk(e), ieder(e)* ('each')	218	106
Continuative	*aan het* (locative expression to indicate continuative meaning, lit. 'at the') *voortdurend* ('continuously') *zit te/zitten te/zat te/zaten te* (light verb construction to indicate continuative meaning, lit. 'sit/sat to') *hele dag/heel de dag* ('whole day') *continu* ('continuously') *door* (postposition or verb particle to express continuity, lit. 'through') *constant* ('constantly') *HELE (gloss)* (WHOLE)	520	106
Iterative	*opnieuw* ('again') *herhaaldelijk* ('repetitively') *steeds* ('always') *elke/iedere keer* ('each time') *keer* ('time') *vaak* ('often')	269	28

Each sentence that potentially involved the relevant aspect type was included. The inclusion criteria for the habituals are explained in van Boven & Oomen (2021: 165–166), but are briefly repeated here. Adopting definitions of habituals by Comrie (1976) and Rathmann (2005), van Boven & Oomen searched for any sentence that references an event that is regularly repeated over an extended period of time (see also the definitions in Sections 3.2.2 and 3.2.3). As Table 3.1 shows, 106 sentences met this criterion, and representative examples are given in (10) (van Boven & Oomen 2021: 166). For all of the examples extracted from the corpus, the corpus file number (CNGTxxxx), signer number (Sxxx), and begin time of the example (m:s.ms) are provided (see the *Notation conventions for glossed sign language examples*).

(10) *Examples included in the habitual data set* (van Boven & Oomen 2021: 166; PART.AFF = affirmative particle)

a. INDEX_1 GO++ PART.AFF PALMS.UP.
'I go there regularly.' [CNGT0064; S006; 01:56.90]

b. ONE TIME DAY GO BEACH […].
'Every day we went to the beach […].'
[CNGT0049; S006; 04:06.20]

Table 3.1 also shows that 112 sentences showed up in the searches for habituals, but did not meet the inclusion criteria – i.e., they did not involve a systematically recurring event, and therefore were excluded. Two representative examples are given in (11) (van Boven & Oomen 2021: 166). Both showed up in the searches because the Dutch translations contain *altijd* 'always'.

(11) *Examples excluded from the habitual data set* (van Boven & Oomen 2021: 166)

a. ALWAYS INDEX_3.
'Was he always like that?' [CNGT0370; S019; 00:57.20]

b. INDEX_3 BOOK READ ALWAYS IMPORTANT INDEX_3.
'And that – reading books – is always important.'
[CNGT0429; S021; 02:59.50]

For continuative aspect, I adopted the definition given in Section 3.2.2, i.e., the sentence was included when "an event is progressing dynamically over a time frame opened up by an utterance" (Mair 2012: 803), and also when a situation is in progress. In total, 106 sentences met these criteria, as Table 3.1 shows. Two representative examples are given in (12).

(12) *Examples included in the continuative data set*

a. CONTINUE INDEX_1 WRITE.
'I continued to write.' [CNGT0121; S007; 00:24.92]

b. INDEX_{3a} TALK CONT++.
'She [the cashier] just continued talking.'
[CNGT0134; S008; 01:20.64]

As is evident from Table 3.1, 414 sentences showed up in the searches for continuative aspect but did not meet the criteria, and were thus excluded. Representative examples are given in (13) – these do not involve ongoing, progressing events or situations. These sentences showed up in the search hits because their Dutch translations contained *(koppelen) aan het* 'connect to' (13a) and *(ingehaald) door* 'caught up with by' (13b).

(13) *Examples excluded from the continuative data set*

a. SAME START WRITE READ CONNECT SPEECH.THERAPY HAVE.TO.
'You can connect speech therapy to reading and writing.'
[CNGT0255; S013; 05:50.88]

b. STOP POLICE GO.AWAY QUICK.
'Then we were quickly caught up with by the police.'
[CNGT0050; S006; 00:35.28]

Iterative aspect had not previously been investigated for NGT. Therefore, I assumed the definition proposed by Rathmann (2005: 37), which is also given in Section 3.2.3.1 above: "The iterative morpheme contributes the meaning that multiple instances of the eventuality unfold in their own interval. A break is possible between each interval". It was thus important that an event occurred multiple times, each instance with its own starting point (similar definitions are given in, e.g., Comrie 1976; Bybee 1985). In total, 28 sentences met these criteria (see Table 3.1), and representative examples are given (14).

(14) *Examples of sentences included in the iterative data set*

a. SOME PEOPLE TRY SET.UP+.
'Some people tried to set something up over and over again.'
[CNGT0259; S014; 04:16.88]

b. SLEEP++ DRIVE.CAR.
'My eyes kept closing [I kept falling asleep] while driving the car.'
[CNGT0050; S006; 00:32.56]

However, the vast majority of the sentences that showed up in the searches for iterative aspect, 241 in total (see Table 3.1), did not involve multiple occurrences of an event and were therefore excluded from the data set. Two representative examples are given in (15); both found their way into the search hits because the Dutch translations contain *opnieuw* 'again'.

(15) *Examples of sentences excluded from the iterative data set*

a. <u>headshake</u>
PLEASANT NEW LEARN INDEX$_1$ AGREE.
'It wasn't pleasant to learn that [sign] again // to learn a new sign.'
[CNGT0069; S006; 03:33.8]

b. […] AGAIN START.UP […].
'[…] and it (the computer) restarts […].'
[CNGT1721; S071; 00:16.6]

3.3.2 Data elicitation

In order to complement the corpus data, an elicitation task was designed, aimed at eliciting NGT sentences that contain continuative, habitual, and iterative aspectual marking.

3.3.2.1 Participants

Six deaf NGT signers participated in this study (none of which are included in the Corpus NGT). All signers grew up with NGT. Their mean age is 41 years (range 27–67), two are male and four are female, and they come from various sign regions in the Netherlands (one from Zoetermeer, two from Groningen, two from Amsterdam, one from mixed regions). While three of them have deaf family members, the other three grew up with only hearing family. Data from one additional participant had to be excluded from the analysis, as this participant did not carry out the test as it was intended.

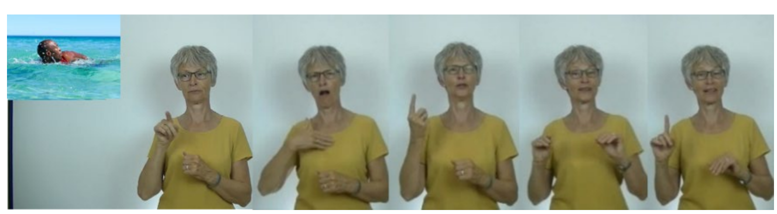
3.3.2.2 Stimuli

The elicitation task aimed at eliciting aspect marking on six different NGT verbs with different phonological features, as shown in Table 3.2.[10] For each verb, participants were presented with six items (i.e., there were 36 stimuli in total): two for each aspect type, once in a non-past context and once in a past context (note that NGT does not mark tense on the verb; rather, the tense information was provided by time adverbials such as YESTERDAY).

Table 3.2. Verbs included in the elicitation task.

Verb type		
Body-anchored	**Internal movement**	**No potentially constraining features**
SLEEP	MELT	CLEAN
HUG	TALK	SWIM

Each elicitation item consisted of two parts: (i) a picture denoting the verb, for instance, a man who is swimming, and (ii) a question in NGT about that picture, preceded by a brief context, for instance, "This man lives close to the beach. What has he been doing the past few hours?"; see Figure 3.2.



INDEX$_{3a}$ LONG HOURS DO WHAT

Figure 3.2. Example of an elicitation item: "[This man lives close to the beach.] What has he been doing for hours?". Targeted answer: "The man has been swimming for hours." (Stimulus picture from Dreamstime.com, Image ID: 75474659, Copyright Mimagephotography, https://www.dreamstime.com/mimagephotography_info).

[10] In practice, participants sometimes used different variants of these verbs with different phonological features – for example, for MELT, a variant without internal movement but with body contact was sometimes used, as will become clear below.

Participants were asked to answer the question based on the picture they saw. Importantly, the question was phrased such that it would elicit an answer that contains marking for one of the aspectual distinctions under investigation. That is, the preceding context and the question specify how often a certain event occurs and/or how long the event lasts. Neither the context nor the question contained the target verb (in the example "to swim"), in order to avoid influencing the answers as much as possible. Participants were instructed to answer in complete sentences (in our example, an expected answer would be translated as 'The man has been swimming for hours').

Additionally, the base form of each verb was elicited (six items in total), in order to be able to compare the verbs in the sentences potentially marked for aspect to their base form articulated by the same participant. This was done by simply asking what the person on the picture is doing. Therefore, in total, the participants were presented with 42 elicitation questions and pictures. An English translation of the elicitation task, including instructions, is publicly available (van Boven 2023b). All items and instructions were presented by a deaf NGT signer, who was also consulted when designing the elicitation items.

Some of the contexts presented to the participants were based on the TMA-questionnaire developed by Dahl (1985) and adapted for NGT by Oomen (2016). That is, I based the items for continuative and habitual aspect on the contexts in this questionnaire for those verbs that can be depicted on a picture (i.e., SLEEP, HUG, TALK, and CLEAN) – although where necessary, some changes were made – and complemented these with two new verbs (MELT, SWIM), as well as new contexts for iterative aspect.

The stimuli were piloted with one deaf NGT signer, after which six stimuli were adapted since they did not elicit the targeted aspect types. The adaptations were done in consultation with a deaf signer.

3.3.2.3 Procedure

After the pilot, six other signers participated in the task, which was designed in Qualtrics.[11] Before the actual task started, they provided their informed consent, allowing for the use of the gathered data and video stills. They were then presented with a few background questions (age, sex, sign region, hearing status of family members, and the languages they know). Subsequently, a deaf signer provided instructions for the task in NGT, which, importantly, mentioned that participants should use entire sentences to answer the questions about the pictures (that is, not just the verbs). They were then shown two example items and answers featuring

[11] Available at https://www.qualtrics.com.

verbs that were not included in the actual task. The example items did not involve aspectual meaning. Then the actual test started.

Four participants (of which one had to be excluded) came to the recording studio to take part in the study, while the other three participants preferred to take part via a videocall. In all cases, a hearing researcher (who signs NGT as a second language) was present, either in person or via the videocall platform.

The 42 stimuli were presented in a semi-randomized order that was different for each participant. Within the randomization, it was ensured that items targeting the same verbs, the same aspect types, and the same tenses did not follow each other. Stimuli were presented one by one, and after watching a stimulus, participants signed their answer to the camera (either on their laptop or the camera in the recording studio). They could then move on to the next stimulus, sign their answer, and so on. There was no time pressure; participants could decide themselves when they wanted to move on to the next elicitation item. The hearing researcher only answered any practical questions a participant might have and did not interfere during the task.

3.3.3 Data annotation and analysis

The data annotation was done for both data sets in ELAN (Crasborn & Sloetjes 2008) – see Section 3.3.3.1. The statistical analyses were conducted in R (R Core Team 2008) and are introduced in Section 3.3.3.2.

3.3.3.1 Data annotation

The annotation tool ELAN (Crasborn & Sloetjes 2008) was used to annotate both data sets. To illustrate, a screenshot of the annotations is shown in Figure 3.3. For both data sets, I annotated (i) the aspect type of the sentence, (ii) whether the predicate was reduplicated, (iii) whether the sentence contained an adverb marking the aspect type, (iv) any non-manual markers potentially expressing aspect, and (v) any additional comments or relevant information about the phonological features of the predicate. For the elicited data, I additionally annotated (vi) any difference between the targeted aspect type and the aspect type actually produced by the participant, (vii) whether the sentence is past or non-past, and (viii) whether the participant added CONT to the sentence. All data annotations for both data sets are openly available (van Boven 2023b).

For the habituals in the corpus data, I adopted the relevant annotations already made by van Boven & Oomen (2021) (i.e., on reduplication, adverbs, non-manual markers, past tense, and comments).[12] I added annotations of the relevant phonological features.

As for the elicited data, I did not only annotate productions including the targeted verbs, but also sentences in which participants produced a verb that was not targeted, but which still involved one of the aspects. Sometimes, participants produced the targeted verb meaning, but used a different variant of that verb than was expected (e.g., the target form of MELT involves internal movement, but some participants produced a variant without internal movement, but with body contact; see also footnote 10) – these were also included.

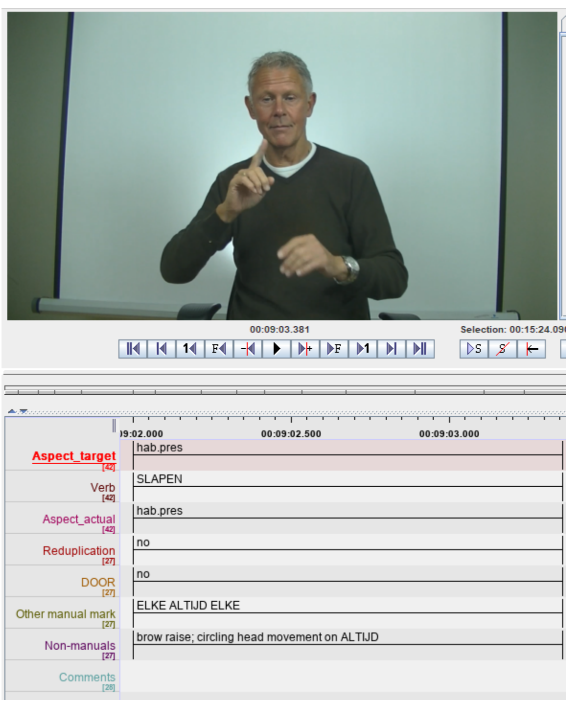


Figure 3.3. Example of the annotations in ELAN.

[12] I adapted two of the annotations originally made by van Boven & Oomen (2021). These involve two habitual sentences with the predicate GET.USED.TO (Dutch gloss WENNEN, [CNGT1627; S067; 00:50.8] and [CNGT1926; S078; 01:22.1]). Originally, van Boven & Oomen annotated that this predicate was reduplicated, but upon further analysis I decided to annotate that it was not. In its citation form, GET.USED.TO has an inherently repeated movement – in the NGT dictionary (https://www.gebarencentrum.nl/Gebarenwoordenboek) it has four movement cycles. Both corpus instances have only two movement cycles, even less than the citation form, and therefore they are now subsumed under inherent repetition, and no longer annotated as reduplicated.

3.3.3.2 Statistical analyses

A statistical analysis was conducted to investigate under what circumstances aspectual reduplication occurs (i.e., research questions (I) and (III)), specifically whether (i) the aspect types differ with respect to each other in terms of reduplication (in both data sets), (ii) the data sets (i.e., the corpus and the elicited data) differ from each other in terms of reduplication, and (iii) there is an interaction between aspect type and data set. The data were trimmed: I excluded elicited verbs that could not be analyzed for reduplication (see Section 3.4.1).

I fitted a generalized linear mixed effects models using the lme4 package (Bates et al. 2015). I built a model with reduplication as the dependent variable, a binomial factor with two levels: '1' (when the predicate is reduplicated) or '0' (when the predicate is zero-marked). Aspect type and data set were included as fixed effects, and an interaction between them was included. With the aim to fit a maximal model justified by the design (Barr et al. 2013), a random intercept for subject was also included as well as a by-subject random slope for aspect type.

I used orthogonal sum-to-zero contrast coding for the aspect type variable. I set the following comparisons: a) continuative and habitual against iterative (contrast coded as −1/3, −1/3, +2/3, respectively); b) continuative against habitual (contrast coded as −0.5, +0.5, respectively, with iterative coded as 0). I also used orthogonal sum-to-zero contrast coding for the data set variable. Corpus data was coded as +0.5 and elicited data as −0.5.

An important qualification, however, is that the analysis of binomial data, such as the data analyzed here, is known to require large samples. For instance, Moineddin et al. (2007), in their simulation study, report that multilevel logistic regression models require at least 50 groups, with a group size of 50, in order to produce valid estimates, and that in each group the expected number of outcomes should be more than one. When using logistic regression on smaller data sets, "researchers can expect to encounter convergence problems, large biases in their model estimates and inadequate statistical inference procedures. Our findings suggest that when choosing a sample size, researchers should base their decision on the level of bias that they consider acceptable for that particular study" (Moineddin et al. 2017: Discussion and conclusion, para. 11). Given that the data set analyzed here involves 363 observations of 55 participants (corpus and elicited data together), the estimates reported here should be taken with caution. See Section 3.5.3 for more discussion.

Further, for the elicited data, it was analyzed statistically whether there is a relationship between reduplication and the predicates' potentially constraining phonological features, as well as between reduplication and past tense. For this, the data were trimmed, too, excluding again elicited verbs that could not be analyzed for reduplication, as well as the corpus data. Given the fact that this involves an even smaller sample size (123 observations of six participants), no logistic regression model was conducted. Instead, I conducted Pearson Chi-Squared Tests in R (R Core Team 2008). However, we should bear in mind that a chi-squared test assumes that the observations in the data set are independent of each other (see, e.g., Agresti 2007 for more information about chi-squared analysis), which is not the case in the present data sets. The results could, in fact, be due to several dependencies in the data (for instance, the fact that there are multiple measurements per participant), and this should be kept in mind when interpreting the results. See footnote 13 and Section 3.5.3 for more discussion.

Finally, a Pearson Chi-Squared Test was also conducted in R (R Core Team 2008) to investigate whether there is a relationship between the occurring aspect type and the data set. Again, the same caveat as mentioned above should be kept in mind.

The statistical analyses (a .Rmd-file and an html version) are openly available (van Boven 2023b).

3.4 Results

In total, 240 sentences in the corpus were analyzed as involving one of the three targeted aspect types. In addition, 172 sentences were elicited; see Table 3.3 for an overview.

Table 3.3. Habitual, continuative and iterative sentences in the Corpus NGT and the elicited data.

Aspect type	Corpus (N)	Elicited (N)
Habitual	106[a]	63
Continuative	106	47
Iterative	28	62
Total	*240*	*172*

[a] See van Boven & Oomen (2021)

Table 3.3 makes clear that all aspect types occur in both data sets, but that iterative aspect is clearly underrepresented in the corpus data. The Pearson Chi-Squared Test I conducted in R (R Core Team 2008), in order to investigate the relation between aspect type and data type (i.e., Table 3.3), shows a significant relation between the two variables (X^2 (2, N = 412) = 36.3, p < 0.001).[13] An overview of all statistical data is provided in Appendix 3-A, and see van Boven (2023b) for the complete analysis in R.

3.4.1 Reduplication of the predicate

Table 3.4 shows how often reduplication is used to express an aspectual distinction in the corpus data. Clearly, reduplication of the predicate occurs, but not always: for habitual and continuative sentences, about half of the predicates is reduplicated in the corpus data, while for iteratives in the same data set about 30% of the sentences does not involve a reduplicated predicate.

For the elicited data, some sentences could not be analyzed for reduplication, since for some predicates, no corresponding base form produced by the same participant could be elicited – be it because the elicitation of the base form did not succeed, or because the participants inflected a verb for aspect that was different from the targeted verb. For this reason, 14 continuative, 25 habitual, and 10 iterative sentences could not be analyzed for reduplication. Table 3.5 shows the results for reduplication of the predicate in the remaining elicited sentences – for habitual and continuative sentences in the data, about 20% involves predicate reduplication, while this percentage is, again, about 70% for iterative aspect.

[13] However, we should bear in mind that a chi-squared test assumes that the observations in the data set are independent of each other (see, e.g., Agresti 2007 for more information about chi-squared analysis), which is not the case in the present data sets. The result could, in fact, be due to several dependencies in the data, for example, because certain participants differ from others (there are multiple measurements per participant). However, it is likely that the significant result is due to the fact that in the elicited data, I targeted an equal amount of sentences for each aspect type, likely resulting in an unusually high number of iteratives as compared to the naturalistic language use in the corpus data. I refer to Section 3.5.3 for further discussion of this difference in frequency.

Table 3.4. Reduplication encoding aspectual meaning in the corpus data.

Aspect type	N (total)	Predicate reduplicated (%)
Habitual (van Boven & Oomen 2021)[14]	106	47 (44.3%)
Continuative	106	56 (51.9%)
Iterative	28	20 (71.5%)
Total	*240*	*123 (51.3%)*

Table 3.5. Reduplication encoding aspectual meaning in the elicited data.

Aspect type	N (analyzed)	Predicate reduplicated (%)
Habitual	38	8 (21%)
Continuative	33	8 (24%)
Iterative	52	37 (71%)
Total	*123*	*53 (43.1%)*

As described in Section 3.2.2, it was analyzed statistically whether there is a difference between aspect types and between data sets in terms of reduplication. There was no significant difference between habitual and continuative aspect (p = 0.41); however, participants were five times more likely to use reduplication with iterative aspect than with habitual and continuative (odds ratio = 5.47, $p < 0.001$, z = 4.86, 95 percent confidence interval from 2.8 to 10.87). While I cannot conclude anything about the difference between habituals and continuatives in terms of likelihood of reduplication, iterative aspect is thus clearly more likely to be encoded by predicate reduplication than habitual and continuative aspect. Moreover, there was a significant effect of data set: participants were two times more likely to use reduplication in the corpus data than in the elicited data (odds ratio = 2.17, p = 0.03, z = 2.15, 95 percent confidence interval from 1.07 to 4.4). No significant interaction between data set and aspect type was found (p = 0.08 for continuative/habitual compared to iterative; p = 0.8 for continuative compared to habitual). An overview

[14] Recall from footnote 12 that I re-analyzed two instances that van Boven & Oomen (2021) originally analyzed as predicate reduplication. The number in Table 3.4 for reduplication in habituals in the corpus is therefore slightly lower than in their analysis (47 rather than 49 instances).

of all statistical data for the fixed effects is provided in in Appendix 3-A, and see van Boven (2023b) for the complete analysis in R.

3.4.1.1 Phonological restrictions on reduplication

Following Hoiting & Slobin (2001), it may be expected that predicates that are not reduplicated are body-anchored and/or involve internal movement. In total, 68 body-anchored verbs, 37 internal movement verbs, and 67 verbs without constraining features were elicited. Recall, however, that not all elicited verbs could be analyzed for reduplication. Table 3.6 shows the numbers excluding those verbs that could not be analyzed for reduplication.

Table 3.6. Verb types in the elicited data; numbers after exclusion of predicates that could not be analyzed for reduplication.

Verb type	N (analyzed)
Body-anchored	56
Internal movement	18
No constraining features	49

Table 3.5 showed that out of the 123 elicited predicates that could be analyzed for reduplication, only 53 were in fact reduplicated. We can thus analyze whether the 70 non-reduplicated predicates involve internal movement or are body-anchored. However, this is not the case: out of the 70 non-reduplicated predicates, only 15 involve internal movement, and 26 are body-anchored. The other 29 verbs are not specified for one of the constraining features, suggesting that reduplication is optional even for verbs that are unconstrained; see Table 3.7.

Table 3.7. Potentially constraining features and reduplication in the elicited data; numbers after exclusion of predicates that could not be analyzed for reduplication.

Body-anchored/internal movement	Reduplicated	Not reduplicated
Yes	33	41
No	20	29

The Pearson Chi-Squared Test I conducted in R (R Core Team 2008), in order to investigate the relation between potentially constraining features (body-anchoredness/internal movement) and reduplication (i.e., Table 3.7), shows no significant relation between the two variables (X^2 (1, N = 123) = 0.05, p = 0.82). I cannot conclude anything as to whether there is a relation between the potentially constraining features on the one hand and predicate reduplication/zero marking on the other. An overview of all statistical data is provided in Appendix 3-A, and see van Boven (2023b) for the complete analysis in R.

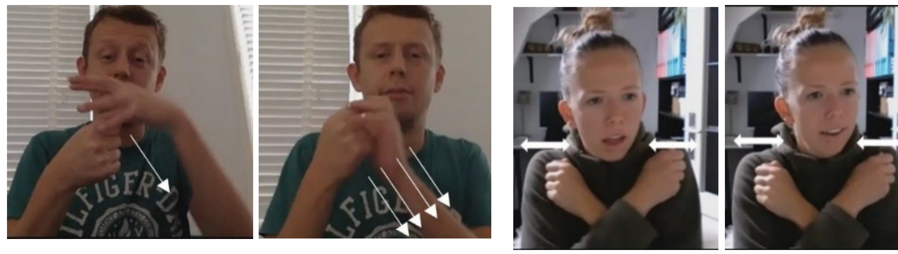
We can, however, check for each aspect type whether predicates that involve internal movement or are body-anchored are reduplicated, and which ones these are. Table 3.8 shows the results.

Table 3.8. Reduplication of "constrained" predicates per aspect type in the elicited data (BA = body-anchored, IM = internal movement); shaded cells highlight unexpected patterns.

Verb type	N	Continuative	Habitual	Iterative
Reduplicated BA	30	4 (13%)	5 (17%)	21 (70%)
Reduplicated IM	3	0 (0%)	0 (0%)	3 (75%)

As Table 3.8 shows, the phonological restrictions previously identified for habitual and continuative aspect do not hold for iteratives in the elicited data: 24 predicates that are body-anchored or involve internal movement are reduplicated for this aspect type. For continuative and habitual aspect in the elicited data, the previously identified constraint on reduplicating internal-movement predicates seems to hold. However, for the phonological feature body-anchoredness, the picture is less clear, as there is a total of nine cases where a body-anchored predicate is reduplicated (the shaded cells in Table 3.8), namely HUG (N = 3), SLEEP (N = 1) and MELT (N = 5). Although at first glance, it thus seems that these contradict the phonological constraint previously identified, it is worth inspecting them further.

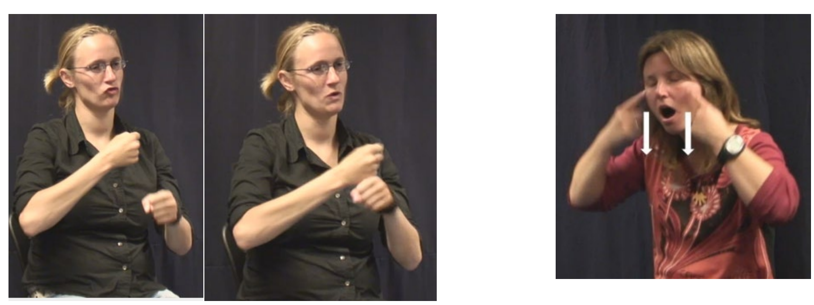
The five instances of MELT involve a variant of this verb that was analyzed as body-anchored, because the non-dominant hand is the place of articulation, while the dominant hand moves. Here, the verb actually does not contact the body, but rather the other hand – and in fact, the hands are often in proximity to each other, rather than actually making contact. This verb and its reduplicated form are illustrated in Figure 3.4a. For HUG, it appears that it actually cannot be reduplicated in the expected way, that is, by repeating the entire path movement performed by the hands. Still, some participants employ an alternative strategy to reduplicate this body-anchored verb. The data suggest that HUG is lexically specified for a short, swaying body movement. Some participant reduplicate the verb by repeating this body movement rather than the path movement of the hands. The hands thus retain contact with the body, as illustrated in Figure 3.4b. Finally, for SLEEP, it appears that the repetition may well have been a slip of the hand (but see an alternative explanation below: it contacts not the trunk, but the head).



a. MELT MELT+++ b. HUG+

Figure 3.4. Reduplication of body-anchored predicates MELT (a) and HUG (b).

For the corpus data, it was more challenging to analyze potential effects of phonological features on reduplication, since it was obviously impossible to deliberately include base forms with different phonological specifications in this data set. Still, when we take a closer look at the corpus data in light of the patterns observed in the elicited data, some striking observations can be made. For both continuative and habitual contexts, it appears that body-anchored predicates can be reduplicated by repeating the path movement, but this only holds for a specific type of body-anchoredness in the corpus, namely predicates that contact the non-dominant hand, e.g., PLAY-SOCCER in Figure 3.5a (much like MELT in the elicited data), or the head, e.g., CRY in Figure 3.5b (much like SLEEP in the elicited data).



a. PLAY.SOCCER [CNGT0416; S021; 00:26.24]

b. CRY [CNGT0252; S014; 01:04.96]

Figure 3.5. Body-anchored predicates PLAY.SOCCER (a) and CRY (b). For aspectual inflection, both can be reduplicated by repeating the path movement.

As for predicates with internal movement in the corpus (e.g., handshape change in TALK in Figure 3.6a), it appears that they are not reduplicated for habitual and continuative aspect, much like the elicited data. There is, however, one exception: wiggling of the fingers (as in FINGERSPELL in Figure 3.6b and TYPE) does not block aspectual reduplication.

a. TALK
[CNGT2210; S087; 00:12.52]

b. FINGERSPELL
[CNGT1923; S078; 00:26.52]

Figure 3.6. Internal movement predicates TALK (a) and FINGERSPELL (b). For aspectual inflection, only FINGERSPELL can be reduplicated by repeating the path movement.

Thus, the data suggest that, in the context of aspectual marking, both body-anchoredness and internal movement should be defined more narrowly – in fact, body-anchoredness could be re-defined as the location feature [trunk], while internal movement only comprises a change in finger position (or aperture, e.g., in the case of TALK a change from open to closed). Moreover, as for predicates involving [trunk], it appears that only reduplication of *path movement* is blocked rather than all types of repetition (as evidenced by the repetition of body movements for HUG in Figure 3.4b). These refinements should be taken with due caution, however, as our data does not involve negative evidence, and the data extracted from the corpus do not systematically include verbs for all phonological specifications. It remains to be investigated whether these constraints also hold outside of the current data set.

Finally, another important note should be added: the phonological restrictions identified in the data only apply when reduplication expresses specific types of aspect only. In some of the corpus sentences, reduplication seems to also mark multiple arguments (object and/or subject) on the verb, i.e., plurality, as in (16), and it is sometimes ambiguous whether reduplication actually encodes plurality of arguments, aspect, or both.

(16) […] HEARING **TALK+**$_{\textbf{2H/alt}}$ OVER.EACH.OTHER THEATER PALMS.UP.
‘[…] All of the hearing people were (continuously) talking over each other during their play.’ [CNGT0294; S018; 02:09.81]

It seems that in cases in which reduplication (also) expresses plurality, verbs with an opening or closing of the hand can be reduplicated, as evidenced by the reduplication of TALK in (16), which involves a handshape change – for this type of marking (but not for “pure” aspectual marking), the second hand is often added, and sometimes the hands move in alternation, as (16) also demonstrates. This type of reduplication occurred with internal movement verbs where the hands open and close, like TALK, OBSERVE and ACCEPT. For corpus data, it is notoriously difficult to disentangle the functions that reduplication of the predicate may have in a specific sentence. This may also partly explain why participants were two times more likely to reduplicate the predicate in the corpus data than in the elicited data (see above), as such cases, in which reduplication may have multiple functions, have also been included in the corpus data, while other potential meanings of reduplication were controlled for in the elicited data (see also Section 3.5.3 for this and further possible explanations for the difference).

3.4.1.2 Past and non-past

The phonological restrictions on reduplication identified in the previous section cannot be the sole reason why the predicate is not always reduplicated. As already mentioned for the elicited data, many of the non-reduplicated predicates are not specified for one of the potentially constraining phonological features and could thus, in principle, have been reduplicated, but are not. We now turn to another potential explanation as to why reduplication does not always occur: whether the sentence is situated in the past or not.

Events situated in both the past and the non-past were elicited (recall that NGT does not mark tense on the verb, but rather uses time adverbials). For the elicited sentences that could be analyzed for reduplication it was checked whether events situated in the past are marked more often than events in the non-past, following Oomen's (2016) results. Table 3.9 shows the percentages for all aspect types together. These percentages do not suggest a clear difference between past and non-past in the data. The Pearson Chi-Squared Test I conducted in R (R Core Team 2008), in order to investigate the relation between past tense and reduplication (i.e., Table 3.9), shows no significant relation between the two variables (X^2 (1, N = 123) = 0.71, p = 0.4). I thus cannot conclude anything as to whether there is a relation between past/non-past contexts on the one hand, and predicate reduplication/zero marking on the other. An overview of all statistical data is provided in Appendix 3-A, and see van Boven (2023b) for the complete analysis in R.

Table 3.9. Reduplication of the predicate in past and non-past sentences for all aspect types in the elicited data.

	N (analyzed)	**Predicate reduplicated**	**Predicate not reduplicated**
Past	47	23 (49%)	24 (51%)
Non-past	76	30 (39%)	46 (61%)

Oomen (2016) only reported the difference between past and non-past for habituals, however. Table 3.10 shows the percentages of reduplicated and non-reduplicated predicates for habituals (that could be analyzed for reduplication) specifically, and the percentages are exactly the same for both tenses. In fact, they are in line with the more general frequency of reduplication in the elicited data (see Table 3.5). (17) illustrates the use of reduplicated predicates in a habitual past (17a) and non-past (17b) context.

Table 3.10. Reduplication of the predicate in past and non-past habitual sentences in the elicited data.

		N (analyzed)	Predicate reduplicated	Predicate not reduplicated
Habitual	**Past**	14	3 (21%)	11 (79%)
	Non-past	24	5 (21%)	19 (79%)

(17) a. INDEX$_{3a}$ MAN INDEX$_{3a}$ LIVE HOME. INDEX$_{3a}$ SO.FAR EVERY PERIOD+ AFTER LUNCH **CLEAN+**.
'That man lives at home. Up until now, he has cleaned every day after lunch.' [p01]

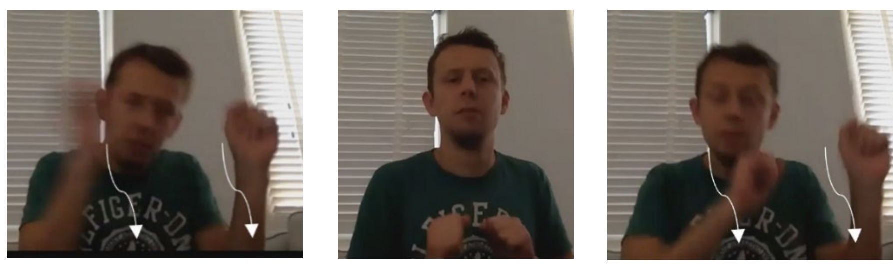
b. MAN PERSON$_{3a}$ INDEX$_{3a}$ EVERY EVENING HOME **CLEAN+**.
'That man cleans his home every evening.' [p03]

Van Boven & Oomen (2021) already demonstrated that for the habituals in the corpus data, the vast majority of sentences situated in the past (i.e., 91%) contains some type of manual marking; the fact that this percentage is higher than in the elicited data can be explained by two facts: (i) van Boven & Oomen subsumed under manual marking both reduplication and marking by means of an adverb, and (ii) reduplication occurs more frequently in the corpus in general – see Section 3.4.1.

More generally, given that I do not find any significant relation between past and non-past sentences on the one hand, and reduplication/zero marking on the other for the elicited data, I cannot conclude anything as to whether tense restricts aspectual reduplication in NGT (but see van Boven & Oomen 2021 for a discussion on the effect of datatype).

3.4.1.3 Movement characteristics

Cross-linguistically, different aspect types have been found to be distinguished from each other by differentiating the manner and rate of the movement of the reduplication cycles (e.g., Klima & Bellugi 1979; Rathmann 2005).[15] In the elicited data, we observe one striking difference between iterative aspect on the one hand, and habitual and continuative aspect on the other: in the former, the movement cycles are often separated from each other by means of pauses, which is not the case for the latter two aspect types, where the movement cycles are uninterrupted. Iterative reduplication with pauses is illustrated in Figure 3.7.



CLEAN+

Figure 3.7. Iterative reduplication of CLEAN with a pause in between reduplication cycles.

Finally, a characteristic of aspectual reduplication which had not been described in previous studies but which appeared in the data is spatial displacement of the predicate: sometimes, the reduplicants are articulated at different locations in the signing space. This is illustrated for SWIM in Figure 3.8, where there are four articulations of the verb, alternately on the left and right side of the signer.

[15] According to Hoiting & Slobin (2001), the modulation for habitual aspect in NGT is slower than for continuative aspect, and both involve an elliptical movement, while according to Oomen (2016: 43), the reduplication for continuative aspect is "relatively slow", and elliptical modulation is neither observed for habituals nor continuatives in NGT. Here, I do not address differences in relative speed, as this feature was difficult to systematically analyze. In general, there did not appear to be clear differences in terms of speed, and an elliptical modulation also was not consistently observed in the data.

SWIM+++

Figure 3.8. Iterative reduplication of SWIM with displacement of the reduplicants in space.

3.4.2 Other aspectual markers in NGT

Apart from reduplication of the predicate, two other aspectual markers could be identified in the data: the sign glossed as CONT (Section 3.4.2.1) and some non-manual markers (Section 3.4.2.2).

3.4.2.1 Free aspectual marker CONT

Remember that Hoiting & Slobin (2001) identified CONT as a free aspectual marker, which, in their data, consistently follows body-anchored and internal-movement verbs and takes on the aspectual inflection. While Hoiting & Slobin describe this marker for both habitual and continuative aspect, in the present data, it is only used to express continuity – likely an effect of the diverging definitions of habituality (cf. also van Boven & Oomen 2021).

In the elicited data, CONT appears only 11 times (6% of all elicited sentences). Most of these (N = 8) involve continuative contexts, as in (18a). Sometimes, CONT occurs in a habitual (N = 2) or iterative (N = 1) sentence, but in all of these cases, it encodes the continuity of the event expressed in that sentence, as is true for the talking event in the habitual (18b).

(18) a. MAN PERSON$_{3a}$ INDEX$_{3a}$ YESTERDAY HOME. FOUR.HOUR LONG **CONT+** CLEAN+ […].
‘That man was home yesterday. He cleaned for four hours […].’ [p03]

b. INDEX$_{3a}$ CHILD+> INDEX$_{3a}$ LAST WEEK CLASS OUT BEEN. SO.FAR EVERY EVENING TOGETHER **CONT** TALK […].
‘Those children went on a class outing last week. Every night, they talked continuously […].’ [p01]

Out of the 11 elicited sentences with CONT, six could be analyzed for reduplication of the predicate. In three of those, both CONT and the predicate are reduplicated (18a), while in the other three, only CONT is reduplicated. As for the remaining five instances, CONT is reduplicated in four of them. As for the potentially constraining factors body-anchoredness and internal movement, we observe that CONT co-occurs both with constrained (N = 5) (18b) and unconstrained (N = 6) (18a) predicates – that is, if we apply the broader definition of "constrained", thus including all types of body contact and internal movement. If we apply the narrower definition proposed in Section 3.4.1.1, CONT combines with a constrained predicate in only four of the cases. Clearly, in the elicited data, CONT does not (only) occur as a particle taking on the aspectual inflection in contexts in which the verb cannot be inflected.

In the corpus data, CONT appears 26 times (11% of all corpus sentences); it is mostly used as an aspect marker in continuative sentences (N = 21). It also occurs in habituals (N = 2; see van Boven & Oomen 2021) and iteratives (N = 3), but in those cases, again, it is not used as a marker of those aspect types; rather it expresses that the continuity of the action in that sentence. This use of CONT to encode continuity in combination with another aspectual meaning was already identified in the corpus data analyzed by van Boven & Oomen (2021: 172).

3.4.2.2 Non-manual markers

Both Hoiting & Slobin (2001) and Oomen (2016) identified several non-manual markers for habitual aspect (lax lips and protruding tongue, slowly circling head movement, left-to-right body movement) and continuative aspect (pursed lips and blowing gesture, back-and-forth body movement). The elicited data were analyzed for each of these markers, but none of them seems to express habituals/continuatives consistently in the data.

However, if we look at body and head movements and/or leans more generally in the elicited data, i.e., without differentiating between left/right and back/forth, 127 out of all 172 elicited sentences are non-manually marked in this way (74%).[16] These include: 31 continuative sentences (67% of all elicited continuatives), one of which has already been provided in (18a), and is repeated in (19a); 42 habitual sentences (67% of all elicited habituals), one of which has been

[16] Potentially, head and body movement back-and-forth and left-and-right are different realizations of the same feature. Previous studies have described similar results, i.e., grammatical contexts where different instantiations of a certain non-manual, such as brow movement (raising vs. lowering), express the same meaning. See, for instance, Gökgöz (2011) on non-manual marking in Turkish Sign Language negation, and Klomp (2019) on non-manual marking in NGT conditionals.

presented in (17a), and is repeated in (19b); and 54 iterative sentences (87% of all elicited iteratives), exemplified in (19c).

(19) a. MAN PERSON$_{3a}$ INDEX$_{3a}$ YESTERDAY HOME. FOUR.HOUR LONG
body back-and-forth
CONT+ CLEAN+ […].
'That man was home yesterday. He cleaned for four hours […].' [p03]

body left-to-right
b. […] INDEX$_{3a}$ SO.FAR EVERY PERIOD+ AFTER LUNCH CLEAN+.
'[…] Up until now, he has cleaned every day after lunch.' [p01]

c. MAN HOME INDEX$_{3a}$. YESTERDAY TOTAL FOUR TIME CLEAN. AGAIN
body lean forward
ONE TIME CLEAN++. FOUR TIME WAVE.
'That man is home. Yesterday he cleaned four times. Still once again he cleaned. Four times!' [p07]

These examples also show that the scope of the non-manual marker may vary: it may accompany the predicate alone (19b), the manual markers (particles) and the predicate (19c), or may spread over the entire sentence (19a). It should be noted, however, that in reality, the numbers of occurrence are likely to be slightly lower, since in the data it is not always entirely clear whether a specific body or head movement indeed expresses aspect (e.g., in some cases, it might encode an enumeration rather than aspect). Still, these high percentages are rather striking.

For the corpus data, body and head movements are also the most prevalent non-manual markers, marking 35.9% of the habituals (cf. van Boven & Oomen 2021), and even 76.4% of the continuatives and 60.7% of the iteratives – again, rather high percentages for the latter two, especially for corpus data.

3.5 Discussion

The results presented in the previous section show that reduplication can express habitual, continuative and iterative aspect in the NGT data. Yet, while reduplication is a frequent concomitant of these three aspects, it does not obligatorily express aspect as a grammatical category. Why reduplication does not always occur, is not immediately clear – with respect to reduplication for all aspect types together in the elicited data, I can neither draw any conclusions regarding the relationship between past tense and reduplication, nor regarding the relationship between constraining phonological features and reduplication. Still, for habitual and continuative aspect, there appear to be rather specific phonological constraints on reduplication in the data, while this is not the case for iterative aspect. The continuative marker CONT occurs, but not only with constrained predicates.

Section 3.5.1 further discusses the phonological constraints, while Section 3.5.2 addresses the finding that there is no formal difference between habituals and continuatives in the data, while iteratives are clearly distinct. This section also briefly addresses the optionality of aspectual reduplication I observe. The results presented here paint a picture that is rather different from previous research; both methodological and sociolinguistic factors could play a role, as discussed in Section 3.5.3.

3.5.1 Reconsidering phonological constraints on aspectual reduplication in NGT

The present study offers a new perspective on the phonological constraints on aspectual marking in NGT that have previously been put forward by Hoiting & Slobin (2001). Considering all aspect types in the elicited data together, no significant relationship was found between the phonological features of the predicates (i.e., internal movement/body-anchored or not) and reduplication, and thus I cannot conclude anything as to whether there is a relationship. Still, if we have a closer look at specifically the body-anchored and internal movement predicates in imperfective contexts in our data, it seems that the constraints "body-anchored" and "internal movement" require a more precise definition, as proposed in Section 3.4.1.1. Independent evidence for the narrower definition of these constraints comes from phonological models developed for sign languages. First, for the "body-anchored" constraint, I argued that in the current data predicates articulated on the trunk are phonologically constrained, while predicates contacting other body parts are not. In phonological models of sign languages – e.g., Sandler's (1989) Hand Tier model and Brentari's (1998) Prosodic model – it is assumed that signs are specified for a major location, the trunk or torso being one of them, as opposed to, for instance, the non-dominant hand and the head. The fact that these major locations are distinguished in these models supports my proposal that one major location, the trunk, blocks reduplication, while the others do not.

Second, for internal movement, I noted that, in the data, handshape change blocks reduplication, while finger wiggling does not. In the phonological models mentioned above, finger wiggling and handshape change are represented differently, despite the fact that both are hand-internal movements. Recall that finger wiggling has been subsumed under trilled movement, and it is represented as such in both models. Sandler (1993: 252) defines trilled movement as "rapidly repeated hand-internal movement", and in her Hand Tier model, signs with trilled movement have a feature [trill]. In Brentari's (1998: 164) Prosodic model, trilled movement is a so-called "articulator-free feature". Handshape change, however, is not represented by specific features in the phonological models. In the Hand Tier model, a change in finger position is represented by branching at the finger position node (see, e.g., Sandler 1993; Sandler & Lillo-Martin 2006). In the Prosodic model, one underlying handshape is specified, while the other (redundant) handshape can be predicted from the opposing value of the underlying shape at the aperture node (Brentari 1998). The fact that finger position/aperture changes on the one hand, and trilled movement on the other, are represented separately in both models is in line with the observation that only the former blocks reduplication. To further investigate this, it would be interesting to test whether other types of trilled movement (such as circling, rubbing, and hooking, as identified by Brentari) also block reduplication in NGT.

Based on these observations, I propose to revise the previously identified phonological constraints on aspectual reduplication in NGT (Hoiting & Slobin 2001), as in (20).

(20) *Proposed revised constraints on aspectual reduplication in NGT (version 1)*

a. In the habitual and continuative aspect, the major location feature [trunk] blocks reduplication of verbs.

b. In the habitual and continuative aspect, handshape change (i.e., a change in finger position/aperture) blocks reduplication of verbs.

Interestingly, these constraints do not apply to iteratives in the data set. Indeed, as mentioned in Section 3.4.1, participants were five times more likely to use reduplication with iterative aspect than with habitual and continuative aspect, which may result from this difference in terms of constraints on reduplication. Possibly, combining a change in finger position with movement repetition is too complex when the movement cycles are uninterrupted, as is true for habituals and continuatives. In iteratives, the reduplication cycles are separated from each other by means of pauses, making the movement combinations less complex. As for the [trunk] location, it is less evident why a combination with repeated movement would yield a phonologically too complex form (in fact, there are verbs in NGT which are lexically specified for both body-anchoredness and repeated movement, such as BE.SCARED, which contacts the trunk). Still, the resistance of body-anchored signs to undergo reduplication appears to be a more general phenomenon: for plural reduplication, the study reported on in Chapter 2 (see also van Boven 2021) found that NGT nouns specified for inherent repetition or body contact are less likely to be reduplicated than nouns without those features, although reduplication was not completely blocked. In other sign languages, body-anchoredness has been observed to completely block plural reduplication (Pizzuto & Corazza 1996 for Italian Sign Language; Sutton-Spence & Woll 1999 for BSL; Pfau & Steinbach 2005a for German Sign Language).

The fact that iterative reduplication is never blocked in the data suggests that there is an interaction between the phonological make-up of a sign and the aspect type: the phonological constraints are specific to the inflectional morpheme. An interaction between the phonology, morphology and reduplication type has also been described by Harley & Leyva (2009) for Hiaki, an Uto-Aztecan language, although the findings do not exactly correspond to what is found here for NGT. They report five different reduplication types, and the application of two of the reduplicative allomorphs (the disyllabic and closed-syllable reduplication) is determined by a combination of not only phonological, but also morphological (transitivity-marking suffixes) properties of the stem.

Yet, it is not immediately clear which morphological distinction we are dealing with in NGT: iterative versus habitual versus continuative, or perfective versus imperfective more generally. This matter is the focus of the next section.

3.5.2 Reconsidering grammaticalized aspectual distinctions in NGT

The data in this study were collected from a semantic starting point, that is, the sentences were divided into habitual, continuative, and iterative aspect based on their meaning, and only after that, their form was analyzed. In doing so, I identified potential phonological constraints on habitual and continuative reduplication, but not on iterative reduplication, where the movement cycles are separated by means of pauses. Additional evidence for the distinct status of iteratives comes from another striking feature: the sign AGAIN can sometimes intervene between different instances of the verb, as in (21).

(21) HUG AGAIN HUG AGAIN HUG AGAIN HUG.
‘They hugged several times / they hugged again and again.’ [p01]

Here, the additional material appears in between single instances of the verb, i.e., instances with one movement cycle. Two potential explanations for the insertion of AGAIN can be offered. It is possible that the pauses in iterative reduplication allow for the insertion of (phonologically light) material in between reduplication cycles. Or, alternatively, the insertion of AGAIN in between several instances of the verb actually came first, and is in the process of grammaticalization into the iterative reduplication with pauses between reduplicants. The data are uninformative as to which explanation is the correct one, leaving this question open for future analyses. For the other two reduplication types, this type of inter-cycle insertion is never observed in the data.

The fact that iterative reduplication is optional in both data sets, despite not being phonologically constrained, suggests that it is not (yet) completely grammaticalized (pointing towards the second explanation offered in the previous paragraph). Indeed, more generally, there is quite some variation, since reduplication alternates with sentences without reduplication for all three aspects. This is reminiscent of Johnston et al.'s (2015) study on what they call FINISH-type signs in Auslan, which express perfective aspectual meaning: they suggest that the grammaticalization of such signs "is not well advanced" (p. 152) (see Johnston et al. 2015 for more elaborate discussion). The present data suggest the same for NGT aspectual reduplication.

Other studies, again in line with the present one, also describe optionality and variation in sign language aspectual marking. Recall from footnote 6 that aspectual reduplication (denoting repeated or continuing events) was found to be optional in Auslan (see Gray 2013),[17] and Palfreyman (2019) describes variation in the expression of completive aspect in the urban sign language varieties of Solo and Makassar (Indonesia). Such variation and optionality is not entirely unexpected, as it has also been described for other grammatical domains in NGT (e.g., Oomen & Pfau 2017 for variation in negation; van Boven, Oomen, et al. 2023 for the optionality of negative concord), as well as in other sign languages (e.g., Fenlon et al. 2018 for optionality of verb modification in BSL, and the factors conditioning it; Palfreyman 2019 for variation in negation in the Solo and Makassar varieties).

When reduplication applies, however, iteratives are clearly distinct from habituals and continuatives in the data. Recall from Section 3.2.3.1 that earlier research on other sign languages already showed that aspect types can be distinguished by movement modulations such as adding pauses in between reduplication cycles (e.g., Klima & Bellugi 1979). The fact that NGT iterative reduplication is distinguished from other aspects by means of this modulation is thus not surprising from an intra-modal perspective. Interestingly, several spoken languages have also been described to employ different types of reduplication for different aspect types. For instance, in Coos (a now extinct isolate from Oregon), reduplication of the first syllable expresses "intensity of action, repetition, duration, and customary action" (Frachtenberg 1922: 377), while reduplication of the final

[17] Recall also from footnote 6 that for Gray (2013) this optionality is one of the reasons to reject a morphological analysis. However, here, unlike Gray, I do observe that fixed reduplication types express fixed aspectual meaning in NGT, which is in line with previous studies suggesting aspectual morphemes, which have fixed forms.

syllable expresses “distribution, mutuality, and, in intransitive verbs, an action that is performed now and then” (Frachtenberg 1922: 380). The reduplication types thus have several different functions, some of them aspectual. Mithun (1999) presents similar findings on the Salish language family, where most languages are described to have three reduplication types with different (some aspectual) functions. Similarly, in Hiaki, different reduplicant shapes are semantically contrastive, but only for specific verbs (e.g., *noka* ‘speak’ and *vahume* ‘swim’). A light-syllable reduplicant is used to derive habitual meaning for these verbs, while a reduplication + gemination form expresses emphatic, idiosyncratic, or iterative meaning (Harley & Leyva 2009). Although this is not described as a general pattern across all verbs in Hiaki, the parallel with the NGT data (and data from other sign languages) in using different types of reduplication to express iterative or habitual meaning is notable.

While the iteratives I analyzed thus appear to be distinct from the habituals and continuatives in terms of their reduplicative form, a formal distinction between the latter two could not be established in this study. In fact, in the present data, they are expressed by the same type of reduplication, without pauses in between cycles, which appears phonologically constrained. I take this to suggest that the semantic distinction between habitual and continuative may not be grammaticalized in NGT in the form of verbal inflection. Recall from Section 3.2.1 that the habitual and continuous aspects have been proposed as a subdivision of imperfective aspect more generally (Comrie 1976), while iterative aspect is perfective. I thus put forward the proposal that, when there is reduplication, NGT distinguishes perfective and imperfective, but does not make a further formal distinction between habitual and continuous. If this is indeed the case, then the phonological constraints in (20) can be revised again, as in (22).

(22) *Proposed revised constraints on aspectual reduplication in NGT (version 2)*

a. In the imperfective aspect, the major location feature [trunk] blocks reduplication of verbs.

b. In the imperfective aspect, handshape change (i.e., a change in finger position/aperture) blocks reduplication of verbs.

From a cross-modal perspective, this finding is not surprising. As described in Section 3.2.1, Bybee (1985) reports that most spoken languages in her sample distinguish only the imperfective and the perfective inflectionally (see also Dahl & Velupillai 2013). This pattern was actually more common than further distinguishing habitual and continuous. Compare (23), from Spanish, where the imperfect can express habitual or continuative meaning,[18] to (24ab), where NGT also uses one and the same form to express habitual (24a) and continuative (24b) meaning.

(23) *Juan llegaba.*
'John was arriving.'
'John used to arrive.' [Spanish; Comrie 1976: 25]

(24) a. MAN INDEX$_{3a}$ HOME INDEX$_{3a}$. INDEX$_{3a}$ EVERY EVENING **CLEAN+**.
'That man is at home. He cleans every evening.' [p01]

b. MAN HOME. YESTERDAY FOUR.HOUR LONG **CLEAN+**.
'That man is at home. Yesterday, he was cleaning for four hours.' [p04]

From an intra-modal perspective, however, the findings presented here are more striking. In the literature on aspect marking in sign languages, specific verbal modulations for habituals or continuatives are often mentioned, as we also saw in Section 3.2.3.1 (e.g., Sutton-Spence & Woll 1999 for BSL; Cabeza Pereiro & Fernández Soneira 2004 for Spanish Sign Language; Rathmann 2005 for ASL). The fact that the NGT data exhibit one form for both habituals and continuatives, without modulating the sign's movement, situates NGT differently from other sign languages in the landscape of aspectual inflection, thus adding to our understanding of intra-modal variation in this domain.

So far, it has been assumed that habitual and continuative aspect are both instances of the imperfective viewpoint. Note, however, that Rathmann (2005) analyzes these as instances of situation aspect in ASL.[19] While our data are not informative as to whether the continuative/habitual morpheme(s) could be analyzed as an instance of situation-type aspect, the NGT data are still different from ASL in at least one way: we cannot formally distinguish habituals from continuatives. To put it differently: The semantic distinction between habitual and continuous does not

[18] Spanish does have a separate progressive form, but this is optional, as the imperfect does not exclude a progressive reading (Comrie 1976).

[19] Rathmann (2005) argues that ASL has only two viewpoint morphemes: one to mark perfective viewpoint (the particle FINISH), and one to mark imperfective viewpoint (the conative morpheme). The other morphemes (including habitual and continuative) are argued to contribute situation-type aspect, as they can co-occur with the perfective marker, and they are concerned with duration, telicity, and dynamism (which is characteristic of situation aspect, according to Rathmann); see also footnote 5.

appear to be grammaticalized in the NGT data – irrespective of whether they are situation- or viewpoint-type. For now, I assume that they are instances of imperfective viewpoint, and leave this matter for future studies. Such studies could focus on the question whether the reduplication that is used to encode both continuatives and habituals can combine with a perfective marker in NGT. If we are in fact dealing with imperfective viewpoint, the expectation would be that this combination is ruled out.

This outcome stands in sharp contrast with findings reported in previous studies on NGT: while Hoiting & Slobin (2001) and Oomen (2016) did not agree on the specific form of the marking, they both identified a formal distinction between habituals and continuatives. A likely explanation lies in the different methods of the studies: the previous studies on NGT only considered elicited data from a limited number of participants. The same is true for several previous studies on other sign languages (e.g., Cabeza Pereiro & Fernández Soneira 2004 consider data from only two participants for LSE). In contrast, this study draws on corpus and elicited data and includes more signers, and consequently, the data more closely represent the language as it is actually used. Further methodological considerations, as well as potential sociolinguistic variation, will be discussed in the next section.

3.5.3 Methodological and sociolinguistic considerations

The combination of corpus data and elicited data has several important implications that should be taken into account. First, there are some, mostly quantitative, differences between the data sets. For instance, while iteratives are relatively rare in the corpus (N = 28), they are the most frequent aspect type in the elicited data (N = 62). Footnote 13 already indicated that, while there is a significant relation between the data set (corpus or elicited) and aspect type (habitual, continuative, or iterative), this result might, in fact, be due to several dependencies in the data, most likely the fact that I targeted an equal amount of sentences for each aspect type in the elicited data, which may have resulted in an unusually high number of iteratives as compared to the naturalistic language use in the corpus data. In addition to this, the fewest searches were performed for iteratives on the translation tier (see Table 3.1), indicating that Dutch might have fewer particles expressing iteratives than particles expressing the other two aspect types. Iteratives are thus difficult to find in the corpus because they might be less likely to be overtly marked in Dutch.[20]

[20] Or one could speculate that (overtly marked) iteratives are generally infrequent in natural language use, which might be an alternative explanation as to why phonological constraints have not (yet) developed for this aspect type.

Another difference between the two data sets lies in the frequency of predicate reduplication, as the statistical analysis showed that corpus participants were two times more likely to reduplicate the predicate than participants in the data elicitation (see Section 3.4.1). Again, there are a few possible explanations. In the elicited data, phonological features of the predicates were controlled for, and the stimuli thus included a fair number of predicates that cannot be reduplicated. Obviously, in the corpus data, it was impossible to control for such phonological features. Another potential explanation is that in the corpus data, different functions of reduplication were sometimes difficult to disentangle. This challenge has already been illustrated in Section 3.4.1.1 with (16), repeated here as (25), where it is ambiguous whether the reduplication expresses plurality of arguments, aspect, or both. It is thus quite possible that I sometimes annotated reduplication of the predicate as encoding aspectual meaning, when it actually was not used as such, resulting in an overestimation of how often the predicate was reduplicated for aspect. In the elicited data, this likely did not happen, as the potential meanings of reduplication could be controlled for (e.g., it was ensured that none of the sentences had a distributive meaning).

(25) […] HEARING **TALK+$_{\mathbf{2H/alt}}$** OVER.EACH.OTHER THEATER PALMS.UP.
‘[…] All of the hearing people were (continuously) talking over each other during their play.’ [CNGT0294; S018; 02:09.81]

Finally, the difference in frequency of reduplication between the two data sets might also be due to how the data sets were compiled. I collected the corpus sample for the largest part by searching on the translation tier, selecting sentences with aspectual meaning. This way of collecting the sample did in principle not influence the type of aspect marking I would find: aspectual meaning could be expressed in several ways, e.g., by particles, reduplication, or both. This is different for the elicited data, given that there were aspectual particles in the stimuli in order to make clear which aspectual meaning was targeted. Recall, for example, the stimulus in Figure 3.2, which translates as “What has he been doing for hours?”. Participants, answering the stimulus questions in full sentences, often repeated this overt aspectual marker, in this case, “for hours”. It could be the case that the use of such lexical indicators removed the need to also reduplicate the predicate. At the same time, it is also clear that lexical indicators and reduplication are not in complementary distribution: for instance, in the corpus data, reduplication and adverbs co-occur in 26.4% of the habituals (see van Boven & Oomen 2021), in 27.4% of the continuatives (these numbers might be higher if only unconstrained predicates were included in the data), and in 21.4% of the iteratives. Also, if they were completely complementary, one would expect no reduplication at all in the elicited data. In fact, double marking is not uncommon in sign languages (e.g., in several sign languages, there is double marking of agreement, by inflection of the main verb and an auxiliary; see Steinbach & Pfau 2007). Still, it is expected that the elicited data do not reflect the frequency of aspectual reduplication in natural language use, while the corpus data likely do.

Second, there is some variation between signers in our data. For instance, in the elicited data, one signer is overrepresented in reduplicating body-anchored signs for continuative/habitual aspect, namely the predicates MELT, which involves contact with the non-dominant hand (see Figure 3.4a), and HUG, a body-anchored sign (see Figure 3.4b), for which he repeats the body movement rather than the path movement: four, i.e., half, of the instances come from this signer. On the other hand, there is one signer in the elicited data who never reduplicates body-anchored and internal movement predicates for habitual or continuative aspect. This suggests that it may, to some extent, be signer-dependent how strictly the phonological constraints are interpreted. Potentially, sociolinguistic factors play a role here. Interestingly, the signer who strictly maintains the phonological constraints is from Groningen, and Hoiting & Slobin (2001), who identified these constraints, based their observations on informants from the same region. The participant who is overrepresented in the reduplication of MELT and HUG, on the other hand, is from Amsterdam, and Oomen (2016), who did not find any restrictions on reduplication, tested a participant from this region. This could be taken as further evidence for regional variation in aspectual marking – something that Oomen already suggested as an explanation for the diverging findings. This should be researched further, by more systematically including signers from different regions.[21]

Because of the nature of the data, I cannot answer all open questions. A first drawback is that the data do not provide negative evidence. In order to further test phonological constraints on aspectual reduplication, grammaticality judgement tasks should be conducted. Moreover, the data suggest that reduplication is not obligatory, even for non-restricted predicates: the elicited data included 29 non-restricted predicates that were not reduplicated for habitual or continuative aspect (see Section 3.4.1.1). Iteratives appear not to be subject to phonological constraints, and still 29% of the elicited iteratives does not involve reduplication of the predicate. The corpus data also show inter-signer variation in the use of reduplication: some signers occasionally use reduplication to mark aspect on unconstrained predicates, but not always. We could thus conclude that aspectual

[21] As mentioned previously, regional variation in NGT is normally assumed to be limited to the lexicon (Schermer 2004). However, aspectual marking is not the only grammatical domain in NGT where potential regional variation has been observed: van Boven, Oomen, et al. (2023) suggest that there may be regional variation in the use of negative concord in this language.

reduplication is not obligatory, but it still remains unclear whether it is truly optional, or whether other (potentially syntactic or prosodic) factors are at play here. I consider this an avenue for further research.

Finally, as mentioned in Section 3.3.3.2, the statistical analyses reported here have some drawbacks. I reported the results of a logistic regression model, but the estimates should be taken with due caution, given the small sample size (even though the corpus and elicited data were taken together) (see Moineddin et al. 2017). Further, given that the elicited data constitute an even smaller sample, for this data set, I reported chi-squared analyses, which assume that the observations are independent of each other, while this is not the case in the current data set (e.g., multiple observations per participant). It is hoped that in future research, the outcomes reported here can be investigated further based on a larger sample, in order to conduct logistic regression models and report the (more reliable) estimates. However, given the (relatively small) population under study, this may be a challenging undertaking.

3.6 Conclusion

This study investigated reduplication of the predicate to encode habitual, continuative, and iterative aspect in NGT, taking into account both corpus and elicited data. The results show that reduplication can express all three aspect types, i.e., it is a frequent concomitant of habitual, continuative, and iterative aspect, but is not obligatory. Moreover, it appears to be phonologically constrained for habitual and continuative aspect: verbs which have [trunk] as their major location and verbs which involve a handshape change were never reduplicated in the data. For iterative aspect, no phonological constraints could be identified, and I hypothesized that this is a consequence of the fact that iterative reduplication cycles are separated by means of pauses, which is not the case for habituals and continuatives. There are no formal differences between the latter two aspect types in the data, which suggests that NGT may mark imperfective aspect more generally. If this is indeed the case, this would be a surprising finding given previous research on NGT and other sign languages, but in line with what has been reported for many spoken languages (e.g., Bybee 1985).

Additional questions remain for further research, some of which I address here. First, it would be interesting to conduct grammaticality judgements to test (i) whether continuative/habitual reduplication can co-occur with a perfective particle, and (ii) whether verbs with trilled movement other than wiggling can be reduplicated. This could provide more insight into whether continuative/habitual reduplication indeed encodes the imperfective viewpoint more generally, and would allow us to test whether handshape change (i.e., finger position/aperture) is indeed the only type of internal movement that blocks reduplication. Second, future studies should thoroughly explore whether synchronic variation reflects grammaticalization of NGT aspect marking and corresponding phonological constraints (cf. Johnston et al. 2015 on Auslan) – such studies could also uncover linguistic and/or contextual factors underlying the variation (for instance, whether there is a difference in aspect marking between monologues/narratives and dialogues, a factor which was found to be relevant in the analyses of aspect marking by Johnston et al. 2015 on Auslan and by Palfreyman 2019 on the urban sign language varieties of Solo and Makassar in Indonesia).

Finally, a comparison of some of our findings to those reported in previous studies on NGT (Hoiting & Slobin 2001; Oomen 2016) suggests that regional variation might be at play in the domain of aspectual marking; more specifically, it appears that signers from Groningen adhere to the phonological constraints more strictly than signers from Amsterdam (as also suggested by Oomen 2016). It would be interesting to further investigate potential sociolinguistic factors that influence NGT aspect marking, by systematically including signers from different regions, but also different ages and genders (cf. Johnston et al. 2015; Palfreyman 2019).

Chapter 4 | Reciprocal marking in Sign Language of the Netherlands: Phonological, morphosyntactic and semantic restrictions*

4.1 Introduction

Reciprocal constructions are complex in many ways – as has often been pointed out in the literature. In the first place because of their semantics: as Evans (2008: 33) puts it, "reciprocal constructions arguably denote the most complex event type to be expressed in most languages by regular grammatical means." Adding to – or perhaps, because of (see Evans 2008) – this complexity, spoken languages have developed many different ways of marking reciprocity. In his overview of reciprocal constructions, Evans (2008: 45) presents at least 17 different types of constructions, ranging from reciprocal pronouns and auxiliaries to bi-clausal constructions. Further, Evans et al. (2004: 25) note that "most languages have more than one constructional means available for encoding reciprocity, with the choice determined by a range of semantic and syntactic factors".

These observations, however, are for the most part based on spoken languages; to date, reciprocity has been investigated for only a handful of sign languages. Those investigations have shown that some of the constructional means identified for spoken language reciprocals are also attested in sign languages: for instance, reduplication (e.g., Pfau & Steinbach 2003 for German Sign Language), reciprocal pronouns (e.g., Kubus 2008 for Turkish Sign Language), and a bi-clausal strategy (e.g., Zeshan & Panda 2011 for Indo-Pakistani Sign Language). Yet, it is also clear that there are differences between spoken and signed language reciprocals, often resulting from the modality of signal transmission, that is, the oral-auditive modality of spoken languages versus the visual-spatial modality of sign languages. For instance, while affixation is a very common reciprocal marking strategy in spoken languages (Evans 2008), this has not been found for sign languages: due to the simultaneous nature of sign language phonology and morphology, affixation is generally rare in this modality (Aronoff, Meir & Sandler 2005). The unique possibilities afforded by the visual-spatial modality also become clear from reciprocal reduplication, which in sign languages involves simultaneous and/or backward movement (see, e.g., Pfau & Steinbach 2003).

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* This chapter is a slightly modified version of a manuscript under review:
van Boven, Cindy. Reciprocal marking in Sign Language of the Netherlands: Phonological, morphosyntactic and semantic restrictions. Under review at *Morphology*.

Like spoken languages, sign languages have been found to commonly employ multiple reciprocal constructions within one language. In the choice between these constructions, allomorphy usually plays an important role. Further, recent evidence suggests that semantics – more specifically, whether the subevents are temporally decomposable or necessarily occur simultaneously – may also influence the type of marking used. In other words, the order of subevents may be iconically reflected in the signed sentence. This illustrates, again, a possibility that arises in the visual-spatial modality: given the visual nature of sign languages, there is an increased potential for iconicity (e.g., Mandel 1977; van der Kooij 2002; Taub 2012). Nevertheless, the influence of reciprocal semantics on reciprocal marking has not been researched extensively for many sign languages.

The present study adds to existing research on sign language reciprocals in three ways: (i) it provides the first comprehensive description of reciprocal marking (focusing on strong reciprocity between two participants) in Sign Language of the Netherlands (*Nederlandse Gebarentaal,* NGT); (ii) it further investigates potential phonological and morphosyntactic restrictions on reciprocal marking in a sign language, taking previous descriptions as point of departure; and (iii) it also takes into account the potential role of semantics. To this end, an elaborate search in the Corpus NGT was conducted (Crasborn et al. 2008; Crasborn & Zwitserlood 2008), and an elicitation task was developed to elicit reciprocals from six deaf NGT signers.

The chapter is structured as follows: First, a definition of reciprocity is provided, as well as an overview of previous research on reciprocals in both modalities – this will lead to our research questions (Section 4.2). Then the methods as well as the data annotation and analysis are specified (Section 4.3). In the results section, I present the reciprocal markers I identified (Section 4.4.1), and I address the differences between phonological and morphosyntactic verb types (Section 4.4.2), as well as the differences between reciprocal types (Section 4.4.3) – together, these answer the research questions (Section 4.4.4). Finally, the chapter further addresses some topics for future research (Section 4.5.1), and offers cross-linguistic (Section 4.5.2) and methodological (Section 4.5.3) perspectives on the data, before turning to a conclusion (Section 4.6).

4.2 Reciprocals in signed (and spoken) languages

4.2.1 Defining reciprocals

A prototypical reciprocal is defined as "a situation where two participants engage, simultaneously, in mutual action" (Evans 2008: 39), as in (1a). Yet, the construction expressing the canonical reciprocal actually extends over other, less prototypical, meanings as well. Evans et al. (2004) identify three main dimensions along which these meanings can be organized: *cardinality*, *reciprocant saturation,* and *temporal organization*. Cardinality relates to the fact that reciprocal constructions also commonly express situations with more than two participants, as in (1b). For reciprocals with more than two participants, reciprocant saturation is relevant: the relation may be symmetrical between all participants (as in 1b) – also referred to as 'strong reciprocals' (Langendoen 1978) – or not (e.g., a pair-wise grouping as in (1c)). Further, the temporal organization of the subevents may be sequential rather than simultaneous (1d) (Evans et al. 2004; Evans 2008: 40).

(1) a. John and Mary stared at each other.
b. All five family members love one another.
c. All guests at the party were married to each other.
d. John and Mary massaged each other. [Evans 2008: 40]

As is clear from the examples, English commonly expresses reciprocity with *each other* (but not exclusively; see (1b)) – such "bipartite NPs" are common in European languages (e.g., French, Italian, Finnish) and are also found in, e.g., South Asia. In other parts of the world, such as Australia, however, they are very uncommon (Evans 2008: 46–47). Reciprocal markers may also signal other meanings, such as sociative, spatial, or reflexive – English *each other*, for instance, is polysemous as it expresses not only reciprocal, but also sociative and spatial meaning, as Pfau & Steinbach (2016) point out. This type of polysemy occurs cross-linguistically.

According to Evans (2008) and Maslova & Nedjalkov (2013), all languages can express reciprocity by combining expressions for two simple situations as shown for Cantonese in (2). While this is the primary strategy for Cantonese (Evans 2008), the degree to which this strategy is conventionalized differs from language to language (Maslova & Nedjalkov 2013).

(2)	*Ngóh*	*béi-min*	*kéuih*	*kéuih*	*béi-min*	*ngóh*
	I	give-face	him	he	give-face	me

'He and I respect each other.' [Cantonese; Matthews & Yip 1994: 87]

Furthermore, encoding reciprocity may involve reduplication. As Maslova & Nedjalkov (2013) point out, this is an iconic way of expressing reciprocity – for instance, repeating suffixes or reduplicating the verb stem as in (3).

(3) *wa* *wà-wà*
they love-love
'They love each other.' [Godié; Marchese 1986: 231]

Next to the ones mentioned above, numerous other types of reciprocal constructions have been identified in previous research. Evans (2008) provides a comprehensive overview of reciprocal marking cross-linguistically, a simplified version of which is shown in Table 4.1 (adapted from Evans 2008: 45).

Table 4.1. Simplified overview of types of reciprocal constructions cross-linguistically (adapted from Evans 2008: 45).

Single clause [Single proposition]
NP-marking strategy [Argument-marking strategy]
e.g., Bipartite quantifier NP; Reciprocal nominal; Reciprocal pronoun
Verb-marking strategies [Predicate-marking strategy]
e.g., Morphological modification of verb; Auxiliary to verb
Conjunct strategy
Adverbial strategy [Modifier strategy]
Multiple clauses [Multiple propositions]
Conventionalized bi-clausal construction
Zigzag summative construction
Fused multiple predicates
e.g., Verb compounding with mutual predicate; Symmetric signing

Thus, reciprocal marking may take the form of, e.g., verbal affixes, adverbs, pronouns, or particles (see also Maslova & Nedjalkov 2013). I will not go into all of these strategies here, but refer to Evans (2008) for a complete overview. Note finally that in some languages, specific reciprocal markers occur only in specific contexts (Maslova & Nedjalkov 2013).

4.2.2 Reciprocal marking in sign languages

To date, reciprocal marking has only been investigated in detail for a handful of sign languages. While some strategies overlap with those described for spoken languages, there is also a modality-specific flavor to reciprocals in sign languages. Typical for sign language reciprocals is that the choice between the reciprocal strategies a sign language has at its disposal (to some extent) depends on morphosyntactic and phonological properties of the base verb. This allomorphy will be discussed in the next subsection, together with the different marking strategies identified in sign languages. Besides properties of the base verb, the type of meaning expressed has also been found to play a role; such semantic factors will be addressed in Section 4.2.2.2.

4.2.2.1 The role of allomorphy

Before going into the reciprocal strategies that have been described in previous studies, this section first briefly introduces phonological and morphosyntactic properties of sign language verbs that are relevant in sign language reciprocal marking. As for sign language phonology, the sublexical building blocks of a sign are handshape (hand configuration), place of articulation, and movement (Stokoe 1960; Sandler 1989; for an overview, see Fenlon et al. 2017). Since both hands are available as articulators, signs may be one- or two-handed. As for morphosyntax, of importance here is that sign language verbs can be divided into agreement verbs, which indicate the subject and object by modifying the movement and/or orientation of the hands, and plain verbs, which cannot be spatially modified in this way (Padden 1988).

Focusing on situations with two participants, Pfau & Steinbach (2003, 2005b, 2016) observe that German Sign Language (DGS) encodes strong reciprocity (i.e., mutual between all participants, cf. the 'reciprocant saturation' dimension (Evans et al. 2004) introduced above) by means of reduplication of the verb or zero marking. Which strategy applies to a given verb depends on both its phonological (whether the verb is one- or two-handed) and morphosyntactic (whether the verb is an agreeing verb or not) features. Specifically, they distinguish the verb types shown in Figure 4.1.

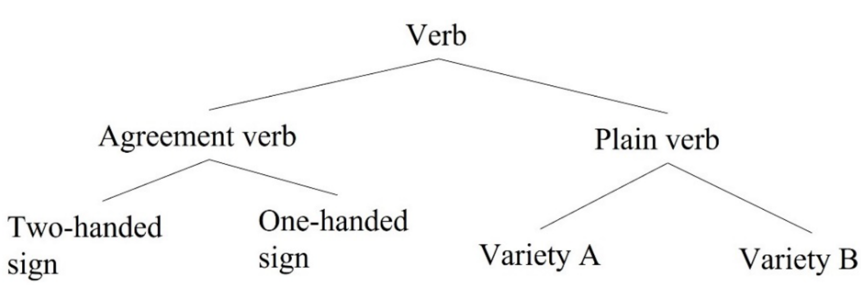
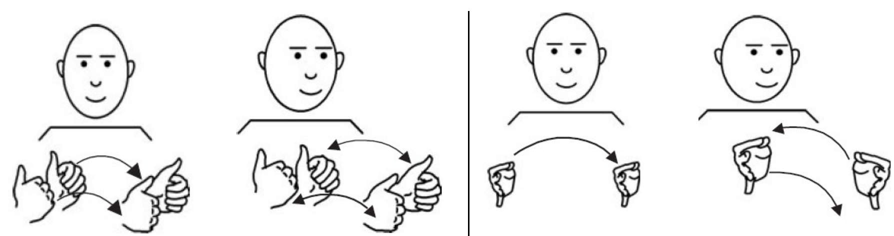


Figure 4.1. Verb types distinguished for German Sign Language by Pfau & Steinbach (2003: 11, adapted; © John Benjamins; reprinted with permission).

According to Pfau & Steinbach, the verb type influences the reciprocal marking. The reciprocal form of all agreement verbs involves reversing their path movement and/or their orientation. However, how they realize the reversal depends on phonological properties. For two-handed agreement verbs, the verb is reduplicated and the movement in the reduplicant is reversed, as illustrated for DGS HELP in Figure 4.2a. Pfau & Steinbach label this strategy 'sequential backward reduplication'. For one-handed agreement verbs, the authors also observe that movement/orientation are reversed; however, in this case, the reversal is not sequential – rather, it is realized simultaneously by the non-dominant hand while all other features of the dominant hand are copied, as shown for DGS GIVE in Figure 4.2b. These are clearly two highly modality-specific strategies, given the movement reversal and simultaneity – two characteristics that are ruled out in principle in the oral-auditory modality. (See *Notation conventions for glossed sign language examples* for the conventions used in this dissertation).



a. HELP HELP+$_{\text{seq/back}}$ b. GIVE GIVE+$_{\text{sim/back}}$

Figure 4.2. Reciprocal marking by means of (a) sequential backward reduplication of DGS HELP and (b) simultaneous backward reduplication of DGS GIVE (Pfau & Steinbach 2003: 12–18; © John Benjamins; reprinted with permission).

In contrast, for plain verbs, the distinction between one- and two-handedness is irrelevant. However, Pfau & Steinbach report diverging judgements from their informants for this verb type and conclude that two varieties of DGS can be distinguished. In Variety A, reciprocity is expressed by zero marking on the plain verb in combination with dropping the verb's object, as shown for the DGS plain verb TRUST in Figure 4.3a. In Variety B, on the other hand, the plain verb is combined with an overt marker in postverbal position. The overt marker is glossed as PAM (person agreement marker), and it undergoes sequential backward reduplication, much like two-handed agreement verbs – this is illustrated for the DGS plain verb TRUST in Figure 4.3b.

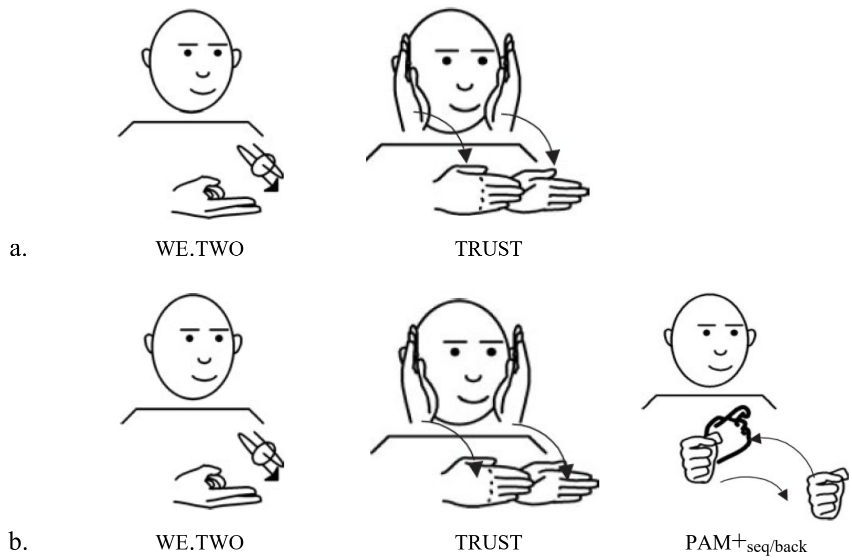


Figure 4.3. Two varieties of reciprocal marking on plain verb TRUST in DGS: zero marking with object drop (a) and sequential backward reduplication of PAM (b). The translation is: 'We trust each other.' (Pfau & Steinbach 2003: 20–21; © John Benjamins; reprinted with permission).

Similar findings have been reported for other sign languages. The reciprocal form of agreement verbs involves backward reduplication in Austrian, Brazilian, Catalan, Irish, and Italian Sign Language (Pfau & Steinbach 2016), as well as in Turkish Sign Language (TİD; Kubus 2008; Kubus & Hohenberger 2013); also, in both TİD and Indo-Pakistani Sign Language (IPSL), one-handed agreement verbs are reported to undergo simultaneous backward reduplication (Kubus 2008; Kubus & Hohenberger 2013 and Zeshan & Panda 2011, respectively). As for plain verbs, their reciprocal form involves zero marking in TİD (Kubus & Hohenberger 2013). In IPSL, predicates that cannot be reduplicated may combine with a reciprocal auxiliary which then undergoes the reciprocal derivation (i.e., simultaneous backward reduplication), similar to DGS PAM – there may even be double marking, whereby the auxiliary combines with a verb that is already marked for reciprocity (Zeshan & Panda 2011).

Finally, in her descriptive grammar of NGT, Klomp (2021) briefly addresses reciprocal marking in the language, reporting on a small-scale study involving a consultation session with one signer. According to Klomp (2021), NGT agreement verbs can be marked for reciprocity. The reciprocal form of two-handed agreement verbs involves sequential backward reduplication, much like DGS. For one-handed agreement verbs, Klomp reports three options for marking reciprocity: sequential backward reduplication with one hand, sequential backward reduplication with both hands, or simultaneous backward reduplication. Thus, it appears that in NGT the phonological properties of the base noun also play a role, but it remains unclear how the choice between the options for one-handed agreement verbs is made, and what the reciprocal form of plain verbs looks like (i.e., the role of morphosyntax).

Apart from reduplication, which is subject to allomorphy cross-linguistically, other reciprocal strategies have also been described for several sign languages. Pfau & Steinbach (2016) note that both Irish Sign Language and Catalan Sign Language (LSC) have a reciprocal pronoun (glossed as EACH-OTHER and RECIPROCAL, respectively). In LSC, this pronoun can combine with backward reduplication of the verb. Interestingly, no clear cases of polysemy of reciprocal markers have been described for these sign languages (Pfau & Steinbach 2016). For TİD, Kubus (2008) describes three kinds of reciprocal pronouns that can express the reciprocal meaning when the verb is zero-marked (note that here, the use of the term zero marking thus does not imply that reciprocal is not marked at all in the clause, it only refers to marking on the verb; this is also how I will use this term, as will become clear in Section 4.4.2). Pfau & Steinbach (2016) state that DGS does not make use of a reciprocal pronoun, and the same observation is made by Klomp (2021) for NGT. Finally, in IPSL, reciprocals can be marked by sequencing agreement verbs or auxiliaries in separate clauses (similar to “I help you, and you help me”, cf. also example (2) from Cantonese in Section 4.2.1) (Zeshan & Panda 2011).

4.2.2.2 Semantics

Most previous studies on sign language reciprocals thus show that properties of the base verb to some extent determine the choice of reciprocal strategy. However, recall from Section 4.2.1 that different types of reciprocal meaning can be distinguished. Indeed, meaning may also play a role in choosing a reciprocal strategy, as shown by Ergin et al. (2020), who describe Central Taurus Sign Language (CTSL), a newly emerging sign language in Turkey. They distinguish between symmetrical and reciprocal actions. Symmetrical actions involve two arguments that equivalently and simultaneously participate in an event – they give the example of Bill shaking hands with John, as it is impossible for John to shake Bills hand, but not the other way around (p. 173). In a reciprocal action, on the other hand, the bidirectional interpretation is imposed by the semantic property of *each other*, as Ergin et al. (2020) put it.

Ergin et al. (2020) show that when expressing reciprocity (e.g., two people punching each other), CTSL signers can express subevents in a serial order, using multiple clauses – similar to what has been described for spoken languages (Section 4.2.1) and other sign languages (Section 4.2.2.1). In contrast, CTSL signers do not employ this strategy for symmetrical actions (e.g., shaking hands), as these necessarily involve simultaneous participation. Thus, the event cannot be temporally decomposed, as opposed to reciprocals (cf. Evans et al.'s 2004 dimension of temporal organization).

Another strategy, which is employed for both reciprocal and symmetrical actions in CTSL, is body segmentation: one side of the body represents one of the characters, and the other side the other character. Moreover, to express the bidirectional nature of both reciprocals and symmetrical actions, body segmentation co-occurs with simultaneous or sequential mirrored articulators, i.e., 'mirroring', where each hand performs the same action on the other, as in Figure 4.4. This seems comparable to simultaneous backward reduplication described for DGS (Pfau & Steinbach 2003) and IPSL (Zeshan & Panda 2011).

Right and left hands represent PERSON_1 and PERSON_2, respectively

PERSON_1 and PERSON_2 punch each other

Figure 4.4. Body segmentation and mirroring to express reciprocal meaning in CTSL (Ergin et al. 2020: 188; © John Benjamins; reprinted with permission).

The influence of meaning on form also becomes clear in Börstell et al.'s (2016) study, which considers the possibility that sign languages have a lexically specified category of plurals (i.e., signs that carry intrinsically plural meaning) by investigating the relation between two-handedness and lexical plurality in ten sign languages. Based on a target list of 50 lexically plural concepts divided over three categories, one of which is lexical reciprocals, such as 'to marry', they find that the corresponding signs have a preference for being two-handed (mostly balanced) across all ten sign languages. From the three categories, reciprocals are most highly correlated with two-handed forms, whereby the two hands tend to represent a side of the reciprocal situation each. They conclude that the visual-spatial modality allows for several forms of articulatory plurality – such as representing multiple referents with multiple articulators, but also reduplication – because it employs more than one articulator moving around in space.

Finally, I should note that temporal structure does not influence reciprocal marking in all sign languages: The reciprocal derivation described by Zeshan &

Panda (2011) for IPSL can be used for both sequential and simultaneous reciprocal events; the exact internal temporal structure is irrelevant.

4.2.3 The present study

Previous studies have shown that reduplication of the verb is a common marker of reciprocity across sign languages, and that the application of this morphological strategy may be constrained by morphosyntactic and phonological properties of the base verb. The small-scale study by Klomp (2021) suggested the same for NGT, but the details remain unclear. At the same time, temporal structure and iconicity have also been shown to play a role in sign (and spoken) language reciprocal marking. As of yet, it is unclear whether this is also the case in NGT. In the present study, I focus on reciprocals with two arguments, and I include reciprocals involving both sequential and simultaneous subevents. I will not investigate 'symmetrical' actions.

To be more specific, I investigate the following research questions:

(i) How is reciprocity marked (on the verb) in NGT? (RQ1)

(ii) Do we observe a difference in reciprocal marking between agreement and plain verbs, and between one- and two-handed verbs in NGT? (RQ2)

(iii) Do we observe a difference between reciprocals where the subevents occur simultaneously ('simultaneous reciprocals') and where the subevents occur sequentially ('sequential reciprocals') in NGT? (RQ3)

To answer these questions, I investigate both corpus data and elicited data.

4.3 Method

The investigation started with extracting data from an existing corpus – this process is described in Section 4.3.1. I also designed an elicitation task to elicit data from signers, as detailed in Section 4.3.2. Finally, Section 4.3.3 describes the annotation and analysis of the two data sets.

4.3.1 Corpus search

The corpus data set analyzed for the present study was extracted from the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008). The corpus contains over 70 hours of data and includes video recordings of 92 deaf NGT signers (age

17–84 years), who performed several tasks, such as discussing certain topics and retelling video clips, resulting in semi-spontaneous monologues and dialogues.[1] Part of the corpus has been transcribed by fluent signers, using the annotation tool ELAN (Crasborn & Sloetjes 2008).

The available transcriptions include annotations on gloss tiers, where signs are glossed in Dutch on separate tiers for the dominant and non-dominant hand, and a translation tier, which includes Dutch translations (Crasborn et al. 2008). There were no previous annotations available for reciprocity or reduplication. In order to find reciprocal constructions in the corpus, I conducted searches on both the translation and the gloss tiers. On the translation tier, I searched for the Dutch reciprocal pronoun *elkaar* 'each other', as well as *onderling* 'mutual(ly)', which can be used as an adjective or adverbial expressing a reciprocal meaning (e.g., *We zijn onderling afhankelijk* 'We are interdependent = We depend on each other'). Additionally, I also searched for ELKAAR (EACH.OTHER) on the gloss tier. Table 4.2 provides an overview of the specific search terms, specifies how many search hits there were in total for each of them, and how many sentences actually turned out to be reciprocal.[2]

Table 4.2. Search terms and hits to find reciprocals in the Corpus NGT.

Search term	**Tier**	**N (total hits)**	**N (reciprocal)**
ELKAAR 'each other'	gloss	187	4
elkaar 'each other'	translation	216	78
onderling 'mutually'	translation	20	7
	Total	*423*	*89 (85 unique hits)*

The search hits were divided between two annotators, who – based on the sentence's meaning and the context surrounding it – decided whether or not a specific hit would be included in the data set. Any sentence in which the participants engage in some mutual action (simultaneously or sequentially) was included. As Table 4.2 shows, 85 sentences met this criterion, and representative examples are given in (4): in (4a), the signer explains that two characters in a video that was just shown simultaneously look at each other; in (4b), the signers conclude that they can interrupt each other's stories; and in (4c), we actually see two instances of

[1] For more information on the Corpus NGT, such as the elicitation materials, metadata and all public corpus files, see: https://archive.mpi.nl/tla/islandora/object/tla:1839_00_0000_0000_0004_DF8E_6?asOfDateTime=2018-03-02T11:00:00.000Z.

[2] These are not all unique hits, as some sentences in the corpus showed up for multiple search terms (e.g., when ELKAAR was translated as 'elkaar').

reciprocity: the inherently reciprocal verb MEET, and when the signer explains that two deaf people can make agreements with one another. As also explained in the *Notation conventions for glossed sign language examples*, the corpus file number (CNGTxxxx), signer number (Sxxx), and begin time of the example (m:s.ms) are provided for all of the examples extracted from the corpus, reduplication is represented by a + added to a sign's gloss, and a subscript specifying the type of reduplication: *sim* for simultaneous, *seq* for sequential, and *back* for backward.

brow raise, wide eyes

(4) a. LOOK.AT+$_{sim/back}$.
'They're looking at each other and they're startled.'
[CNGT0209; S012; 00:31.960]

b. DISCUSS CAN INTERRUPT+$_{seq/back}$ CAN.
'During a discussion we can interrupt each other.'
[CNGT0510; S025; 03:26.840]

c. DEAF MEAN INDEX$_1$ MEET WISH CHILD MAKE AGREEMENT INDEX$_1$ $_1$DUAL.PRO-3$_2$.
'I mean, when two deaf people meet each other and they want to have a child, they make agreements with each other.'
[CNGT0099; S001; 00:33.810]

Table 4.2 also shows that 334 search hits did not meet our inclusion criteria. Especially for ELKAAR on the gloss tier, many hits were excluded, because in most of the search hits, ELKAAR is part of a gloss that clearly does not have reciprocal meaning – mostly the signs DOOR.ELKAAR 'mixed together' and ARMEN.OVER.ELKAAR 'arms crossed'. Similarly, Dutch 'elkaar' and 'onderling' are polysemous and are thus also commonly used in contexts that do not express clear reciprocal meanings as defined above, for example in the constructions *uit elkaar* 'apart' (5a) or *onderling bedenken* 'come up with in consultation with each other' (5b).[3] Constructions like these were excluded from the data set, as NGT might not necessarily use reciprocal marking here (recall that Pfau & Steinbach 2016 note that polysemy is unusual for sign language reciprocal markers, unlike spoken language reciprocal markers).

[3] The Dutch translations were included in examples (5ab) in order to illustrate which of the search terms they contain, i.e., why they showed up in the corpus searches.

(5) a. THINK $INDEX_1$ PALMS.UP GROUP.
Dat vind ik, die groepen uit ***elkaar***.
'I think those groups should be apart.'
[CNGT0055; S006; 00:32.520]

b. […] WE SIGN […].
[…] gebaren die ***onderling*** *worden bedacht en gemaakt […].*
'[…] the signs that we come up with in consultation with each other […].' [CNGT0436; S021; 01:41.800]

4.3.2 Elicitation

4.3.2.1 Participants

Six deaf NGT signers participated in the elicitation task (5 female, 1 male, mean age 53 years, age range 28–68). All participating signers grew up with NGT. The participants come from various sign regions (dialects) in the Netherlands: Groningen in the North (1), Amsterdam in the West (1), Rotterdam (1) in the South-West, Zoetermeer (1) in the South, and mixed regions (2). Five of them grew up with only hearing family, while one signer has some deaf family members.

4.3.2.2 Stimuli and procedure

Before participating, signers provided their informed consent for using the gathered data. They were also presented with a few background questions (on age, sex, sign region, hearing status of family members, and known languages). Then, at the beginning of the actual experiment, participants were shown a video in which a deaf NGT signer explained to them what reciprocal constructions are (explaining the difference between mutual and one-sided actions), and that these constructions are the topic of the present research. That is, participants knew – in general terms – what the goal of the study was. This was done in order to ensure that participants would actually sign the reciprocal form of verbs in response to the stimuli – rather than, for instance, use role shift. Note that participants were never shown signed examples of reciprocals, in order to avoid influencing the answers; the general concept of reciprocity was explained to them, and they were shown representative examples in written Dutch (all participants indicated that they have at least some proficiency in written Dutch).

The elicitation task was designed with Qualtrics software[4] with the goal to elicit the reciprocal form of the one- and two-handed plain and agreeing verbs shown in Table 4.3.

Table 4.3. Verbs targeted in the elicitation task.

	One-handed	**Two-handed**
Agreement	GIVE LOOK.AT	VISIT TEACH
Plain	SEARCH SPY.ON	EXPLAIN

For practical reasons, only one two-handed plain verb was targeted. It proved to be difficult to find verbs of this type that could be clearly captured in a stimulus video. Originally, I aimed to record a stimulus for DISTRACT, but this proved too complicated.

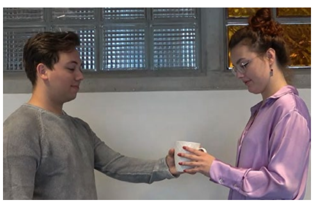
For most verbs, participants were presented with three elicitation items: one eliciting a simultaneous reciprocal, one eliciting a sequential reciprocal, and one eliciting the non-reciprocal form of the verb, for comparison. For the three two-handed verbs (VISIT, TEACH, and EXPLAIN), there was no item eliciting the simultaneous reciprocal, since this would constitute a semantically unlikely situation (e.g., visiting each other at the same time would be unlikely, if not impossible). Thus, the elicitation task consisted of 18 items in total. See Section 4.5.3 for further discussion of certain gaps in the method due to various, mostly practical, reasons.

Each elicitation item consisted of a video showing a situation involving two characters, called ‘Anna’ and ‘Luuk’. Each situation involved one of the three target contexts: a simultaneous reciprocal action, a sequential reciprocal action, or a non-reciprocal action. Stills from the video’s targeting GIVE are shown in Figure 4.5.

[4] Version November 2022 of Qualtrics. Copyright © 2022 Qualtrics. Qualtrics and all other Qualtrics product or service names are registered trademarks or trademarks of Qualtrics, Provo, UT, USA. https://www.qualtrics.com.

a. simultaneous reciprocal situation for GIVE

b. sequential reciprocal situation for GIVE



c. non-reciprocal situation for GIVE

Figure 4.5. Stills of the elicitation videos for GIVE, aiming to elicit the simultaneous reciprocal (a), sequential reciprocal (b) and non-reciprocal (c) forms of the verb.

Only one situation video was shown at a time, followed by another video (presented on the same screen) in which a deaf NGT signer signs the target verb in its base form, in this case GIVE; a video still is shown in Figure 4.6.

GIVE in NGT

Figure 4.6. Still of the video showing the participants the base form of GIVE in NGT.

In the instruction video, a deaf NGT signer introduced the two characters to the participants. The participants were asked to watch both videos (i.e., the situation video and the base verb video) and then come up with a story about Anna and Luuk, describing the situation in the video and using the verb they were given. The instruction explicitly mentioned that the verb was given in its base form, and that participants were allowed to adapt it to the context as they saw fit. The signers were also told that some of the situations shown to them would be reciprocal, and others would not. Finally, they were shown two non-reciprocal practice items with verbs that were not included in the actual task (e.g., Anna giving an envelope to Luuk paired with the verb INVITE). The 18 stimuli were presented in a randomized order that was different for each participant. An English translation of the complete elicitation task, including the instructions, as well as the situation video stimuli used in the task are publicly available (van Boven 2023d).

A glossed example of a response to the item shown in Figure 4.5a is given in (6). Whenever relevant, I gloss the left and right hand on separate lines; identical glosses on both lines indicate a two-handed sign. In (6), for instance, the signer simultaneously articulates the sign CUP on both hands on opposing sides of the signing space; the sign articulated by the left hand (location 3b) is then held in space, while the right hand signs BOTH.

(6)	left	L-U-U-K	PLUS			CUP$_{3b}$-------	$_{3b}$GIVE.CUP$_{3a}$.
	right		PLUS	A-N-N-E	INDEX$_{3a}$	CUP$_{3a}$ BOTH	$_{3a}$GIVE.CUP$_{3b}$.

‘Luuk and Anne give each other a cup (simultaneously).’ [p01]

Stimuli were presented one by one on a computer screen. Participants signed their response to the camera after watching a stimulus, and could then move on to the next item without time pressure. All participants came to a recording studio at the university, where a hearing researcher (who acquired NGT as an L2) was present.

4.3.3 Data annotation and statistical analysis

The corpus and elicited data sets were annotated in ELAN (Crasborn & Sloetjes 2008) – as mentioned above, there were two annotators for the corpus data (who annotated non-overlapping sets, but discussed unclear cases and came to an agreement in all cases), while only one of them annotated the elicited data. For the elicited data, it was first annotated whether the intended reciprocal verb was indeed elicited (e.g., whether the item targeting the simultaneous reciprocal of GIVE in Figure 4.5a indeed elicited this meaning). Then, for both data sets, annotations were made on the following tiers:

(i) ‘Reciprocal marker’ tier: On this tier, we annotated what type of reciprocal marking is present in the sentence: (i) marking on the verb,

(ii) marking by means of the auxiliary AUX.OP,[5] (iii) a reciprocal pronoun or another free-standing marker, (iv) an allelic verb (see Section 4.4 for a definition), (v) object drop, or (vi) two or more of these markers;

(ii) 'Reduplication type' tier: Here, we annotated the type of reduplication, if there was any; we specified whether the reduplication is simultaneous or sequential, and whether it is backward or not (i.e., whether the movement of the base is reversed in the reduplicant);

(iii) 'Handedness reciprocal' tier: Here, we annotated whether the reciprocal form of the verb is one- or two-handed;

(iv) 'Base verb' tier: On this tier, we annotated the base form of the verb; here, it was noted whether the base verb is one- or two-handed, and whether it is an agreement or a plain verb;

(v) 'Comments' tier: On this tier, we annotated anything else that we considered noteworthy.

Additionally, for the corpus data, it was also annotated whether the number of participants is 'two' or 'more', and whether the subevents of the reciprocal are 'sequential' or 'simultaneous' – for the elicited data, this was already annotated when we checked whether the targeted meaning was elicited. All data annotations of the two data sets are publicly available (van Boven 2023c).

These annotations were exported to Excel for further analysis. Specifically, I looked at which reciprocal marking strategies occur (RQ1), whether there is a relation between strategy and verb type (RQ2), and whether there is a relation between strategy and reciprocal type (RQ3).

Moreover, it was analyzed statistically whether there is a relation between (i) predicate reduplication/zero marking and agreement properties of the predicate in both data sets, (ii) predicate reduplication/zero marking and the handedness of the predicate in the elicited data,[6] and (iii) predicate reduplication/zero marking and reciprocal type for both data sets. For all three analyses, the data were trimmed: from the elicited data, I excluded the base verbs without reciprocal meaning, and from the corpus data, I excluded allelic predicates and sentences with more than two

[5] In NGT, the auxiliary AUX.OP is used to express agreement by modifying it in the same way as agreeing verbs. Its main use is to express the agreement relation in the context of plain verbs, but it has been observed that it may also combine with agreeing verbs. It is often accompanied by mouthing of Dutch 'op', hence its gloss (see Bos 1994).

[6] No Pearson Chi-Squared Test could be conducted to investigate the relation between handedness and reduplication/zero marking in the corpus, because two of the cells in the contingency table have an expected value of less than five, see Appendix 4-B and van Boven (2023c).

participants (see Section 4.4). Additionally, for the third analysis, I excluded corpus sentences where the reciprocal type was unclear. I conducted Pearson Chi-Squared Tests in R (R Core Team 2008).[7]

The statistical analyses (a .Rmd-file and an html version) are openly available (van Boven 2023c). We now turn to the outcomes of the analyses.

4.4 Results

In total, 85 reciprocals were extracted from the corpus and 62 reciprocals were elicited. In this section, we focus on reciprocals with two participants ('dual reciprocals'). 31 of the reciprocal examples extracted from the corpus actually involved situations with more than two participants, leaving 54 dual reciprocals for analysis in this section. I briefly return to the reciprocals with more than two participants in Section 4.5.1.

A quantitative overview of the reciprocal marking strategies identified in the corpus data and in the elicited data is given in Table 4.4.

[7] It should be kept in mind that such a Chi-Squared Test assumes that all observations in the data are independent (see, e.g., Agresti 2007 for more information about chi-squared analysis). The present data set, however, includes multiple observations for most participants, and in the elicitation, all three aspect types were targeted for each participant. Such dependencies are not taken into account in these analyses, which should be kept in mind when interpreting the results. This could be solved by building a multilevel logistic regression model with reduplication as the dependent variable, agreement, handedness, and reciprocal type as fixed effects, as well as a random intercept for subject, and random slopes for agreement, handedness, and reciprocal type. However, such models require large samples: Moineddin et al. (2007) report the need for at least 50 groups, with a group size of 50. The sample in the current study is clearly too small for such a model, which would lead to inadequate estimates. See Section 4.5.3 for more discussion.

Table 4.4. Reciprocal marking strategies identified (for dual reciprocals) in the corpus and elicited data.

Reciprocal marking	**Number of occurrences in corpus (% of total dual reciprocals)**	**Number of occurrences in elicitation (% of total)**
Reduplication	24 (43.6%)	16 (25.8%)
Reciprocal pronoun or other free-standing marker	10 (18.2%)	5 (8.1%)
Reduplicated auxiliary AUX.OP	0	1 (1.6%)
Combination of strategies	3 (5.5%)	12 (19.4%)
Allelic predicate	12 (23.6%)	0
Bi-clausal	3 (5.5%)	28 (45.2%)
Other	2 (3.6%)	0
Object drop	0	0
Total	*54 (100%)*	*62 (100%)*

Let us address the shaded cell "Allelic predicate" first. Allelic predicates "can be defined as predicates that express a mutual configuration by themselves, without necessary grammatical marking" (Haspelmath 2007: 4). The set of allelic predicates is semantically restricted, and usually involves social actions such as 'to marry', relations of identity such as 'the same as', and spatial relations such as 'next to' (Haspelmath 2007: 4). In the corpus data, we identified 12 sentences with predicates that we deemed allelic, namely MEET (N = 4), DISCUSS (N = 2), COMMUNICATE (N = 2), EXCHANGE (N = 1), MATCH (N = 1), MARRY (N = 1), and COUPLE (N = 1). Except for MARRY, which is one-handed, all these predicates are two-handed, much like the lexical reciprocals described by Börstell et al. (2016). Allelic predicates will be excluded from further discussion, as we are interested in reciprocal marking, and by definition, allelic verbs do not require reciprocal marking. This leaves us with 42 instances from the corpus. Appendix 4-A provides an overview of the different verbs that were deemed non-allelic and that occurred in the 42 dual reciprocals in the corpus data.

Section 4.4.1 will first provide an overview of the reciprocal markers identified in the two data sets, which allows us to answer our first research question regarding how reciprocity is marked in NGT – and, specifically, how it is marked on the verb. Then, Section 4.4.2 will address our second research question on the differences between verb types by describing in detail how one- and two-handed agreeing and plain verbs are marked for reciprocity in the data. Finally, Section 4.4.3 will go into the differences between sequential and simultaneous reciprocals, thereby answering our third research question about the marking of different reciprocal types.

4.4.1 Reciprocal markers in NGT (RQ1)

(i) Reduplication. Table 4.4 shows that for non-allelic verbs, reciprocity is marked by reduplication only in less than half of the corpus hits, and about one fourth of the elicited sentences. Reduplication usually applies to the main verb (7a), but in the elicited data, we sometimes observe reduplication of an element other than the main verb (N = 2); in those cases, another verb is added, which is reduplicated – for instance, in (7b), SPY.ON is not reduplicated, but instead LOOK.AT is. The table also shows one instance where the auxiliary AUX.OP is added to the sentence; similarly, AUX.OP is reduplicated rather than the main verb (7c). Reduplication (of the main verb, some other verb, or the auxiliary AUX.OP) may also combine with other strategies, mostly with free-standing markers as in (7d) (N = 3 in the corpus, of which one involves reduplication of AUX.OP, and N = 8 in the elicited data). In the elicited data, there are two instances where reduplication of the main verb combines with reciprocal marking on the auxiliary AUX.OP, and in one instance, reduplication combines with the bi-clausal strategy – the remaining combination case does not involve reduplication, but is bi-clausal with a free-standing marker (see below).

(7) a. INDEX$_{3a}$ FATHER INDEX$_{3a}$ DEAF INDEX$_{3a}$, STILL USE NOT SIGN, **TALK+$_{\text{sim/back}}$**.
'Her father is deaf too, but still does not use signs. They talk to each other.' [CNGT0134; S008; 02:08.385]

b. A-N-N-E L-U-U-K SIT$_{3a+3b}$. BOOK$_{3a}$ BOOK$_{3b}$. SECRETLY **SPY.ON LOOK.AT+$_{\text{sim/back}}$** SPY.ON.BEHIND.BOOK.
'Anne and Luuk are sitting across from each other, both with a book. They secretly spy on each other from behind their books.' [p01]

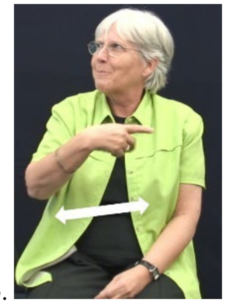
c. L$_{3a}$ A$_{3b}$ TOGETHER CLASS. **AUX.OP+$_{\text{sim/back}}$** $_2$HELP$_1$ TEACH.EXTRA.LESSON […].
'Luuk and Anna are in the same class. They help each other; they teach each other extra lessons […].' [p04]

d. L-U-U-K PLUS A-N-N-E $_{3a}$**DUAL.PRO-1**$_{3b}$ SECRETLY **LOOK.AT+$_{\text{seq/back}}$**.
'Luuk and Anne secretly look at each other.' [p01]

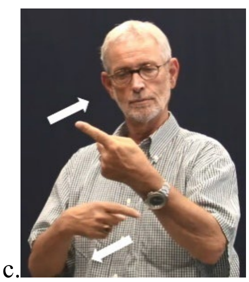
In all, there are 56 sentences in the data where reduplication is either the only marker or one of the markers of reciprocity. This amounts to 53.8% of the entire data set (excluding allelic verbs). Reciprocal reduplication comes in different forms, which will be discussed in more detail in the next section, in relation to the different verb types.

(ii) Free-standing markers. When there is no reduplication, there are a few other options for marking reciprocity. In both data sets, I identify reciprocal sentences with a free-standing marker, which may be the only marker of reciprocity in the sentence (N = 10 in the corpus; N = 5 in elicitation – but note that all five instances are produced by the same signer). The free-standing marker that occurs in both the corpus and the elicited data is a pronoun glossed in the corpus as WIJ-TWEE or TWEEËN ('the two of us, the two of them'; N = 13 in the corpus and N = 13 in the elicited data). There is some variation in its form. The hand moves repeatedly between two referents, which are either the signer and their interlocutor (Figures 4.7a–c), or two localized referents (Figure 4.7d). The sign can be one-handed (Figure 4.7a–b) or two-handed (Figure 4.7c–d), and the handshape is either an index or a 2-handshape (Figure 4.7a). This pronoun can be accompanied by mouthing of the Dutch word *elkaar* 'each other', as in example (8a). A follow-up search in the Corpus NGT for the gloss TWEEËN suggests that (at least some of the forms of) this sign functions not only as a reciprocal marker, but also as a dual pronoun, as in (8b). For this reason, I adopt the gloss DUAL.PRO for this sign, with a number to indicate the variant as shown in Figure 4.7a–d (e.g., DUAL.PRO-1 corresponds to the form in Figure 4.7a). The subscripts indicate the localization of the sign (see *Notation conventions for glossed sign language examples*).

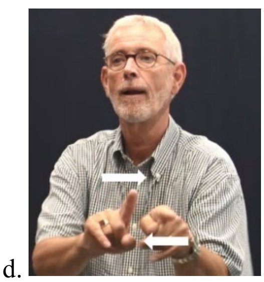
a. [CNGT0065; S005; 00:21.920]
${}_{1}$DUAL.PRO-1_{2}



b. [CNGT0044; S003; 02:24.435]
${}_{1}$DUAL.PRO-2_{2}



c. [CNGT0099; S001; 00:38.560]
${}_{1}$DUAL.PRO-3_{2}



d. [CNGT0098; S001; 05:11.880]
${}_{3a}$DUAL.PRO-3_{3b}

Figure 4.7. Different variants of the dual pronoun DUAL.PRO, which also functions as a reciprocal marker.

(8) a.
elkaar
NICE INDEX$_{1}$ FINALLY TEACHER DEAF SAME SIGN ${}_{1}$**DUAL.PRO-3**$_{2}$ UNDERSTAND.
'It's nice that a teacher and a deaf student can finally understand each other, because of the signs.' [CNGT0296; S018; 01:43.440]

b. INDEX$_{1}$ ${}_{1}$**DUAL.PRO-2**$_{2}$ SUNDAY BIKE GO.TO IN.LAW MOTHER […].
'One Sunday, we biked together to my parents-in-law […].'
[CNGT0004; S003; 00:54.880]

(iii) Bi-clausal constructions. Combining two clauses is frequently observed in the elicited data (N = 28), but only occurs three times in the corpus data. Often, this strategy is used to explicitly mark the (sequential) order of the subevents. In many cases, the clauses are linked by the sign OTHER.WAY.AROUND (Dutch gloss: ANDERSOM) (9a). (9b) is also bi-clausal, and the order of events is indicated by 'first […] then'.

(9) a. MAN SIT TABLE BOOK READ. WOMAN WATCH INDEX SPY.ON INDEX DO WHAT […] **OTHER.WAY.AROUND** WOMAN INDEX TABLE SIT BOOK READ MAN WATCH INDEX SPY.ON INDEX WHAT DO […].
‘The man and the woman watch and spy on each other (in turn) while the other person sits at a table and reads a book […].’ [p02]

b.

right	INDEX$_{3a}$ LUUK INDEX$_{3a}$		BOTH	HAVE CUP$_{3a}$.
left		INDEX$_{3b}$ ANNE	BOTH	CUP$_{3b}$.

right	INDEX$_{3a}$ FIRST $_{3a}$GIVE.CUP$_{3b}$.	CUP$_{3b}$---------------.
left	CUP$_{3b}$-------------------------.	THEN $_{3b}$GIVE.CUP$_{3a}$.

‘Luuk gives Anne a cup, and then Anne gives Luuk a cup (or: Luuk and Anne give each other a cup, in turn).’ [p05]

Interestingly, object drop never occurred as a strategy in either data set.

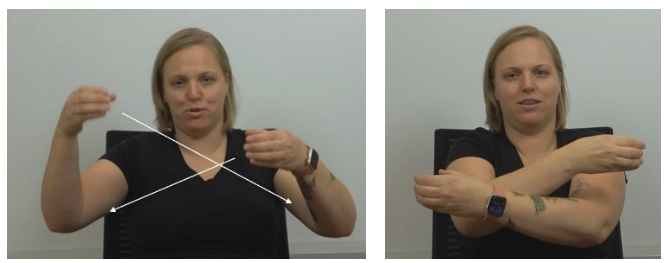
4.4.2 Differences between verb types (RQ2)

For the second research question, the specific types of reciprocal reduplication in NGT are of interest, and whether there is a systematic difference between one- and two-handed verbs on the one hand, and agreeing and plain verbs on the other hand – as has been described for other sign languages. Since I elicited different verb types, I will start from analyzing differences between these types in the elicited data set. I will then check whether the naturalistic corpus data confirm the (potential) patterns extracted from the elicited data.

I identify two types of reduplication in the elicited data: (i) sequential backward reduplication (N = 5), where the movement of the base verb is reversed in the reduplicant, and the reduplicant is articulated sequentially, as in Figure 4.8; (ii) simultaneous backward reduplication (N = 23), where the movement is also reversed, but the reduplicant is articulated simultaneously with the base by the non-dominant hand, as in Figure 4.9.

Right hand: CUP$_{3a}$ $_{3a}$GIVE.CUP$_{3b}$
Left hand: CUP$_{3b}$ $_{3b}$GIVE.CUP$_{3a}$.

Figure 4.8. Sequential backward reduplication of GIVE.



Right hand: CUP$_{3a}$ $_{3a}$GIVE.CUP$_{3b}$.
Left hand: CUP$_{3b}$ $_{3b}$GIVE.CUP$_{3a}$.

Figure 4.9. Simultaneous backward reduplication of GIVE.

The distribution of these strategies over the different verb types is shown in Table 4.5, where the four verb types are represented in the left-most column. This table only includes cases of reduplication of the main verb.

Table 4.5. Distribution of reduplication type across verb type in the elicited data (1H = one-handed; 2H = two-handed; sim. = simultaneous; seq. = sequential).

Verb type	**N (total)**	**Sim. backward reduplication of verb**	**Seq. backward reduplication of verb**	**No reduplication of verb**
1H + plain	*20*	3	0	17
2H + plain	*10*	0	0	10
1H + agreeing	*25*	15	5	5
2H + agreeing	*7*	0	0	7
Total	*62*	*18*	*5*	*39*

Some of the patterns in Table 4.5 are noteworthy. While plain verbs are almost never reduplicated, more than half of the agreeing verbs are reduplicated. Indeed, the Pearson Chi-Squared Test conducted in R (R Core Team 2008) to investigate the relation between agreement properties and predicate reduplication/zero marking in the elicited data shows a significant relation between the two variables (X^2 (1, N = 62) = 16.108, $p < 0.001$). The elicited data thus show that the choice between predicate reduplication and zero-marking is related to agreement properties of the predicate. An overview of all statistical data is given in Appendix 4-B, and see van Boven (2023c).

As for the specific verb types, first, I observe for one-handed plain verbs that there is usually no reduplication, but if there is, it is always simultaneous. In the 17 instances in which a one-handed plain verb is zero-marked, the reciprocal construction is either bi-clausal (see (9a) above; N = 11), the verb combines with a free-standing marker (N = 3), or another verb is added and reduplicated (see (7b) above) (N = 2). The latter two strategies may also combine (N = 1). Thus, here and in the following, use of the term *zero marking* does not imply that reciprocity is not marked at all in the clause, it only means that the verb remains unmarked.

Second, two-handed verbs – be they plain or agreeing – are never reduplicated, unlike one-handed verbs. The Pearson Chi-Squared Test conducted in R (R Core Team 2008) to investigate the relation between handedness properties and predicate reduplication/zero marking in the elicited data shows a significant relation between the two variables (X^2 (1, N = 62) = 11.71, $p < 0.001$) (see also Appendix 4-B and van Boven 2023c). The elicited data thus show that the choice between predicate reduplication and zero-marking is related to handedness properties of the predicate. When zero-marked, two-handed plain verbs may combine with simultaneously reduplicated AUX.OP (N = 1) (see (7c) above) or a free-standing marker (N = 2), but most often the reciprocal is bi-clausal (N = 7) (10a), which in one case also contains a free-standing marker. Two-handed agreement verbs also usually occur in bi-clausal reciprocals (N = 6) (10b), with one exception, where a free-standing marker combines with sequentially reduplicated AUX.OP.

(10) a. FIRST PALMS.UP A$_{3a}$ **EXPLAIN** NEW GRAPH $_{3a}$AUX.OP$_{3b}$ L$_{3b}$.
LATER $_{3a}$OTHER.WAY.AROUND$_{3b}$ ALSO **EXPLAIN** NEW OTHER $_{3b}$AUX.OP$_{3a}$ A$_{3a}$ **EXPLAIN** ALSO.
'First Anne explains a new graph to Luuk. Later it's the other way around: He also explains another one to Anne.' (or: 'Luuk and Anne explain a new graph to each other in turn.') [p04]

b. L-U-U-K NICE $_{1}$**VISIT**$_{3a}$ $_{1}$AUX.OP$_{3a}$ A-N-N-E.
LATER OTHER.WAY.AROUND ALSO NICE **VISIT** $_{3a}$AUX.OP$_{3b}$ L-U-U-K.
'Luuk visits Anne, and it's nice. Later it's the other way around: Anne also visits Luuk, and it's nice (or: 'Luuk and Anne visit each other in turn; both times, it's nice.) [p01]

Third, one-handed agreeing verbs are the only verb type that actually alternates between the two reduplication types, as has already been illustrated in Figures 4.8 and 4.9 for GIVE; yet, this verb type still prefers simultaneous backward reduplication. When there is no marking on the one-handed agreeing verb itself, the reciprocal is bi-clausal (N = 5) – see (9b) above for GIVE.

Taken together, it is clear that all verb types can remain zero-marked when used in a reciprocal context, but this does not mean that there would be no marking at all. The reduplication patterns observed in the elicited data suggest the verb classification in Figure 4.10.

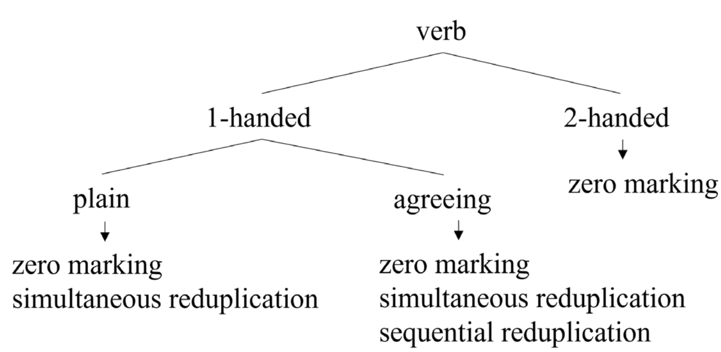


Figure 4.10. Verb classification based on reciprocal marking patterns in the elicited data.

We now turn to the question whether this classification also holds for our naturalistic corpus data. In the corpus, we observe the same two main types of reduplication of the verb, i.e., simultaneous backward reduplication (N = 21; Figure 4.11) and sequential backward reduplication (N = 5; Figure 4.14). Table 4.6 shows how these two types are distributed across verb types, which are again represented in the left-most column.

Table 4.6. Distribution of reduplication type across verb type in the corpus data (dual reciprocals, non-allelic) (1H = one-handed; 2H = two-handed; sim. = simultaneous; seq. = sequential; red. = reduplication).

Verb type	**N (total)**	**Sim. backward red. of verb**	**Seq. backward red. of verb**	**Other**	**No red. of verb**
1H + plain	*14*	8	0	0	6
2H + plain	*3*	0	0	0	3
1H + agreeing	*19*	13	5	0	1
2H + agreeing	*6*	0	0	2	4
Total	*42*	*21*	*5*	*2*	*14*

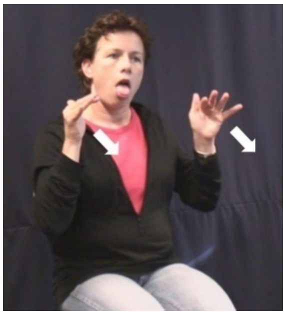
Indeed, the corpus data show roughly the same patterns as identified in the elicited data (Figure 4.10), although for this data set, the Pearson Chi-Squared Test conducted in R (R Core Team 2008) did not reveal a significant relation between agreement properties and reduplication/zero marking (X^2 (1, N = 40) = 2.924, p = 0.09) (see also Appendix 4-B and van Boven 2023c). Based on the corpus data, I thus cannot conclude anything as to whether the choice between predicate reduplication and zero marking is related to agreement properties of the predicate. Like in the elicited data, one-handed plain verbs are either zero-marked or undergo simultaneous backward reduplication (as in Figure 4.11), but a larger proportion undergoes simultaneous backward reduplication than observed in the elicited data set. However, it should be noted that all eight instances of simultaneous reduplication of a one-handed plain verb in the corpus involve the verb TALK, while zero-marking is observed with four different one-handed plain verbs: SAY, LEARN, AGREE and UNDERSTAND (three instances). These all combine with a free-standing marker, e.g., DUAL.PRO-2 in (11).

(11) INDEX$_1$ THINK MAYBE UNDERSTAND $_1$**DUAL.PRO-2**$_2$ **SAY** INDEX$_{3a}$ MAYBE
headshake
INDEX$_{3a}$.
'I believe that he maybe doesn't understand what we are saying to each other.' [CNGT0044; S003; 02:23.255]

Almost all two-handed verbs in the corpus are zero-marked; they either combine with a free-standing marker (N = 4) or are marked by the bi-clausal strategy (N = 3). The two instances classified as 'other' in Table 4.6 involve the verb AANVALLEN 'attack'. For this verb, the non-dominant hand is adapted in its reciprocal form: it performs the reduplicant with a backward movement, as shown in Figure 4.12. It is not yet clear whether this type of reduplication is only possible for this two-handed verb.

Figure 4.11. Simultaneous backward reduplication of one-handed plain verb TALK [CNGT0094; S001; 02:14.96].

a.



Base form of ATTACK.

[CNGT0831; S040; 00:15.600]

b.

Simultaneous backward reduplication of ATTACK to mark reciprocity.

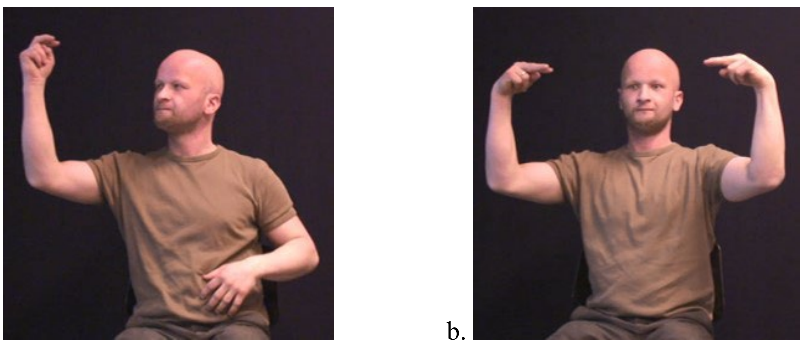
[CNGT0418; S021; 00:18.400]

Figure 4.12. Reciprocal marking on two-handed agreeing verb ATTACK.

One-handed agreeing verbs mostly undergo simultaneous backward reduplication – 12 of the 13 cases involve LOOK.AT, as shown in Figure 4.13; the remaining case is INFLUENCE. One-handed agreeing verbs may also undergo sequential backward reduplication, and for this strategy, there is more variation in verbs (INTERRUPT, illustrated in Figure 4.14; AGREE; UNDERSTAND; ASK; LISTEN).

Strikingly, this verb type is zero-marked only once in the corpus data; this instance concerns the verb GIVE, which combines with the sequentially reduplicated auxiliary AUX.OP and the pronoun DUAL.PRO-1 (12).

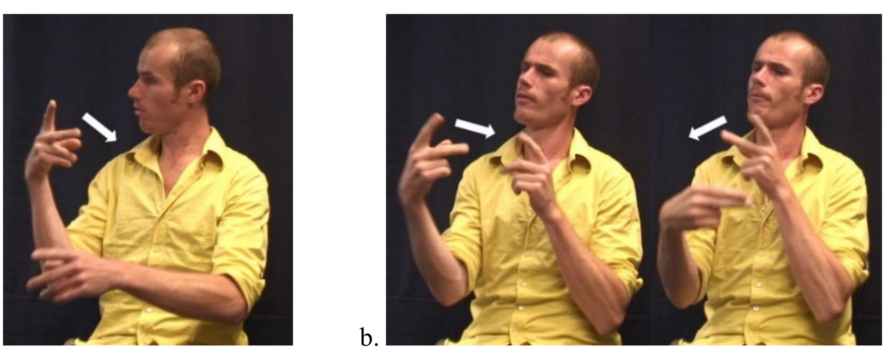
(12) MOMENT MOTHER ENOUGH $_1$**DUAL.PRO-1**$_2$ INDEX$_1$ ALWAYS **GIVE** BLAME **AUX.OP+++++**$_{\mathbf{seq/back}}$.
‘My mother had had enough of us always blaming each other.’ (lit. ‘[…] that we always gave each other blame.’) [CNGT0369; S020; 00:42.280]



a. LOOK.AT for one referent looking at an object on its left side. [CNGT0209; S012; 00:21.200]

b. Simultaneous reduplication of LOOK.AT to mark referents looking at each other. [CNGT0209; S012; 00:32.200]

Figure 4.13. Simultaneous reduplication of one-handed agreement verb LOOK.AT.



a. One-handed articulation of INTERRUPT, in the context ‘I interrupt him’. [CNGT0510; S025; 02:43.640]

b. Sequential backward reduplication of INTERRUPT to mark referents interrupting each other. [CNGT0510; S025; 03:27.600]

Figure 4.14. Sequential backward reduplication of one-handed agreement verb INTERRUPT.

Taken together, the verb classification proposed in Figure 4.10 based on the reciprocal strategies observed in the elicited data can be maintained for the corpus data, with the qualification that no significant relation between agreement properties and predicate reduplication/zero marking could be found; for the corpus data, I thus cannot conclude anything about this relation. Moreover, this data set suggests that there may be additional strategies for two-handed verbs, such as the one illustrated for ATTACK.

We now turn to potential differences between reciprocal types, and how these interact with the verb types.

4.4.3 Differences between reciprocal types (RQ3)

Remember that I systematically elicited reciprocals of the sequential and simultaneous type. I will therefore start, as before, from analyzing differences between these types in the elicited data set, and then check our observations against the naturalistic corpus data.

First, let us look at the frequency of the two different reciprocal types that were targeted, and how often predicate reduplication is observed across the different types (Table 4.7).

Table 4.7. Distribution of predicate reduplication across reciprocal types in the elicited data.

Reciprocal type	***N* (*total*)**	**Predicate reduplication in the sentence (N)**	**No predicate reduplication in the sentence (N)**
Simultaneous	*25*	18	7
Sequential	*37*	5	32
Total	*62*	*23*	*39*

The table makes clear that while the majority of simultaneous reciprocals involves predicate reduplication, the majority of sequential reciprocals does not involve this strategy, i.e., the predicate is zero-marked. The Pearson Chi-Squared Test conducted in R (R Core Team 2008) to investigate the relation between reciprocal type and reduplication/zero marking in the elicited data shows a significant relation between the two variables (X^2 (1, N = 62) = 19.436, p < 0.001) (see also Appendix 4-B and van Boven 2023c). Thus, the elicited data suggest that the choice between predicate reduplication and zero marking is related to the reciprocal type.

Table 4.8 shows how the reciprocal types are distributed over the different verb types.

Table 4.8 Distribution of reciprocal type across verb type in the elicited data (1H = one-handed; 2H = two-handed).

Verb type	*N (total)*	Simultaneous reciprocal (N)	Sequential reciprocal (N)
1H + plain	*20*	10	10
2H + plain	*10*	0	10
1H + agreeing	*25*	15	10
2H + agreeing	*7*	0	7
Total	*62*	*25*	*37*

Unfortunately, no simultaneous reciprocals could be elicited for two-handed verbs. As mentioned in Section 4.3.2.2, for the targeted two-handed verbs – VISIT, TEACH and EXPLAIN – it is semantically highly unlikely, if not impossible, to occur in a simultaneous reciprocal. I thus cannot say anything about a potential difference between reciprocal types for two-handed verbs. All I can say is that in the elicited data, two-handed verbs are zero-marked for sequential reciprocity (see Table 4.5). The fact that they occur in sequential reciprocals only also explains why these verbs mostly employ the bi-clausal strategy as an alternative strategy, as this strategy is used to describe the sequential order of the events, cf. examples (9ab) (N = 13 out of 17 two-handed verbs).

As for one-handed verbs, it is worth further investigating the difference between reciprocal types in terms of reduplication. Their occurrence with the two reduplication types and zero marking is detailed in Table 4.9.

Table 4.9. Distribution of reduplication type across verb type and reciprocal type for one-handed verbs in the elicited data; shaded cells highlight unexpected surface forms (1H = one-handed).

Verb type + reciprocal type	***N (total)***	**Simultaneous backward reduplication in sentence (N)**	**Sequential backward reduplication in sentence (N)**	**No reduplication in sentence (N)**
1H + plain + simultaneous reciprocal	10	6	0	4
1H + plain + sequential reciprocal	10	0	0	10
1H + agreeing + simultaneous reciprocal	15	14	1	0
1H + agreeing + sequential reciprocal	10	1	4	5
Total	*35*	*21*	*5*	*19*

If reciprocal type indeed influenced reduplication type, we would expect that simultaneous reciprocals are marked by simultaneous reduplication, and sequential reciprocals by sequential reduplication. For the largest part, this expectation is borne out. In the table, the shaded cells mark surface forms that are unexpected if we follow this reasoning, and we see that there are only two exceptions.

For one-handed plain verbs, simultaneous reciprocals can be marked by simultaneous reduplication. In three instances, this involves reduplication of the main verb; in the other three, there is reduplication of an added verb. In the cases without reduplication, reciprocal marking either involves a free-standing marker (N = 2) or the construction is bi-clausal (N = 2). However, the bi-clausal strategy looks different from the one used for sequential reciprocals, in that the signers overtly mark that the two subevents occur at the same time. For instance, rather than using OTHER.WAY.AROUND or FIRST…THEN in between the phrases (see (10ab) above), they use the sign ALSO. Both cases involve the verb SPY.ON – a verb that is never reduplicated (see Section 4.5.1 for more discussion). Compare, for instance, (13) to the bi-clausal sequential reciprocal sentence in (9a) above, uttered by the same participant.

(13) MAN WOMAN BOTH TABLE SIT BOOK STUDY. WOMAN LOOK BEHIND WHO WHAT DO INDEX WHAT. LOOK.FROM.BEHIND.BOOK. LITTLE **SPY.ON**. INDEX MAN **ALSO** $_{3a}$AUX.OP$_{3b}$ WOMAN LOOK.FROM.BEHIND.BOOK INDEX WHAT DO INDEX WHAT **SPY.ON** PALMS.UP.

'A man and a woman are both sitting at a table, studying with a book. The woman looks from behind her book to see what the man is doing, she spies on him a little. The man also looks from behind his book to the woman to see what she is doing, he spies on her.' (or: 'The man and the woman look at each other from behind their books; they spy on each other.') [p02]

In contrast, sequential reciprocals never involve reduplication for one-handed plain verbs. In 9/10 cases, we observe the bi-clausal strategy, and in the remaining case, a free-standing marker is used.

For one-handed agreeing verbs, simultaneous reciprocals are almost always marked by simultaneous reduplication of the verb, and never by zero marking. Yet, there is one exception involving reduplication of the verb GIVE, which combines simultaneous and sequential properties: at the beginning, both hands are placed simultaneously at opposite sides of the signing space, but the actual reduplication expressing the reciprocity is articulated sequentially. As for sequential reciprocals with one-handed agreeing verbs, there is also one unexpected instance of simultaneous reduplication, which again involves GIVE. It may be the case that this participant did not notice that the stimulus involved a sequential event – but this explanation must remain speculative. All cases of sequential reciprocals with one-handed agreeing verbs without reduplication employ the bi-clausal strategy, and four sequential reciprocals involve sequential reduplication of the verb.

The patterns in the elicited data thus suggest that the reciprocal type influences reduplication type at least for one-handed verbs – although the patterns appear not to be completely categorical. I therefore suggest the preliminary classification in Figure 4.15.

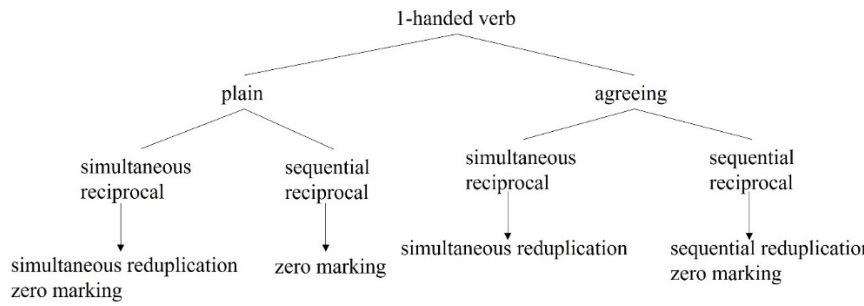


Figure 4.15. Classification for one-handed verbs based on reciprocal marking patterns in the elicited data.

For the corpus data, checking for differences between reciprocal types was less straightforward, since it was not always clear from the context whether the signer expressed a sequential or simultaneous meaning – in four cases, the reciprocal type was unclear. Nevertheless, Table 4.10 shows the frequency of the two different reciprocal types in the corpus, and how often they involve predicate reduplication.

Table 4.10. Distribution of predicate reduplication across reciprocal types in the corpus data (dual reciprocals, non-allelic).

Reciprocal type	*N (total)*	Predicate reduplication in the sentence (N)	No predicate reduplication in the sentence (N)
Simultaneous	*21*	16[a]	5
Sequential	*17*	10	7
Unclear	*4*	2	2
Total	*42*	*28*	*14*

[a] This includes the two instances of simultaneous backward reduplication of ATTACK (see Figure 4.12).

As in the elicited data, the majority of simultaneous reciprocals involves predicate reduplication. Sequential reciprocals are more equally distributed over predicate reduplication and zero marking. The Pearson Chi-Squared Test conducted in R (R Core Team 2008) to investigate the relation between reciprocal type and predicate reduplication/zero marking in the corpus data does not suggest a significant relation between the two variables (X^2 (1, N = 42) = 0.631, p = 0.43) (see also Appendix 4-B and van Boven 2023c). That is, based on the corpus data, I cannot conclude anything as to whether the choice between predicate reduplication and zero marking has a relation with reciprocal type.

Moreover, in the corpus, too, two-handed verbs were never reduplicated (except for the special case of ATTACK; see Table 4.6). Out of the nine two-handed verbs in the corpus data set, five (three agreeing and two plain) occur in a reciprocal construction that is clearly sequential. These sequential reciprocals with two-handed verbs are either bi-clausal (N = 3) (14a), a strategy which is also commonly used for sequential reciprocals in the elicited data (although the clauses are much shorter in the corpus, compare (14a) to (9) and (10) above), or involve a free-standing marker (N = 2) (as in (11) above). The remaining four two-handed signs in the corpus occur in simultaneous reciprocals. Two of these involve the verb ATTACK (N = 2), which, as we have seen, undergoes a special type of reduplication (see Figure 4.12); the other two involve a free-standing marker (14b). Regarding two-handed verbs, further research is needed, as the evidence from the corpus is not conclusive.

(14) a. OR INDEX STORY $_1$**ADD.TO**$_2$ OR $_2$**ADD.TO**$_1$.
‘So, we can add to each other’s stories?’
[CNGT0510; S026; 03:13.120]

headshake
b. INDEX$_1$ $_1$**DUAL.PRO-1**$_2$ **ADAPT** .
headshake
INDEX$_1$ DEAF INDEX$_1$ HEARING INDEX$_1$ NOT.
‘But deaf and hearing people do not adapt to each other.’
[CNGT0095; S002; 00:56.400]

For one-handed verbs, the reciprocal type was unclear in four cases (two plain verbs, and two agreeing verbs). For the others, we can extract the patterns in Table 4.11 from the corpus.

Table 4.11. Distribution of reduplication type across verb type and reciprocal type in the corpus data (one-handed verbs); shaded cells are unexpected surface forms (1H = one-handed).

Verb type + reciprocal type	*N (total)*	Simultaneous backward reduplication in sentence (N)	Sequential backward reduplication in sentence (N)	No reduplication in sentence (N)
1H + plain + simultaneous reciprocal	*3*	0	0	3
1H + plain + sequential reciprocal	*9*	8	0	1
1H + agreeing + simultaneous reciprocal	*14*	13	1	0
1H + agreeing + sequential reciprocal	*3*	0	3	0
Total	*29*	*21*	*4*	*4*

For one-handed plain verbs, the corpus data present us with a clearly unexpected pattern for sequential reciprocals, as these are largely marked by simultaneous backward reduplication. As mentioned before, all these instances involve the verb TALK. Talking to each other is an event that prototypically occurs sequentially rather than simultaneously. Further, talking to each other is a rather frequent event, that is, TALK probably commonly occurs in a reciprocal context. The form in Figure 4.11, with simultaneous reduplication, may thus be lexicalized, or it may even be an allelic predicate at this point. Still, given that one-handed plain verbs in the elicited data also never undergo sequential reduplication, even in sequential reciprocals, an alternative explanation might be that this verb type disprefers sequential backward reduplication in general.

Another unexpected case is the one-handed agreeing verb that is marked by sequential reduplication, although the reciprocal type is simultaneous. This particular instance involves the verb AGREE – to agree with each other usually implies simultaneity. AGREE is a one-handed verb articulated on the ipsilateral side of the chest. It would be articulatorily difficult to articulate its reduplicant simultaneously. Possibly, these phonological features may override semantic considerations when choosing a reciprocal strategy.

For one-handed verbs, there is only one sequential reciprocal without reduplication in the corpus; in this case, a free-standing marker is used. For simultaneous reciprocals, we find three cases without reduplication, all of which also involve a free-standing marker.

4.4.4 Answering the research questions

The data discussed in Sections 4.4.1–4.4.3 allow me to answer all three of the research questions to a large extent.

RQ1: How is reciprocity marked (on the verb) in NGT? Our data show that strong reciprocity between two participants can be marked by sequential or simultaneous backward reduplication – it is usually the main verb that is reduplicated, but sometimes reduplication affects another verb in the sentence or AUX.OP. Reduplication may be the only reciprocal marker, or it may combine with a pronoun ('the two of us', 'the two of them'), which appears to have both a dual and a reciprocal meaning. However, not all reciprocal sentences are marked by reduplication. When there is no reduplication (i.e., zero marking on the verb), the reciprocal is always marked in some other way, namely by the aforementioned pronoun and/or a bi-clausal strategy.

RQ2: Do we observe a difference in reciprocal marking between agreement and plain verbs, and between one- and two-handed verbs in NGT? The most notable difference is observed between one- and two-handed verbs: none of the two-handed verbs in our data set are reduplicated, while one-handed verbs frequently undergo reduplication. Indeed, a chi-squared analysis of the elicited data reveals a relation between the choice of predicate reduplication or zero marking on the one hand, and handedness of the predicate on the other. Further, a chi-squared analysis of the elicited data suggests a relation between predicate reduplication or zero marking on the one hand, and agreement properties on the other. Such a chi-squared analysis of the corpus data does not show a significant relation between these variables, and thus does not allow me to conclude anything as to whether the choice of reduplication/zero marking relates to agreement properties of the predicate. Finally, as for the specific reduplication types within the group of one-handed verbs, we observe that agreeing verbs can undergo both sequential and simultaneous backward reduplication, while plain verbs only undergo simultaneous backward reduplication. Yet, reduplication is optional even for one-handed verbs: both agreeing and plain verbs sometimes remain zero-marked.

RQ3: Do we observe a difference between 'simultaneous reciprocals' and 'sequential reciprocals' in NGT? For one-handed verbs in the data, the reciprocal meaning clearly influences the reduplication type used. For one-handed plain verbs, simultaneous reciprocals are marked by simultaneous reduplication or zero marking, while sequential reciprocals are always zero-marked. For one-handed agreeing verbs, simultaneous reciprocals are marked by simultaneous reduplication, while sequential reciprocals are marked by sequential reduplication or zero marking. The corpus data generally align with these patterns. I argued that the two exceptions in the corpus – simultaneous reduplication of TALK and sequential reduplication of AGREE – can likely be explained by lexicalization and articulatory factors, respectively. For the choice between predicate reduplication and zero marking in general, a chi-squared analysis of the elicited data suggests that there is a significant relation with reciprocal type, while a chi-squared analysis of the corpus data could not establish a significant relation with reciprocal type.

4.5 Discussion

Section 4.5.1 addresses further findings that are considered interesting, but that have not been discussed yet, as they do not directly relate to our RQs. From these findings, suggestions for future research follow. Subsequently, Section 4.5.2 offers a cross-linguistic perspective on the present findings, comparing them to reciprocal marking in other signed and spoken languages. Finally, in Section 4.5.3, I take a methodological perspective on the data.

4.5.1 Further findings and topics for future research

While Section 4.4 describes the general patterns in NGT reciprocal marking, a few noteworthy details have not yet been discussed; these will be addressed here. First, I discuss a number of issues related to zero marking. Then I briefly address strong reciprocity.

It is clear that reduplication of the verb alternates with zero marking on the verb. While – as has already been shown – zero marking can often be explained by semantic and/or phonological factors, I should point out that certain verbs are *always* zero-marked in our data – even when there are no phonological or semantic factors preventing the reduplication. An interesting case in the elicited data set is the one-handed plain verb SPY.ON, which is zero-marked in all occurrences (9 in total) – even in simultaneous reciprocals, where other one-handed plain verbs undergo simultaneous reduplication (e.g., TALK in (7a)). SPY.ON is a body-anchored verb, articulated close to the signer's face. Interestingly, in reciprocal contexts, SPY.ON sometimes combines with another verb, namely the one-handed agreeing verb LOOK.AT (see Figure 4.13a above), which is simultaneously reduplicated to mark the reciprocal – cf. (7b) above, repeated here as (15).

(15) A-N-N-E L-U-U-K SIT$_{3a+3b}$. BOOK$_{3a}$ BOOK$_{3b}$. SECRETLY **SPY.ON LOOK.AT+$_{\textbf{sim/back}}$** SPY.ON.BEHIND.BOOK.
‘Anne and Luuk are sitting across from each other, both with a book. They secretly spy on each other from behind their books.’ [p01]

In this case, LOOK.AT appears to function as a light verb, i.e., it does not have any semantic content of its own, but is rather used to encode reciprocal meaning when it combines with SPY.ON. The exact function, form and use of LOOK.AT in these contexts, and whether it can be used with other verbs as well, is an interesting topic for future research. Note that for other sign languages, it has been argued that equivalents of the sign LOOK.AT have taken on grammatical functions: for DGS, Oomen (2019) argues that it functions as an attitude predicate, and Hou (2022) observes that it is grammaticalizing from a verb of visual perception to a stance verb in American Sign Language. It is not unlikely that LOOK.AT is in the process of taking on a grammatical function in NGT, too. The use of a light verb in NGT has been suggested before by Couvee & Pfau (2018), who observe that the verb GIVE can function as a light verb when combined with a noun or adjective (cf. GIVE BLAME in (12) above).

Given that SPY.ON is a body-anchored verb, future research could also focus on the role of body-anchoredness in the choice between zero marking and reciprocal reduplication. Indeed, there appears to be a general tendency for body-anchored signs to be resistant to reduplication in sign languages. For instance, in several sign languages, body-anchored nouns cannot be pluralized by means of reduplication, even when reduplication is a productive pluralization process in the language (e.g., Pizzuto & Corazza 1996 for Italian Sign Language; Sutton-Spence & Woll 1999 for British Sign Language; Pfau & Steinbach 2006 for DGS).[8] Similarly, in IPSL, body-anchored verbs cannot undergo reciprocal-marking reduplication (Zeshan & Panda 2011). In this respect, it is interesting that other one-handed body-anchored verbs articulated close to the face in our corpus data, such as UNDERSTAND, SAY and LEARN (N = 5), are never reduplicated for reciprocity either, at least in our data set. However, since there are only a few instances of such verbs in our data, and since the data cannot provide negative evidence, more research is needed. For more discussion of the role of body-anchoredness in NGT reduplication, see Chapter 2 (and van Boven 2021), Chapter 3, and Chapter 7.

More generally, while the semantic, phonological, and morphosyntactic factors I took into account can partially explain the choice between zero marking

[8] On a similar note, body-anchored verbs also cannot be modified spatially to mark agreement, as this would change their lexically specified location feature (Zwitserlood & van Gijn 2006).

and reduplication as well as the choice between reduplication types, they are clearly not the whole story. This is also illustrated by the cases of AGREE and TALK discussed in Section 4.4.3. This interplay between different factors warrants further investigation.

Even when the verb remains zero-marked, reciprocity is always encoded by some other means, commonly by the bi-clausal strategy. Indeed, this strategy appears to be an alternative for reduplication, as the two strategies never occur together, with one exception in the elicited data. Interestingly, in the elicited data, when an agreement verb occurs in a bi-clausal construction, we observe five cases with partial agreement, i.e., the verb only agrees with its object. This involves the two-handed verb VISIT four times, and the two-handed verb TEACH one time; in contrast, LOOK.AT and GIVE – both one-handed – always fully agree, even when the bi-clausal strategy is used. In all three corpus instances of the bi-clausal strategy, there is full agreement (with the verbs ADD.TO, TAKE.OVER, and INFLUENCE, which are all two-handed).

Finally, up until now, I only addressed strong reciprocity between two participants. Yet, the corpus search also yielded some reciprocals with more than two participants (N = 31, of which 13 involve allelic verbs). These were not the focus of the present study, but a preliminary analysis of the 18 instances without allelic verbs suggests the use of a few markers that I did not find in (non-allelic) dual reciprocals. Strikingly, object drop is observed in five instances, as in (16a) below. I also identify two free-standing markers that did not surface in the dual, namely the sociative marker SAMEN ('together'; N = 4; cf. (16b)) and a sign glossed as ONDERLING ('mutually'; N = 1; cf. (16c)). I further find two strategies that are also attested in dual reciprocals: reduplication of AUX.OP (N = 2; once sequential and once simultaneous) and reduplication of the verb (N = 3). While these instances involve simultaneous reduplication, they still look different from the reduplication as observed in dual reciprocals: there is an additional movement in space to indicate that there are multiple participants. The marking of reciprocals with more than two participants in NGT is another interesting avenue for future research.

(16) a. SEE DEAF CONTACT SIGN TABLE.TENNIS SOCCER CONTACT.
'I see that deaf people are in contact with each other, playing table tennis and soccer.' [CNGT0099; S001; 03:46.16]

b. YESTERDAY SCHOOL REGION_{3a} REGION_{3b} REGION_{3c} THREE INDEX_{3a} INDEX_{3b} INDEX_{3c} **TOGETHER** BE.IN.TOUCH […].
'The three schools in the different regions used to be in touch with each other […].' [CNGT0099; S001; 04:17.04]

c. […] FIT **MUTUALLY**.
'But they fit together/match each other.'
[CNGT0527; S025; 01:56.56]

4.5.2 A typological perspective

The general reciprocal marking strategies identified here for NGT – i.e., use of a reciprocal pronoun, the bi-clausal strategy, and reduplication – have also been described for different spoken languages (see the summary in Section 4.2.1), as well as for other sign languages (see the summary in Section 4.2.2). This section therefore first takes a cross-modal perspective on our data, and then goes into intra-modal patterns and variation.

4.5.2.1 A cross-modal perspective

As for reciprocal pronouns, typological studies suggest that they are often polysemous (e.g., Maslova & Nedjalkov 2013). Indeed, this is also the case for DUAL.PRO identified in the present study, as it also functions as a dual pronoun (and it may have other functions that are yet to be identified). In spoken languages, however, reciprocal pronouns often also encode spatial functions (Lichtenberk 1985; e.g., 'next to each other'), but, as already suggested by Pfau & Steinbach (2016), this does not seem to be the case for sign language reciprocals, as a consequence of the visuo-spatial modality – sign languages tend to use the signing space to express such information, for example, to show the spatial relation between entities (see Pfau & Steinbach 2016 for an overview of different sign languages). While I did not focus on potential other functions of the markers found here, previous research indicates that the spatial function is indeed encoded by such alternative strategies in NGT, too (e.g., Zwitserlood & Nijhof 1999).

As for the bi-clausal strategy, recall from Section 4.2.1 that according to Evans (2008) and Maslova & Nedjalkov (2013), all (spoken) languages can express reciprocity by combining expressions for two simple situations; yet, the degree to which this strategy is conventionalized differs from language to language. I have shown that NGT, too, employs this strategy, as illustrated mostly by the elicited data. The corpus data, however, suggest that it is not necessarily conventionalized in natural language use, as it occurs in only 5.5% of the analyzed sentences. I refer to the next section (4.5.3) for more discussion of this difference between data sets.

Of course, reduplication is also used to mark reciprocity in spoken languages; yet, in NGT (and in other studied sign languages), this particular strategy comes with a modality-specific flavor, as reduplication commonly involves the simultaneous addition of the non-dominant hand as well as backward movement. Moreover, our investigation also shows that the choice between simultaneous and sequential backward reduplication largely depends on semantic, rather than phonological and/or morphosyntactic, factors (cf. Ergin et al. 2020). This is a typologically interesting observation, given Everaert's (2000: 78) claim that "the semantics of reciprocals is quite diverse and complicated […] but, surprisingly, it appears as if these semantic differences never have consequences for the distributional properties of reciprocals". Evans (2008: 92), also citing Everaert (2000), already points out that this claim is proven false by the fact that in investigated sign languages, the "seriative" (e.g., "the students followed one another onto the stage") is not expressed by a reciprocal construction, but rather by placing referents in the signing space (cf. Pfau & Steinbach 2016). Our NGT data provide even further evidence against Everaert's (2000) claim, given that the construction type used to mark the reciprocal correlates – at least to some extent – with the reciprocal type (sequential or simultaneous). As already pointed out in the introduction section, there is an increased potential for iconicity given the visual nature of sign languages (e.g., Mandel 1977; van der Kooij 2002; Taub 2012). It is thus not surprising that a sign language would exploit this potential in reciprocal marking, too. Still, this topic has not been elaborately researched for many sign languages; it clearly deserves more attention in future studies of sign language reciprocals.

We also encountered two less frequently occurring reciprocal marking strategies: reduplication of the auxiliary AUX.OP and the addition of reduplicated LOOK.AT, which appears to function as a light verb. Both strategies are reminiscent of "reciprocal-coding auxiliaries" in spoken languages, as identified by Evans (2008: 70). For instance, in the Nyulnyulan language Warrwa (Australia), reciprocal constructions involve the reciprocal-marking auxiliary *wanji* 'exchange' (Evans 2008: 71).

While the strategies described above are attested in both signed and spoken languages, a difference between the two modalities is the fact that, according to Evans (2008: 68), "[a]ffixation to the predicate is one of the commonest methods of forming reciprocal constructions" in spoken languages, while no reciprocal affix has been described for sign languages so far. As already pointed out in our introduction section, and also by Pfau & Steinbach (2016), the lack of a reciprocal affix is not unexpected, given that affixation is generally rare in sign languages (Aronoff, Meir & Sandler 2005).

4.5.2.2 An intra-modal perspective

When comparing the present findings to those reported for other sign languages (which were summarized in Section 4.2.2.1), we see some considerable overlap in terms of reciprocal marking strategies. Recall that reciprocal pronouns have been identified for Irish Sign Language, LSC (Pfau & Steinbach 2016), and TİD (Kubus 2008), and that a bi-clausal strategy has also been described for IPSL (Zeshan & Panda 2011). Like NGT, both DGS and IPSL have reciprocal-marking auxiliaries at their disposal (Pfau & Steinbach 2003; Zeshan & Panda 2011, respectively). Still, sign languages differ from each other with respect to the exact marking strategies they employ. For instance, Pfau & Steinbach (2016) report that DGS does not have a reciprocal pronoun. Similarly, while DGS marks reciprocity by means of object drop in the context of certain (e.g., body-anchored) verbs, I did not observe this strategy in NGT (for reciprocals with two participants, that is).

Further, NGT reciprocals can be marked by reduplication of the verb, and there is allomorphy – similar to what has been described for other sign languages (i.e., DGS (Pfau & Steinbach 2003, 2005b, 2016), Austrian, Brazilian, Catalan, Irish, and Italian Sign Language (Pfau & Steinbach 2016), TİD (Kubus 2008), and IPSL (Zeshan & Panda 2011)). Interestingly, however, while in other investigated sign languages the morphosyntactic verb type (agreement vs. plain verb) usually plays a pivotal role in the choice between reduplication and zero marking, in NGT, the choice between these two strategies (also) seems to depend on phonological properties of the verb, i.e., the distinction between one- and two-handed verbs. Another interesting difference from studies on reciprocals in other sign languages is the fact that those studies often describe clear-cut patterns. For example, for DGS, Pfau & Steinbach (2003, 2005b, 2016) find that plain verbs never undergo reduplication, while agreement verbs are always reduplicated. I find that in NGT, even verbs that in principle could be reduplicated, are sometimes zero-marked (reciprocity being marked elsewhere in the sentence). This is in line with previous findings on NGT reduplication, which appears to be optional across-the-board (see Chapter 2 (and van Boven 2021) for plural reduplication; van Boven & Oomen 2021 and Chapter 3 for aspectual reduplication). This difference with DGS may well result from methodological differences – unlike Pfau & Steinbach, I included naturalistic corpus data. The next section offers more discussion of the method employed here and its consequences for the findings.

4.5.3 A methodological perspective

Since this study combined two types of data, it is important to also offer a methodological perspective on the results. I acknowledge some shortcomings of both methods, but also show how the two data sets complement each other.

First, there are some gaps in the data when it comes to two-handed verbs. As mentioned in Section 4.3.2.2, I was unable to elicit simultaneous reciprocals for these verbs, given that the meaning of all two-handed verbs included in the task inherently involves sequential subevents (VISIT, TEACH, and EXPLAIN). Further, I only managed to create video-items for three different two-handed verbs, while four different one-handed verbs were targeted in our task. In other words, it proved difficult to come up with two-handed NGT verbs that (i) denote events that can take place sequentially *and* simultaneously, and (ii) are clearly depictable on a video. As for the corpus data, it is of course impossible to control the verb types that come out of our searches, and only 9 out of 42 instances involved two-handed verbs. The finding that two-handed verbs remain zero-marked in reciprocal contexts is thus based on limited evidence, due to (practical) methodological reasons – grammaticality judgements of reciprocal marking on two-handed verbs are needed to further verify (or disprove) our observation.

Second, while the two data sets largely include the same reciprocal marking strategies, they do suggest a somewhat different distribution: While reduplication is by far the most common strategy in the corpus data (43.6%), the bi-clausal strategy is most common in the elicited data (45.2%). Conversely, the bi-clausal strategy occurs very rarely in the corpus (only 5.5%). It appears that the controlled environment in which the reciprocals were elicited gives a skewed view of how frequently this bi-clausal strategy occurs. Indeed, in the video clips eliciting sequential reciprocals, participants first saw, for example, 'Luuk' visiting 'Anna', and then the other way around. When describing such clips, participants seem more likely to use two clauses: one for each part of the clip. The corpus data suggest that, while this is indeed a possible reciprocal marking strategy in NGT, it is not used very frequently in natural language use.

This latter point neatly illustrates how the corpus and elicited data complement each other. In fact, although the exact distributions in the two data sets differ from each other, the corpus and elicited data do not contradict each other. The data elicitation draws a clear picture of the possible reciprocal marking strategies in NGT, and of the factors that play a role in the choice between these strategies (phonological, morphosyntactic, and semantic). The natural language use in the corpus data suggests some nuances that the data elicitation, due to the set-up of the experiment, could not uncover – in terms of frequency, but, as pointed out in Section 4.5.1, also in terms of other factors that potentially play a role in the choice of reciprocal marking strategy. Nevertheless, the elicited data revealed patterns that likely underly (part of) the corpus data, showcasing once again the value of combining these two methods (see also Kimmelman et al. 2018 for a discussion of the advantages and limitations of combining data elicitation with corpus analysis in sign language research).

Yet, the question of what motivates the choice between predicate reduplication and zero marking in reciprocal sentences requires some further study. Chi-squared analyses performed on the elicited data suggest that this choice is related to handedness, agreement, and reciprocal type. At the same time, this result may (in part) be due to dependencies in the data that were not taken into account in this analysis (see footnote 7), and chi-squared tests of the corpus data do not allow me to conclude anything about the relationship between these factors.[9] While the current study provides a first overview of the factors that likely play a role, it is hoped that, starting from these findings, future work can gather data from a larger sample, allowing for more reliable statistical analyses. This would provide more insight into the question whether there is a consistent relation between reciprocal reduplication and handedness, agreement, and reciprocal type (and possibly other factors) in NGT.

4.6 Conclusion

This study is the first to provide an extensive overview of reciprocal marking in NGT, investigating both corpus data and elicited data. The analyses show that reciprocity can be marked on the verb by simultaneous and sequential backward reduplication, but also by means of a reciprocal pronoun DUAL.PRO, reduplication of the auxiliary AUX.OP, a bi-clausal strategy, or a combination of these. Reduplication of the verb alternates with zero marking on the verb, and the present study set out to uncover the factors that influence the choice between these two strategies. The data show that this choice largely depends on phonological and morphosyntactic properties of the base verb, as had already been found in other sign languages – albeit in slightly different form: two-handed verbs in the data are always zero-marked, while one-handed plain verbs alternate between zero marking and simultaneous backward reduplication, and one-handed agreeing verbs alternate between zero marking, simultaneous backward reduplication, and sequential backward reduplication. I also investigated the role of reciprocal semantics, and for

[9] Recall from footnote 6 that no chi-squared test could be conducted for the relation between handedness and reduplication in the corpus data, as two of the cells in the contingency table have an expected value below five (see Appendix 4-B; van Boven 2023c).

one-handed verbs, we observe a difference between sequential and simultaneous reciprocal meaning: simultaneous reciprocals are marked by simultaneous backward reduplication or zero marking, while sequential reciprocals are marked by sequential backward reduplication or zero marking. This highlights the role of iconicity in reciprocal marking in the visual-spatial modality.

While this study thus demonstrated the importance of phonological, morphosyntactic, and semantic factors, it is also clear that they are not the whole story: throughout the chapter, I discussed several other potential factors that may play a role in the choice between zero marking and reciprocal reduplication of the verb, such as lexicalization and phonetic factors (illustrated by the verbs TALK and AGREE, respectively). Future research – ideally testing a larger sample and involving grammaticality judgements – should focus on these factors to provide an even more comprehensive picture of reciprocal marking in NGT. Moreover, future research could further investigate whether sequential and simultaneous reciprocals differ from each other in other sign languages, too, to obtain further insights into the role of iconicity in sign language reciprocal marking.

To conclude, the present NGT data, as well as data from other sign languages, show that while reciprocal marking in the visual-spatial modality involves strategies that have also been identified for spoken languages, they come with a modality-specific flavor – thus illustrating once more the added value of considering sign languages in typological descriptions of linguistic constructions.

Chapter 5 | Nominal plurals in Sign Language of the Netherlands: Accounting for allomorphy and variation*

5.1 Introduction

Ever since the advent of sign language linguistics in the 1960s, one of the guiding themes has been the question in how far linguistic phenomena at all levels of grammatical description are dependent on the modality of signal transmission, that is, the oral-auditive modality of spoken languages vs. the visual-spatial modality of sign languages. These phenomena include, for instance, the phonological make-up of lexemes, the strategies for building morphologically complex words and signs, and the ways in which these are combined into syntactic structures. By implication, this research agenda raises the question whether theoretical models that have been put forward to account for phonological, morphological, and syntactic structures in spoken languages can also account for sign language structures, that is, in how far these models are modality-independent (Sandler & Lillo-Martin 2006; Quer et al. 2021). In the past 50 years, sign language linguists have contributed significantly towards answering such descriptive and theoretical questions.

In the present study, we offer a contribution to this ongoing debate. The domain of grammar that we are concerned with can be located at the interface between phonology and morphology; the theoretical model that we are going to use is Optimality Theory (OT; Prince & Smolensky 1993 [2004]). As for morphology, it has indeed been claimed that it is, to some extent, characterized by modality-specific properties. Most of the sign languages that have been described to date allow for morphologically complex signs (in particular, verbs). However, in contrast to spoken languages, much of the morphological modifications apply simultaneously, that is, stem-internally (e.g., Aronoff, Meir, Padden & Sandler 2005; Aronoff, Meir & Sandler 2005; Sandler & Lillo-Martin 2006; Pfau 2016). These stem-internal changes may affect all phonological building blocks of signs: handshape, location, movement, and also non-manual features (including, for instance, the cheeks and the eyebrows). In contrast, clear cases of sequential affixation are rare across sign languages (Aronoff, Meir, Padden & Sandler 2005; Aronoff, Meir & Sandler 2005). A morphological process that involves neither sequential affixation nor stem-

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internal modification, and that has been shown to be very common across sign languages, is reduplication (e.g., Pfau & Steinbach 2005b; Wilbur 2009) – and it is this particular process which will be the center of our attention.

Across sign languages, reduplication realizes morphological features which are also commonly encoded by that same process in spoken languages (Moravcsik 1978; Rubino 2005), most importantly plurality (e.g., Pizzuto & Corazza 1996; Pfau & Steinbach 2005a) and certain aspect types (e.g., Fischer 1973; Klima & Bellugi 1979; Sandler 1989; Bergman & Dahl 1994; Wilbur 2005). In addition, reduplication has been found to encode reciprocity (Pfau & Steinbach 2003) and intensification and to play a role in the noun-verb distinction (Supalla & Newport 1978) in some sign languages – again, morphological processes that may also be encoded by reduplication in spoken languages, albeit less commonly. The fact that reduplication is common in both modalities is not surprising, given that it can often – though not always (see Downing & Stiebels 2012 for an overview of iconicity in language) – be considered an iconic process, as the copying of phonological material may reflect a multitude of entities or events of the same type, or, as Dingemanse et al. (2015: 604) put it, “across spoken and signed languages, repetition in word forms is often connected to repetition in their meanings” (see also Kouwenberg & LaCharité 2015).

In the following, we will only be concerned with plural reduplication. As will become clear, this modality-independent process comes with a modality-specific flavor, as the visual-spatial modality allows for reduplication types that are not attested in spoken languages.

OT has been used to account for spoken language reduplication in many studies (for an overview, see Downing & Inkelas 2015), and also for sign language reduplication in two previous studies (Pfau & Steinbach 2003, 2005a, on reciprocals and plurals, respectively). Still, while an important feature of OT-constraints is their universality (Prince & Smolensky [1993] 2004, 1997), it remains unclear to what extent previously proposed constraints can account for both modalities. This paper addresses in how far it is possible for OT-constraints to be modality-independent, and what modality-independence means in this context. Concretely, we offer (i) the first OT-analysis of reduplication in Sign Language of the Netherlands (*Nederlandse Gebarentaal*, NGT), and (ii) the first formalization of sign language variation within stochastic OT. We aim to introduce constraints that are maximally modality-independent, using constraint types that have been proposed for spoken language reduplication. In doing so, we evaluate in how far constraints that have been proposed for the formalization of spoken language reduplication can account for sign language data as well.

We start in Section 5.2 by summarizing previous research on strategies of nominal pluralization in NGT, the sign language that is the topic of our research. Our OT-analysis of nominal reduplication in NGT is presented in Section 5.3, where we first address the patterns observed in the corpus and elicited data that our analysis builds on, and then address the issue of variation. In Section 5.4, we reflect on our formalization, specifically on the question to what extent it is possible to introduce modality-independent OT-constraints, and we also consider how our account fares when it comes to cross-linguistic variation. In this section, we also address some topics for future research. We conclude in Section 5.5.

5.2 Nominal pluralization in Sign Language of the Netherlands

The study reported on in Chapter 2 (van Boven 2021) described the nominal pluralization strategies in NGT, based on both data from the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008) and data elicited by means of a novel elicitation technique, a gap-filling task (for a detailed description of this task, see van Boven 2020). The results obtained by these combined methodologies are different from those reported in previous work on NGT pluralization (Zwitserlood & Nijhof 1999) and, in interesting respects, similar to patterns described for other sign languages, most importantly, German Sign Language (*Deutsche Gebärdensprache*, DGS; Pfau & Steinbach 2005a). Since phonologically triggered allomorphy turned out to play an essential role in NGT pluralization, Section 5.2.1 introduces the relevant phonological distinctions. Section 5.2.2 then summarizes the pluralization strategies found in NGT. These results are the basis of the analysis offered in the present study. We give relevant examples of the data in the present article, but also refer to Chapter 2 and van Boven (2021) for a detailed description. Finally, see Appendix 2-B for an overview of the different nouns included in the data.

5.2.1 Phonological noun types in NGT

It has been shown that, at the manual level, signs have phonological structure: the identified sublexical building blocks – which can be described in terms of distinctive features – are the handshape, place of articulation, and the movement of the sign (Stokoe 1960; Sandler 1989; for an overview, see Fenlon et al. 2017).

For the present study, only specific movement and location (place of articulation) features are of relevance, since these have been shown to influence the pluralization strategy in NGT (van Boven 2021; see Chapter 2), as well as a number of other sign languages (Pizzuto & Corazza 1996 for Italian Sign Language; Sutton-Spence & Woll 1999 for British Sign Language; Pfau & Steinbach 2005a for DGS). We follow Pfau & Steinbach (2005a) in distinguishing four different phonological noun types based on these features, all of which are privative: body-anchored nouns, lateral nouns, midsagittal nouns, and complex movement nouns, as summarized in Figure 5.1.[1] Three examples of each noun type are given in Figures 5.2–5.5.

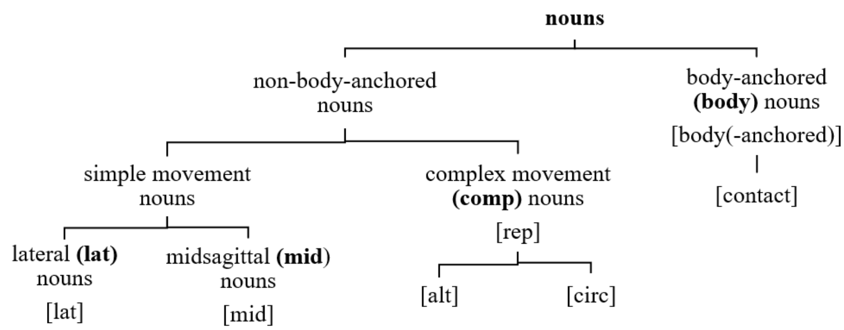

Figure 5.1. Noun types distinguished for NGT (based on Pfau & Steinbach 2005a: 118) and their feature specifications; the abbreviations for the four main noun types are given in bold in brackets.

a. WOMAN b. HUMAN c. FARMER

Figure 5.2. Examples of body-nouns WOMAN (a), HUMAN (b) and FARMER (c) in NGT.

[1] Pfau & Steinbach (2005a) use slightly different abbreviations for the different noun types, i.e., B-, L-, M-, and C-nouns; for readability, we adopt the more transparent abbreviations body-, lat-, mid-, and comp-nouns for these phonological noun types.

a. BICYCLE b. CAR c. TRAIN

Figure 5.3. Examples of comp-nouns BICYCLE (a), CAR (b) and TRAIN (c) in NGT.

a. CHILD b. PERSON c. THING

Figure 5.4. Examples of lat-nouns CHILD (a), PERSON (b) and THING (c) in NGT.

a. BOOK

b. CHAIR

c. TROUSERS

Figure 5.5. Examples of mid-nouns BOOK (a), CHAIR (b) and TROUSERS (c) in NGT.

The first phonological distinction we make (top of Figure 5.1) is based on place of articulation, and distinguishes nouns that are body-anchored (body) from those that are not. All nouns that have the feature [body] (shorthand for [body-anchored]) are subsumed under body-nouns. The value [body] does not necessarily imply that the noun is articulated on the body; it applies to all nouns that are articulated in clear relation to a specific body part. Body-nouns that actually contact the body are further specified with the feature [contact]. The body-nouns WOMAN (which does not have the feature [contact]), HUMAN, and FARMER (which both do have the feature [contact]) are illustrated for NGT in Figure 5.2.

Then, there are nouns that are not body-anchored. Following Pfau & Steinbach (2005a), we further distinguish these based on movement type: nouns with complex movement and nouns with simple movement. All complex movement (comp) nouns have an inherent repeated movement, i.e., they are lexically specified for the feature [rep]. Additionally, they may have a circular ([circ]) and/or an alternating ([alt]) movement. The NGT noun BICYCLE, illustrated in Figure 5.3a, for instance, is lexically specified for all three movement features and is thus classified as a comp-noun. Other examples of comp-nouns are CAR (Figure 5.3b), which has repeated alternating movement, and TRAIN (Figure 5.3c), which has repeated circular movement.

Simple movement nouns are not specified for inherent repetition in their base form. Within simple movement nouns, we further distinguish midsagittal (mid) nouns from lateral (lat) nouns, the difference being their place of articulation. The place of articulation of lat-nouns is the lateral side of the signing space, i.e., they have the feature [lat]. The lat-nouns CHILD, PERSON, and THING are illustrated in Figure 5.4. Finally, mid-nouns are articulated not on the lateral side, but rather in relation to the midsagittal plane, and thus have the feature [mid]. The mid-nouns BOOK, CHAIR, and TROUSERS are illustrated in Figure 5.5.

Additionally, since signs may be one- or two-handed, we make a distinction that applies across noun types: for all two-handed nouns, we assume a feature [2H], shorthand for [two-handed]. Thus, the nouns BICYCLE, CAR, TRAIN (Figure 5.3), BOOK, CHAIR, and TROUSERS (Figure 5.5) have a feature [2H] to indicate that they are articulated with both hands simultaneously.[2] The nouns WOMAN, HUMAN, FARMER (Figure 5.2), CHILD, PERSON, and THING (Figure 5.4), conversely, have the feature [1H] (for [one-handed]) since they are articulated only with the dominant hand.

The phonological noun types largely influence the choice of pluralization strategy in NGT. The next section discusses this phonologically triggered allomorphy.

5.2.2 Pluralization strategies in NGT

Several pluralization strategies have been described across sign languages (e.g., Steinbach 2012). One strategy uses the unique possibility of the visual-spatial

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[2] Although this feature applies to all two-handed nouns, we should note that different types of two-handed signs have to be distinguished, but are not all equally represented in our data set. Rather, the vast majority of the two-handed nouns in our data are so-called symmetrical signs, in which both hands move – be it fully symmetrically (e.g., BOOK, Figure 5.5a) or in alternation (e.g., BICYCLE, Figure 5.3a) – and are specified for the same handshape (‘type 1’ signs in Battison 1978; for a more recent account of two-handed signs, and of the constraints on their form first identified by Battison, see Eccarius & Brentari 2007). Yet, in other two-handed signs, only the dominant hand moves while the non-dominant hand serves as place of articulation; in this case, the two hands may have the same handshape (‘type 2’) or be specified for different handshapes (‘type 3’). Our data included one type 2-noun, the mid-noun variant of BOTTLE (N = 2), and two nouns that can be classified as type 3, namely CAFÉ (N = 2) and the mid-noun variant of HOTEL (N = 1). For this reason, we introduce a feature [2H] for all two-handed signs rather than a feature [symmetrical], since the data also include non-symmetrical two-handed signs.

modality to localize (plural) referents in the signing space, i.e., plural nouns can be localized in the signing space according to their real-life spatial arrangements (the meaning being, for instance, 'five cars in a row', see, e.g., Zwitserlood & Nijhof 1999 for NGT; Schlenker & Lamberton 2019 for ASL). Yet, sign languages can also form the 'pure' plural of nouns, that is, the plural form (i.e., 'cars') without conveying information about the spatial distribution of plural entities. In our analysis, we will only be concerned with the latter.

As described in Chapter 2, in a previous study into the nominal pluralization strategies in NGT (van Boven 2021), 297 plural nouns extracted from the Corpus NGT and 189 elicited plural nouns were analyzed for morphological plural marking on the base noun, distinguishing the phonological noun types introduced in the previous section.

The Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008) consists of recordings of 92 deaf NGT signers, both (semi-spontaneous) monologues and dialogues. Part of the data in the corpus has been transcribed by fluent signers. The transcriptions contain glosses for signs as well as translations. Signs that are – according to the transcribers – marked for plurality, contain '.PL' in their gloss (for instance, CHILD.PL for 'children'). Plural nouns were extracted from the Corpus NGT by searching for .PL on the gloss tiers. Moreover, in order to also take into account potentially zero-marked forms, a search for the plural form of frequent nouns in Dutch was conducted on the translation tier as well. In this way, 297 nouns that were deemed to be plural by fluent signers were collected. Only plurals that do not denote spatial configuration were included in the data set.

To complement the corpus data, a novel elicitation technique was developed to elicit plural nouns. Five deaf NGT signers participated. They were presented with sentences in which the plural noun was omitted and replaced by a question mark sign (e.g., a sentence that translates as 'Last October, the QUESTION.MARK were on strike'). Participants were asked to repeat the sentence and fill in the gap based on a picture that shows the targeted plural noun (in this case, an illustration of farmers). Crucially, the spatial configuration of the referents was irrelevant in all sentences. Importantly, these sentences ensure that the nouns are articulated in a plural context. As a double-check, control stimuli elicited the same nouns in singular contexts, in order to distinguish inherent, i.e., lexically specified, repetition from reduplication, where the latter is only used for pluralization of nouns (see Chapter 2). For a more elaborate discussion of this task, we refer to van Boven (2020). Further, an English translation of the complete elicitation task, including instructions given to participants, is openly available (van Boven 2023a).

The analysis of the corpus data and the elicited data yielded similar results; the pluralization strategies found for each of the four main noun types are summarized in Table 5.1 (adapted from Table 2.4 in Chapter 2). The subdivision of body-nouns by [contact] and of comp-nouns by [alt] and [circ] turned out to be irrelevant in this data set; see the detailed table in Appendix 5-A. All data annotations for both the corpus and the elicited data are openly available (van Boven 2023a).

Table 5.1. Pluralization strategies per phonological noun type in NGT; shaded cells indicate frequent strategies (adapted from Table 2.4 in Chapter 2; red. = reduplication; sim. = simultaneous).

Noun type	**N**	**Zero marking**	**Simple red.**	**Sideward red.**	**Sim. articulation**	**Sim. sideward red.**
body	185	40.2%	55.7%	3.2%	1.1%[a]	0%
comp	40	57.5%	37.5%	5%	0%	0%
lat	224	15.6%	1.8%	67.9%	1.8%	12.9%
mid[b]	37	43.2%	29.7%	21.6%	0%	0%

[a] This 1.1% comprises two instances of simultaneous articulation: both concern the body-noun PROBLEM, articulated by one signer in the corpus, within only three seconds. In both cases, PROBLEM is followed by the two-handed noun CRISIS (once directly, and once separated by a pointing sign and a two-handed palms-up sign). Since CRISIS has the same handshape as PROBLEM, this simultaneous articulation may well be the result of assimilation to the following two-handed sign.
[b] The attentive reader will have noticed that the percentages for the mid-nouns in the last row do not add up to 100%. The reason for this is that two mid-noun tokens in our data set undergo strategies that occurred only once: One signer articulates BOOK (5a) without repetition, but with the hands moving further apart from one another than in its base form, indicating plurality, and another signer articulates CHAIR (Figure 5.5b) at different locations in space, but with one, fluent movement – not with repetitive movements. We ignore these exceptional strategies, and they were therefore not included in the table.

Table 5.1 makes clear that no categorical patterns can be extracted from the data – in fact, while there is a correlation between noun type and pluralization strategy, the data also show variation (both within and across signers, and in both data sets). Note that this table does *not* suggest that nouns with similar phonological features have different plural forms, as is for instance the case in spoken German (see the analysis by Trommer 2021); our data do not provide evidence for this type of variation. Rather, in NGT, the same singular form has multiple options for forming its plural: for instance, all mid-nouns such as BOOK, CHAIR or TROUSERS (Figure 5.5) can be pluralized by means of simple or sideward reduplication, or can be left zero-marked.

We first discuss the frequent patterns, i.e., the shaded cells in Table 5.1 (see also Chapter 2 and van Boven 2021). The shaded cells in Table 5.1 indicate four frequently occurring pluralization strategies in NGT: (i) zero marking, (ii) simple reduplication, (iii) sideward reduplication, and (iv) simultaneous sideward reduplication. We assume that these strategies are indeed employed to realize pluralization, given the nature of the data: they occur in contexts that are deemed to be plural by fluent signers (for the corpus data) or are used to distinguish plural nouns from singular nouns (in the elicited data). As for zero marking, additional evidence comes from the fact that zero-marked nouns co-occur with other elements that are overtly marked for plurality, as in (1a) and (1b), which were also presented in Chapter 2 (and in van Boven 2021: 345). In (1a), the zero-marked noun TROUSERS is followed by the verb TRY.ON, which is marked for plurality by means of reduplication. In (1b), the zero-marked noun SHOP is followed by a sideward reduplication of INSIDE, to indicate that the signer went into multiple shops. Similarly, zero-marked nouns sometimes co-occur with indexical signs with an arc-shaped movement, which refer to plural entities as in (1c). Still, often only the context makes clear that the noun should be interpreted as plural rather than singular, as in (1d), and in (1e), which was also presented in Chapter 2 (and in van Boven 2021: 340). Zero marking occurs with all noun types – that is, reduplication is not obligatory for any of the noun types.

(1) a. INDEX$_1$ MANY **TROUSERS** TRY.ON+++.
‘I tried on many [pairs of] trousers.’ [p02]

b. **SHOP** INSIDE>+>+>+.
‘In shops.’

c. **GIRL** INDEX$_{arc}$ […].
‘Girls […].’ [p06]

d. AMSTERDAM NICE **SHOP** PRESENT.
‘There are nice shops in Amsterdam.’ [p04]

e. […] INDEX$_{3a}$ SELF PSYCHOLOGY **PROBLEM** […].
‘[The child] could develop psychological problems […].’
[CNGT0132; S008; 03:06.040]

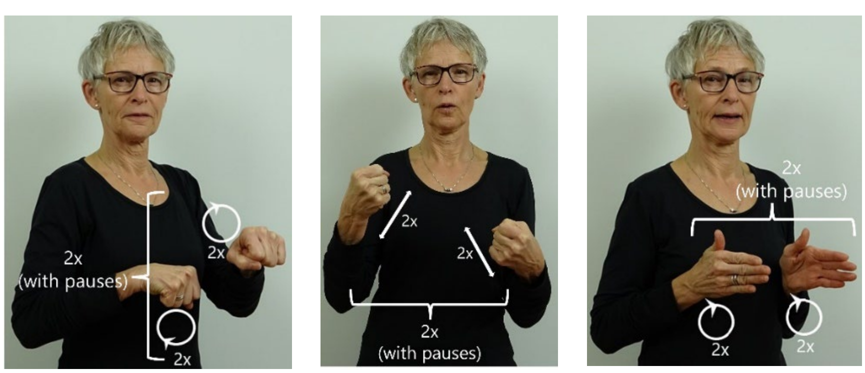
Yet when there is plural marking, the choice between the different reduplication types largely depends on the phonological properties of the base nouns, i.e., on the noun types we introduced above.

Both body-nouns (see Figure 5.2) and comp-nouns (see Figure 5.3) usually undergo simple reduplication, whereby the noun is repeated at one location. Simple reduplication of the body-nouns WOMAN, HUMAN, and FARMER is illustrated in Figures 5.6a–c, and simple reduplication of the comp-nouns BICYCLE, CAR, and TRAIN is illustrated in Figures 5.7a–c. For the sake of clarity and for privacy reasons, nouns that were either extracted from the corpus or elicited have been reproduced.

We gloss simple reduplication by adding pluses to the gloss of the sign; the number of pluses indicates the number of repetitions – thus, if a sign is repeated twice, this means that there are three movement cycles (e.g., WOMAN in Figure 5.6a has a movement in its base, and a movement in each of the reduplicants). This is noted by a gloss of the base noun and two pluses; in other words, the number of pluses reflects the number of reduplicants – see also *Notation conventions for glossed sign language examples*.

a. WOMAN++ b. HUMAN++ c. FARMER++

Figure 5.6. Simple reduplication of body-nouns WOMAN (a), HUMAN (b) and FARMER (c) (all signs reproduced).

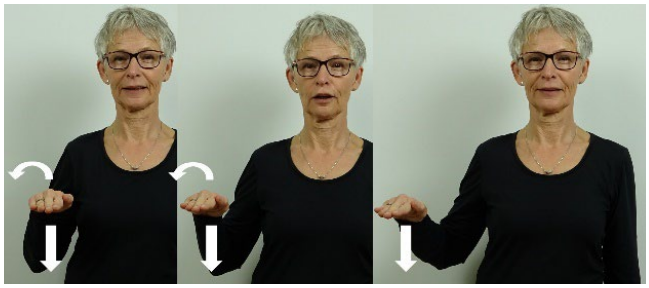


a. BICYCLE+ b. CAR+ c. TRAIN+

Figure 5.7. Simple reduplication of comp-nouns BICYCLE (a), CAR (b) and TRAIN (c) in NGT (all signs reproduced).

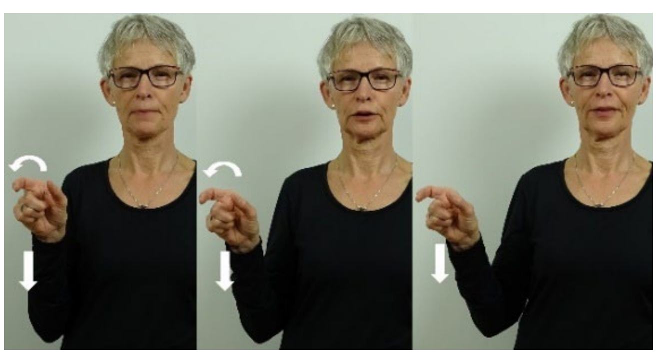
Unlike body- and comp-nouns, lat-nouns (e.g., CHILD, PERSON, and THING in Figure 5.4) normally undergo sideward reduplication, illustrated in Figure 5.8, whereby the noun is repeated while moving the hand sideward. For this noun type, sideward reduplication sometimes combines with simultaneous articulation, illustrated in Figure 5.9, where a one-handed base-noun is articulated with two hands. Note that under simultaneous sideward reduplication, the two hands move in opposite directions.[3] Sideward reduplication is glossed by adding >+ to the noun gloss; again, the number of pluses (and arrows) reflects the number of repetitions/reduplicants (e.g., adding two repetitions to CHILD results in three movement cycles, as shown in Figure 5.8a – this is reflected by two arrows and pluses; one for each repetition/reduplicant). Simultaneous articulation is glossed by the subscript 'sim' – cf. the *Notation conventions for glossed sign language examples*.

[3] Note that under simultaneous sideward reduplication of lat-noun PERSON, the hands move alternately rather than in parallel, as shown in Figure 5.9c – we come back to this in our discussion, Section 5.4.3.



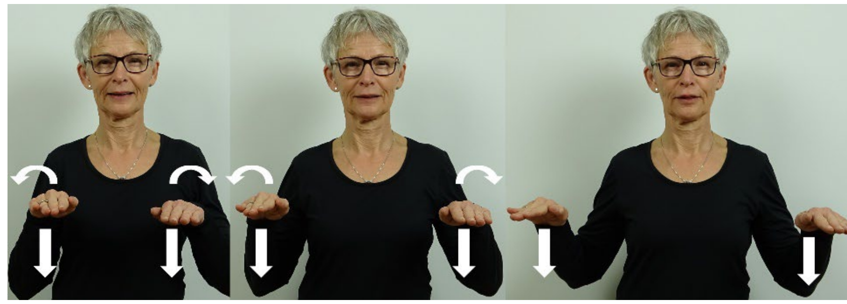
a. CHILD>+>+

b. THING>+>+



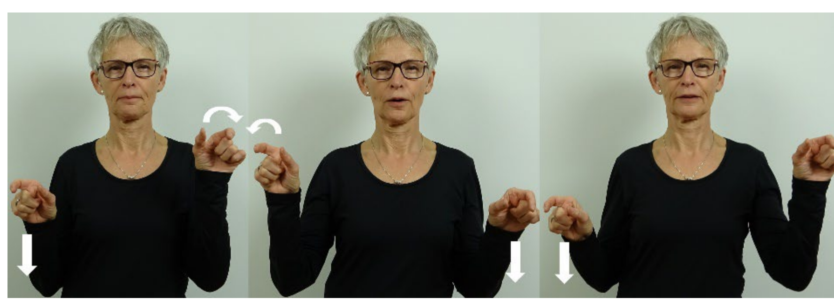
c. PERSON>+>+

Figure 5.8. Sideward reduplication of lat-nouns CHILD (a), THING (b) and PERSON (c) in NGT (all signs reproduced).



a. CHILD$_{\text{sim}}$>+>+

b. THING$_{\text{sim}}$>+>+



c. PERSON$_{\text{sim}}$>+>+

Figure 5.9. Simultaneous sideward reduplication of lat-nouns CHILD (a), THING (b) and PERSON (c) in NGT (all signs reproduced).

Note that, for obvious reasons, simultaneous articulation can only occur when the base noun is one-handed. Our data set did not contain any one-handed mid- or comp-nouns, and thus it would have been impossible for this strategy to co-occur with these noun types.[4]

[4] While one-handed comp-nouns exist in NGT (e.g., SIREN), but were simply not included in our data set, we suspect that there are no one-handed mid-nouns in NGT. One-handed nouns

A reviewer speculates that the sideward movement observed in the reduplication of lat-nouns might not be motivated by phonological constraints alone. Phonological features of signs sometimes have a semantic motivation (Stokoe 1991; van der Kooij 2002; Sandler 2018), that is, the sublexical building blocks may reflect semantic properties of the referent in iconic signs (e.g., in BICYCLE in Figure 5.3a, the handshape and movement reflect the pedals of a bike). If the lat-noun CHILD was reduplicated without sideward movement, the resulting form could potentially be misinterpreted as a repeated action (i.e., an iconic representation of bouncing a ball). This is an interesting suggestion, and it motivated us to check for all lat-nouns in our data set whether simple reduplication could potentially give rise to such a misinterpretation. Yet, while this might hold for some of our lat-nouns (e.g., LAMP in Figure 5.10, where simple reduplication could be interpreted as 'flashing light'), for others (such as PERSON (Figure 5.4b), WEEK, THING (Figure 5.4c) and BOTTLE), it seems highly unlikely that repeating the sign in one location could lead to a misinterpretation as a repeated action.

LAMP

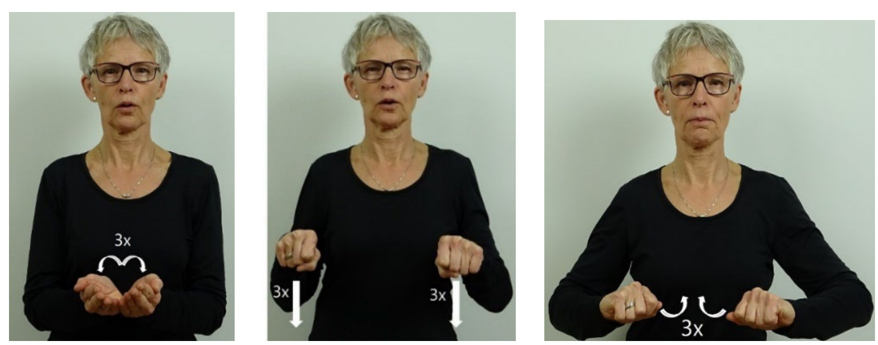
Figure 5.10. Lat-noun LAMP in NGT (Klomp 2021: 156; © Ulrika Klomp, reprinted with permission).

Another argument against a semantic explanation for sideward reduplication is that this misinterpretation could also happen with noun types that do undergo simple reduplication in NGT, such as comp-nouns. Consider the comp-noun BICYCLE, where simple reduplication (Figure 5.7a) could also be taken to mean 'to bike again and again', given the fact that the NGT verb BIKE has the same form as the noun (in fact, reduplication also functions as an aspect marker in NGT, cf.

articulated on the midsagittal plane are also body-anchored (e.g., APPLE), and are therefore specified as body-nouns in our classification.

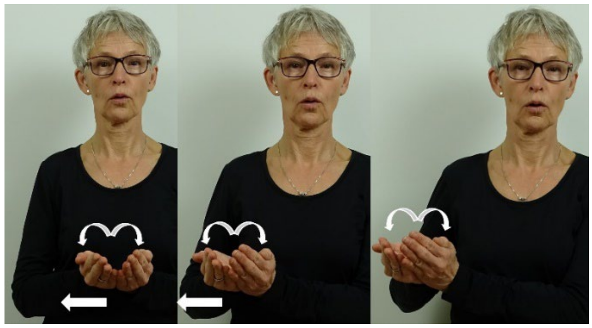
Hoiting & Slobin 2001; Oomen 2016; van Boven & Oomen 2021; Chapter 3). Still, no sideward movement is added to avoid the potential confusion. A similar situation may arise in spoken languages, when the plural form of a noun happens to be homophonous to a verbal meaning. In German, for instance, such homophonous nominal and verbal meanings may not even be related to each other: e.g., [bakŋ̍] ‘cheeks’ or ‘to bake’, [bʁa͡ʊən] ‘eye brows’ or ‘to brew’, [ʋɛkŋ̍] ‘bread rolls’ (regional variant) or ‘to wake up’. Given these facts, we conclude that the sideward movement in NGT nouns is indeed added for phonological rather than semantic reasons.

Finally, Table 5.1 shows that mid-nouns (e.g., BOOK, CHAIR, and TROUSERS in Figure 5.5) sometimes undergo simple reduplication, illustrated in Figure 5.11, and sometimes sideward reduplication (with comparable percentages, see Table 5.1), as illustrated in Figure 5.12.

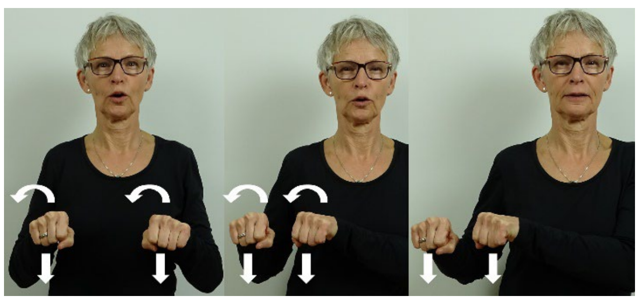


a. BOOK++ b. CHAIR++ c. TROUSERS++

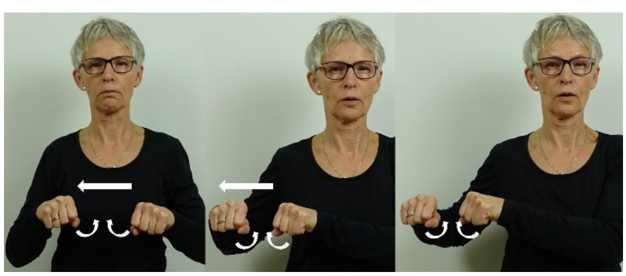
Figure 5.11. Simple reduplication of mid-nouns BOOK (a), CHAIR (b) and TROUSERS (c) in NGT (all signs reproduced).



a. BOOK>+>+



b. CHAIR>+>+

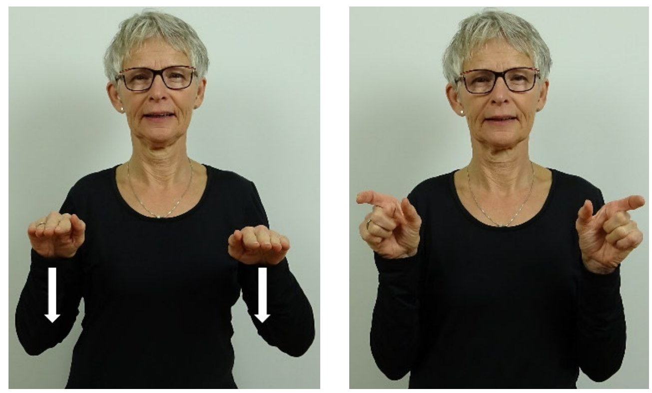


c. TROUSERS>+>+

Figure 5.12. Sideward reduplication of mid-nouns BOOK (a), CHAIR (b) and TROUSERS (c) in NGT (all signs reproduced).

Up until now, we have ignored the instances of simple and sideward reduplication and of simultaneous articulation that occurred in 5% or less of the cases for a specific noun type. These instances show that there is quite some variation in the data set, and that the patterns that we describe above are not completely categorical. For instance, while comp-nouns for the largest part undergo simple reduplication or are zero-marked, a small percentage actually undergoes sideward reduplication. Also, all noun types alternate between reduplication and zero marking: compare, for instance, zero-marked TROUSERS in (1a) to simple

(Figure 5.11c) and sideward (Figure 5.12c) reduplication of the same noun. Finally, we have not yet addressed the strategy of simultaneous articulation, which only occurs with a very small percentage of lat-nouns and possibly body-nouns (see Table 5.1). Simultaneous articulation involves articulating a one-handed noun with two hands, without additional repetition, as shown in Figure 5.13 for lat-nouns CHILD and THING. We do consider this a special type of reduplication.



a. CHILD$_{\text{sim}}$ b. THING$_{\text{sim}}$

Figure 5.13. Simultaneous articulation of lat-nouns CHILD (a) and THING (b) in NGT (both signs reproduced).

Phonologically triggered allomorphy in plural marking has previously been described for other sign languages as well, although the exact restrictions differ per language. Pfau & Steinbach (2005a) observe that DGS lat-nouns undergo sideward reduplication, while DGS mid-nouns undergo simple reduplication – other strategies are claimed to be ungrammatical for these noun types. Comp-nouns and body-nouns cannot undergo reduplication in DGS, but are always zero-marked. An additional strategy has been described for other sign languages, namely simultaneous reduplication, whereby a one-handed noun is not only repeated, but also articulated with two hands. While this strategy has not been described for DGS, it has previously been noted by Wilbur (1987) for American Sign Language (ASL) and by Skant et al. (2002) for Austrian Sign Language (in both sign languages, simultaneous reduplication involves an alternating movement – see also footnote 3 and Section 5.4.3). Simultaneous reduplication has also been described for NGT by Harder et al. (2003), who found that one-handed base signs were sometimes articulated with two hands. As discussed, our data only presented us with simultaneous sideward reduplication (i.e., repetition combined with sideward movement, see Figure 5.9) and simultaneous articulation (i.e., two-handed articulation without repetition or sideward movement, see Figure 5.13) – but the latter only extremely infrequently.

5.2.3 Modality-specific patterns

Besides offering a description and a formal account of the NGT pluralization patterns, another goal of the present study is to evaluate the modality-independence of the OT-formalization of the attested patterns. In this section, we briefly address modality-independent and modality-specific characteristics of pluralization, while our formalization, in particular the universality of the constraints we use, will be evaluated in Section 5.4.1.

An aspect that is clearly modality-independent is the use of reduplication as a pluralization strategy. This is not surprising, as the copying of phonological material provides the language user with iconic means to signal a multitude of entities of the same type. The change of a phonological feature, as observed in sideward reduplication, can be likened to cases of non-faithful reduplication, i.e., base-reduplicant non-identity, which are common across spoken languages. Besides that, phonologically triggered plural allomorphy is also attested in spoken languages, English plurals being an example. Finally, variation of the type observed in the NGT data (i.e., different reduplication strategies and zero marking applying to one and the same noun) may be uncommon in spoken languages, but it is attested, as we will show in Section 5.3.3.

Turning now to aspects that are modality-specific, it first has to be acknowledged that the phonological features that are responsible for allomorphy – that is, location features like [lat] or [mid] and movement features like [alt] and [circ] – are specific to the visual-spatial modality. This may seem trivial: of course, spoken languages do not employ features like [alt], while features like [voiced] cannot play any role in sign languages. Yet, this obvious fact will have repercussions on the constraints we employ in the next section. Further modality-specific characteristics emerge when we zoom in on the reduplication strategies. Simple reduplication is modality-independent. Sideward reduplication, on the other hand, combines modality-independent and -specific features: as mentioned before, non-identity between base and reduplicant is also observed in spoken languages; what makes sideward reduplication special is that this non-identity involves movement in space and, consequently, a change in location (rather than, e.g., a change in vowel height). The strategies that are most clearly modality-specific are those that involve the simultaneous addition of a second articulator, the non-dominant hand (see Figures 5.9 and 5.13). Given the constraints imposed by the vocal apparatus, no comparable strategy is available in spoken languages.

5.3 OT-analysis of nominal reduplication in NGT

This section presents our OT-formalization of the nominal pluralization strategies observed in NGT. No previous OT-formalization of NGT plural reduplication exists, but there is one for another sign language, namely DGS, which was proposed by Pfau & Steinbach (2005a). However, the constraints used in their formalization largely involve modality-specific concepts, and little parallels are drawn to spoken language formalizations. For instance, they propose a constraint *MOVE, which is clearly modality-specific, and they do not include base-reduplicant faithfulness – a concept which has proven useful for spoken languages. Moreover, Pfau & Steinbach (2005a) do not formalize any variation. We will get back to this in more detail in Section 5.4.1.

In our formalization, however, we aim to include constraints that are as modality-independent as possible, given the premise that OT-constraints are universal. As such, we employ constraint types that have previously been proposed for spoken language reduplication. This is visible in several aspects of our analysis, as it (i) distinguishes between IO-FAITH and BR-FAITH constraints; (ii) employs an ALIGNMENT constraint that punishes the non-simultaneous realization of a plural morpheme and the noun stem; and (iii) relies on a systematic implementation of the relevant phonological features of the base noun. We also employ stochastic OT to account for the variation observed in our data, as was also done for spoken languages, but never for a sign language.

In Section 5.3.1, we define a morphological constraint that requires plural realization in the form of reduplication of the noun sign, a constraint that requires the reduplicant plural morpheme to be a syllable, and a general ALIGNMENT constraint. Section 5.3.2 then illustrates how the attested reduplication strategies emerge. Finally, Section 5.3.3 provides the ranking values that can account for the optionality and variation we observed in our data.

5.3.1 Implementing the plural morpheme

We observed multiple ways for realizing the plural in NGT: three frequent types of reduplication, one marginal one, and zero marking. The three frequent reduplication types were (i) simple reduplication by repetition of the base noun, (ii) sideward reduplication, imposing a sideward movement on the reduplicated form, and (iii) simultaneous sideward reduplication with an additional articulation of the second hand for one-handed signs. The marginal one was reduplication by additional articulation of the second hand, which we call simultaneous articulation. We therefore assume that reduplication of the noun is the default strategy for implementing the plural in NGT, while the type of reduplication (simple, sideward, simultaneous sideward, or simultaneous articulation) results from noun-specific phonological features and a requirement on the form of the reduplicant.

Since reduplication is the phonological realization of pluralization, and in order to evaluate the input-output faithfulness of the reduplicant, we employ a MAX constraint as formulated in (2):

(2) MAX-RED$_{PL}$: Assign a violation mark if the reduplicant plural morpheme has no correspondent in the output.

The phonological make-up of signs allows for multiple morphological modifications to apply at the same time – for instance, changing the begin- and endpoints of the sign in verbal agreement, or adapting the handshape in classifier constructions (Pfau & Glück 2000; Aronoff, Meir & Sandler 2005; Meir 2012). In other words, as we mentioned already in Section 5.1, sign languages often apply morphological modifications simultaneously, i.e., in stem-internal position (e.g., Aronoff, Meir, Padden & Sandler 2005; Aronoff, Meir & Sandler 2005; Sandler & Lillo-Martin 2006; Pfau 2016). In NGT pluralization, this is also the case in the simultaneous articulation that we observed, where all features of a one-handed base are copied onto the second, non-dominant hand, and as a result the one-handed sign is articulated as a symmetric two-handed sign. Yet, in our data, this reduplication strategy only occurred marginally: we had four instances of lat-nouns that underwent simultaneous articulation.[5] Our data did not include any one-handed mid- or comp-nouns that would allow for simultaneous articulation. A previous study on NGT (Harder et al. 2003) found that simultaneous articulation is used in pluralization, in particular when the meaning to be expressed is ‘two’.[6] We conclude that, although simultaneous articulation is a marginally occurring strategy of plural reduplication in NGT, it nevertheless needs to be accounted for.

Spoken languages also allow for the simultaneous realization of morphemes, for instance with morphological tones or by means of vowel fronting (umlaut), though this type of morphological modification is far less common than in sign languages. In fact, it is articulatorily impossible for a reduplicant to be articulated completely simultaneously with its stem in a spoken language. Still,

[5] In addition, Table 5.1 also indicates that two body-nouns underwent simultaneous articulation, but as explained in footnote a with this table, these were likely instances of assimilation rather than pluralization.

[6] This dual interpretation of simultaneous articulation was also found for British Sign Language (Sutton-Spence & Woll 1999). Of the four instances of lat-nouns that underwent simultaneous articulation in our data, only one had the meaning ‘two’.

some cases come close. For instance, Riggle (2006) analyzes reduplication in Pima (which marks the plural on nouns, adjectives, adverbs, verbs, and some determiners) as infixation: the reduplicant follows the first vowel of the stem (e.g., /hó.ḍai/ 'rock' – /hó.**ho**.ḍai/ 'rocks', p. 858). This infixation is formalized with an ALIGNMENT constraint (in combination with an ANCHOR constraint), which requires the left edge of the reduplicant to occur as close as possible to the left edge of the word (Riggle 2006: 872). Wiese (2009) introduces a similar constraint for schwa insertion in nominal pluralization in German – although this does not involve reduplication. For schwa insertion in a stem, Wiese (2009: 151) proposes a right-alignment constraint: the right edge of a stem is aligned with the right edge of its phonological word, from which it follows that German /zeː.gəl/ 'sail' is preferred above */zeː.glə/ in both its singular and plural form.

Since in sign languages it is actually possible to align base and reduplicant, they generally seem to be more apt to satisfy these so-called ALIGNMENT constraints that have been introduced for spoken languages (see McCarthy & Prince 1993a).[7] An ALIGNMENT constraint relevant for our present analysis is given in (3), requiring the plural morpheme to align with the left edge of the stem.

(3) ALIGN (STEM, L, PLURAL, L), short PLURAL-L:
Assign a violation mark for every instance of the reduplicant plural morpheme that is not aligned with the left edge of a stem.

This constraint is not violated if the plural is not implemented. PLURAL-L is also not violated if the reduplicant plural morpheme is realized by simultaneous articulation. It is violated, however, when reduplicants are added to the stem in a sequential order.

What the non-simultaneously articulated reduplication types all have in common is that the reduplicant introduces a separate syllable. Let us briefly

[7] McCarthy & Prince (1993a: 2) define ALIGNMENT constraints as referring to prosodic and/or grammatical (morphological or syntactic) categories. As their examples on p. 3 show, these constraints can be used in multiple ways: (i) to map morphological categories onto prosodic ones, hence as constraints on the morphology-phonology interface, (ii) to align two types of prosodic categories such as, e.g., the foot and the prosodic word in stress assignment, hence as purely phonological constraints, and (iii) to map morphological categories onto each other, e.g., stem and affixes, hence as morphological constraints. In the present article, we employ possibility (i). With this, we use constraints of the morphology-phonology interface, such as this ALIGNMENT constraint, together with purely phonological constraints, such as Input-Output-IDENT constraints that compare phonological underlying to phonological surface forms, in one mapping. A stricter analysis would involve two separate mappings for this, see, e.g., Boersma & van Leussen (2017) for an example.

elaborate on the notion of syllable. In sign language phonology, it is commonly assumed that syllables consist of locations and movements – be they a hand-internal movement (e.g., handshape change) and/or a path movement – and that the movement component constitutes the syllable nucleus (e.g., Perlmutter 1992; Sandler 2008; Jantunen & Takkinen 2010). Crucially, only sequential movements create syllables; that is, a sign like BOOK (Figure 5.5a), in which both hands simultaneously perform a movement, is monosyllabic. A tendency that has been observed across sign languages is the so-called "monosyllable conspiracy" (Sandler 1999; 2008): words in sign languages tend to be monosyllabic, in spite of their morphological structure. For instance, in ASL, some compounds of two signs are reduced to only one movement, i.e., one syllable (Sandler 1999, 2008; Sandler & Lillo-Martin 2006). Reduplication is striking in this respect, since it actually adds movements, and thus syllables. Still, reduplication in ASL is taken as evidence for the sign language syllable, since under aspectual inflection, only one syllable is reduplicated. For instance, in ASL, BLOW.TOP 'to explode with anger' is a compound that still has two syllables, and when it is inflected for habitual aspect, only the final syllable is reduplicated. For monosyllabic verbs, there is complete reduplication in ASL (Sandler 1989, 2008). Similarly, in NGT, when the nouns under investigation are reduplicated, the reduplicant always contains one movement; thus, in sequential reduplication, a syllable is added with each reduplicant.[8] In contrast, pluralization by means of a simultaneous two-handed articulation of an underlyingly one-handed sign (e.g., CHILD; see Figure 5.13) does not involve the addition of a separate syllable.

In several spoken languages, too, the syllable is the unit that is reduplicated. For example, Gouskova (2007) shows for Tonkowa that there is a templatic requirement on the reduplicative prefix: it is limited to a single light syllable (CV-structure), something that is otherwise marked in the language. The reason that only the light syllable is copied, is because of the templatic cover constraint RED=σ_{μ} "The reduplicative morpheme is a light syllable" (Gouskova 2007: 375).

We postulate that the plural reduplicant in NGT, too, ideally is a separate syllable, expressed with the fairly high-ranked, size-defining constraint in (4) (see also McCarthy & Prince 1993b; Downing 2006: 13; Downing & Inkelas 2015: 518).

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[8] Although not annotated systematically, in some cases of sideward reduplication, the individual movement of each reduplicant was difficult to discern. For instance, for the lat-noun CHILD, we noted that in fast signing, some signers reduced the movement repetition considerably, sometimes to the extent that the downward movement of the base was followed by a single sideward movement. We analyzed this as a case of phonetic reduction and not as a separate pluralization strategy, and still assumed that each reduplicant has its own movement in the phonological surface form.

(4) RED$_{PL}$ = σ: Assign a violation mark if a correspondent of the reduplicant plural morpheme is present in the output but is not a syllable.

The workings of these three constraints and the notations used in the present formalization are illustrated in Tableau 5.1. Input to this and all following tableaux are the noun and the reduplicant plural morpheme RED$_{PL}$, where the latter does not have any underlying features but requires a copy of the features of the noun-stem in the output. Rather than providing the complete phonological feature bundle for the input noun stems, we specify only the following information: (i) their place of articulation with one of the privative features [lat, mid, body] to distinguish lat-, mid-, and body-nouns, (ii) a feature [rep] in the case of comp-nouns, and (iii) whether a sign is one-handed [1H] or two-handed [2H]. Features of type (i) and (ii) are sufficient to distinguish between the noun types we introduced in Section 5.2.1; the third type, one- or two-handedness, will be shown to also be of relevance in accounting for their choice of pluralization allomorphs. Output candidates contain again only realizations of these relevant features, both in the base and in the possible reduplicant.

HUMAN $\begin{bmatrix} \text{1H} \\ \text{body} \end{bmatrix}$ + RED$_{PL}$	MAX-RED$_{PL}$	RED$_{PL}$ = σ	PLURAL-L	IDENT-BR-PLACE	IDENT-IO-[1H]
a) $\begin{bmatrix} \text{1H} \\ \text{body} \end{bmatrix}$	*!				
☞ b) $\begin{bmatrix} \text{1H} \\ \text{body} \end{bmatrix}$ $\begin{bmatrix} \text{1H} \\ \text{body} \end{bmatrix}$			*		
c) $\begin{bmatrix} \text{1H} \\ \text{body} \end{bmatrix}$ $\begin{bmatrix} \text{1H} \\ \text{lat} \end{bmatrix}$			*	*!	
d) $\begin{bmatrix} \text{2H} \\ \text{body} \end{bmatrix}$		*!			*

Tableau 5.1. OT-formalization of pluralization in NGT, with one-handed body-noun HUMAN.

Tableau 5.1 has as input the one-handed body-noun HUMAN. Candidate a) corresponds to the strategy of zero marking (as it only has one feature bundle, corresponding to the base), and thus violates the constraint MAX-RED$_{PL}$ introduced in (2). Candidate b) has a faithful reduplicant of the stem (the second feature bundle, with the same features as provided in the input), and corresponds to the strategy of simple reduplication. Candidate c) involves an unfaithful reduplicant with a change in location from [body] to [lat]: the feature [lat] requires that the reduplicant is articulated at a location lateral to the place of articulation of the base, as explained in the following section. This candidate therefore represents the strategy of sideward reduplication. Both candidates b) and c) have a correspondence to the underlying RED$_{PL}$: the reduplicant occurs as separate syllable sequentially,[9] and therefore both candidates satisfy RED$_{PL}$ = σ but violate PLURAL-L. The zero-marked candidate a), on the other hand, does not involve sequential morphological processes and consequently violates neither PLURAL-L nor RED$_{PL}$ = σ, though it violates MAX-RED$_{PL}$.

Candidate c) is an output form where the base is articulated on the body, while the reduplicant has a lateral location feature (i.e., sideward reduplication of a body-anchored noun). In other words, there is a difference in location features between base and reduplicant. Correspondence between base and reduplicant has proven useful in many OT-accounts of spoken languages, comparing the phonological form of the reduplicant, which may be a complete or a partial copy of the base, to the form of the base (Base-reduplicant correspondence theory; McCarthy & Prince 1993b et seq.). When base and reduplicant are non-identical, i.e., in so-called complex reduplication, in spoken languages the vowels or consonants can be changed or added, or the phoneme order can be reversed (Rubino 2005). The similarity between the base form and its reduplicant is evaluated in OT with so-called Base-Reduplicant Faithfulness Constraints (McCarthy & Prince 1999; henceforth: BR-FAITH). BR-FAITH is relevant for our NGT data, too, since in sideward reduplication of certain nouns (as in candidate c) in Tableau 5.1), there are different location features in the base and the reduplicant. We thus introduce the base-reduplicant faithfulness constraint IDENT-BR-PLACE defined in (5).[10]

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[9] We assume that the base sign precedes the reduplicant, and that signers therefore do not recognize the plural form at the start of the base sign, before the reduplicant is articulated.

[10] Independent evidence for the importance of the location feature [body-anchored] comes from the domain of verbal agreement. Agreement marking in NGT (just as in other sign languages) involves the spatial modification of verbs, such that their begin/end points align with the loci associated with subject/object referents. However, body-anchored verbs cannot be modified spatially to mark agreement, as this would imply changing a lexically specified location feature (Zwitserlood & van Gijn 2006). Moreover, since body-anchoredness often has an iconic motivation (e.g., Meir et al. 2007; Oomen 2017), one might consider to also invoke constraints related to iconicity (see, e.g., Eccarius 2011 for iconic handshapes). However, since not all body-anchored nouns in NGT have a clear iconic motivation, such

(5) IDENT-BR-PLACE: Assign a violation for an incongruency in place of articulation between base and reduplicant.

Candidate d) is a form in which the features of the underlyingly one-handed sign are copied onto the non-dominant hand, and thus represents the reduplication strategy of simultaneous articulation. This candidate violates the constraint $\text{RED}_{\text{PL}} = \sigma$, because the reduplicant does not consist of a syllable. Also, while the input form is a one-handed sign [1H], the output candidate d) is a two-handed sign [2H]. Here, we observe a difference between input and output. Input-Output Faithfulness (IO-FAITH(FULNESS)) constraints are, of course, a crucial component of any OT formalization. Output candidate d) in Tableau 5.1 violates IDENT-IO-[1H] as defined in (6), due to its change in handedness:

(6) IDENT-IO-[1H]: Assign a violation for change in one-handedness between input and output.

In Tableau 5.1, $\text{MAX-RED}_{\text{PL}}$ and $\text{RED}_{\text{PL}} = \sigma$ are highest ranked, though their actual ranking and that of all other constraints to account for all the variation that we found in our data will be determined in Section 5.3.3.

5.3.2 The choice of reduplication strategy

As has been shown in Section 5.2.2, body-, comp-, and mid-nouns can all be pluralized by means of simple reduplication, while this pluralization strategy is not observed with lat-nouns. Instead, lat-nouns employ sideward reduplication, sideward reduplication with a simultaneous articulation of the second hand, and very seldomly also simultaneous articulation on its own. We propose that this unusual behavior is due to (i) a general markedness constraint which refers to the non-salience of one-handed lateral signs and (ii) the interpretation of the feature [lat] under reduplication.

With respect to (i), in OT accounts of spoken language reduplication, there is usually an interaction between BR-FAITH, IO-FAITH and more general markedness constraints. For instance, Alderete et al. (1999: 329) "assume that markedness constraints do not make morphological distinctions, so there is no such thing as a

constraints would not generalize over all body-anchored nouns. Therefore, we use the more general constraint IDENT-BR-PLACE instead.

reduplicant-specific markedness constraint".[11] For NGT reduplication, too, it appears that a general markedness constraint comes into play. This constraint is grounded in perceptual salience. Indeed, perceptual salience has previously been taken into account in formalizations of spoken language reduplication. Wedel (1999) proposed constraints on emphatic reduplication in Turkish, where a CVC syllable is prefixed, of which the initial CV are identical to the initial CV of the stem, and the final C is taken from a restricted set of consonants. For the selection of the final C, he notes that high perceptual salience of the reduplicative morpheme is maintained: when bases that start with {b, m} undergo emphatic reduplication, "the otherwise primary affixal [p] may give way to the suppletive alternates {m, s} in order to maintain high perceptual salience of the reduplicative morpheme." This is captured in a markedness constraint that he names *SHAREDPLACE (Wedel 1999: 4). Similarly, in Amharic, reduplicative infixes that mark the plural on adjectives and the iterative on verbs target heavy syllables (Sande 2014). In this language, heavy syllables receive stress without exception; the reduplicative infixes thus target stressed positions, and if there is no heavy syllable in a word, i.e., when the infix may not be stressed, an alternative marking is used. As Sande (2014: 206) puts it: "It seems that in Amharic the pressure for an infix to be salient, in a prominent position, outweighs the pressure for that target landing site to be present in every word." This is captured in the constraint ALIGN-L(PLURAL, $\sigma_{\mu\mu}$), which requires the plural morpheme to align with the left edge of a heavy syllable (Sande 2014: 200).

While we obviously cannot postulate a constraint based on auditory salience, we will postulate one based on visual salience. During signed communication, addressees do not usually focus their eye gaze on the signer's hands, but rather on the face, where relevant grammatical information is encoded (Siple 1978; Neville & Lawson 1987). Indeed, while Neville & Lawson (1987) find that deaf participants show superior performance in processing peripheral visual stimuli as compared to hearing subjects, their results also indicate that deaf subjects were faster and more accurate in detecting direction of motion of central targets than for peripheral targets (Neville & Lawson 1987: 274). The observation that signers focus on each other's face during communication is also supported by historical tendencies in ASL. A diachronic study by Frishberg (1975: 703) shows that over time, the location of signs articulated below the neck (i) becomes more centralized, and (ii) moves up toward the hollow of the throat (for instance, ASL signs LIKE, FEEL, PLEASE, and LOVE moved from a location over the heart to the center of the chest). These diachronic tendencies suggest that signs articulated in the visual

[11] We also see this in *the emergence of the unmarked* (TETU), where a markedness constraint that is normally outranked by an IO-FAITH constraint becomes important in the reduplicant, as it outranks BR-FAITH (McCarthy & Prince 1994).

periphery are dispreferred, most likely because they are less visually salient to the observer. Signs articulated on the lateral side of the signing space in particular are in the periphery of the addressee's visual field. This observation and the fact that such signs are more salient if produced with both hands is captured in the markedness constraint in (7).[12]

(7) *[lat, 1H]: Assign a violation mark to any output realized with [lat] and [1H].

Although, according to a deaf signer, one-handed lat-nouns are less common than mid-nouns, they do exist in NGT. The constraint in (7) thus cannot be very high-ranked in this language, but it does seem to play a role in pluralization.

While this markedness constraint can account for the involvement of a second hand in the reduplication of lat-nouns, the observed sideward movement is still not accounted for. For this, we propose that the feature [lat] indicates a place of articulation that is relative: relative to the midsagittal plane in the default case, and relative to the base for a reduplicant. As a result, a reduplicant containing the feature [lat] automatically involves a further sideward movement with respect to the lateral base. For [lat] base nouns, a candidate with simple reduplication is thus automatically excluded by its inherent features, as copying the [lat] feature implies sideward movement. Tableau 5.2 illustrates the choice of candidates for the lat-noun CHILD:

[12] Note that Pfau & Steinbach (2005a) also invoke the notion of salience in their account of the pluralization of lat-nouns in DGS. They argue, however, that it is the sideward movement of the reduplicants that enhances the salience of the sign. That is, for lat-nouns, sideward reduplication (which, according to them, is obligatory in DGS) should be more salient than simple reduplication.

CHILD $\begin{bmatrix}\text{1H}\\\text{lat}\end{bmatrix}$ + RED$_{\text{PL}}$	MAX-RED$_{\text{PL}}$	RED$_{\text{PL}} = \sigma$	PLURAL-L	IDENT-BR-PLACE	IDENT-IO-[1H]	*[lat, 1H]
a) $\begin{bmatrix}\text{1H}\\\text{lat}\end{bmatrix}$	*!					*
b) $\begin{bmatrix}\text{1H}\\\text{lat}\end{bmatrix}$ $\begin{bmatrix}\text{1H}\\\text{mid}\end{bmatrix}$			*	*!		*
☞ c) $\begin{bmatrix}\text{1H}\\\text{lat}\end{bmatrix}$ $\begin{bmatrix}\text{1H}\\\text{lat}\end{bmatrix}$			*			*
☞ d) $\begin{bmatrix}\text{2H}\\\text{lat}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\\text{lat}\end{bmatrix}$			*		*	
e) $\begin{bmatrix}\text{2H}\\\text{lat}\end{bmatrix}$		*!			*	

Tableau 5.2. Pluralization of the one-handed lat-noun CHILD.

Candidate a), without reduplication, violates MAX-RED$_{\text{PL}}$. Candidate b) is realized as a laterally articulated base with a reduplicant that is specified as [mid] instead of [lat]. This candidate therefore violates the constraint IDENT-BR-PLACE from (5) that we employed already in Tableau 5.1. Candidate c) has the feature [lat] in the reduplicant, which, as a consequence, is articulated lateral with respect to the base. All three candidates a)–c) violate the markedness constraint *[lat, 1H] because they have surface realizations with the non-salient feature combination [lat] and [1H]. Candidate d) avoids such a violation by employing a second hand (making the sign more salient through simultaneous articulation at both peripheral sides), which leads to a violation of IDENT-IO-[1H]. The last candidate, e), reduplicates via a simultaneous articulation, thereby violating IDENT-IO-[1H] and RED$_{\text{PL}} = \sigma$. Winning candidates with the current ranking are c) and d), both having a separate syllable with the feature [lat] as reduplicant. We can see that in this case, it is the inherent place feature [lat] of the base and its faithful copy in the reduplicant leading to the sideward reduplicated allophone of the plural (with or without simultaneous articulation) for lat-nouns.

That non-lateral noun types are not influenced in their choice of plural form by the newly introduced constraint *[lat, 1H] is obvious from its definition. Tableau 5.3 shows this, and also illustrates that for two-handed nouns like the body-noun

TROUSERS,[13] there are no separate candidates for zero realization and simultaneous articulation. Both surface as candidate a),[14] which violates MAX-RED$_{PL}$ but not RED$_{PL}$ = σ, because a reduplicant is not discernible. A change in place feature for the reduplicant to [lat] as in candidate b), representing sideward reduplication, violates IDENT-BR-PLACE, leaving candidate c), with simple reduplication, as winner.

TROUSERS $\begin{bmatrix}\text{2H}\\ \text{body}\end{bmatrix}$ + RED$_{PL}$	MAX-RED$_{PL}$	RED$_{PL}$ = σ	PLURAL-L	IDENT-BR-PLACE	IDENT-IO-[1H]	*[lat, 1H]
a) $\begin{bmatrix}\text{2H}\\ \text{body}\end{bmatrix}$	*!					
b) $\begin{bmatrix}\text{2H}\\ \text{body}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\ \text{lat}\end{bmatrix}$			*	*!		
☞ c) $\begin{bmatrix}\text{2H}\\ \text{body}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\ \text{body}\end{bmatrix}$			*			

Tableau 5.3. Pluralization of the two-handed body-noun TROUSERS.

One-handed body-nouns were already dealt with in Tableau 5.1, and the addition of the low-ranked markedness constraint *[lat, 1H] does not change the winning candidate of simple reduplication.

For comp-nouns, we also observed only simple reduplication as realization of the plural reduplicant morpheme, and this is what the constraints introduced up to now and their ranking provide, see Tableau 5.4 for the two-handed comp-noun TRAIN:

[13] Note that while the English gloss TROUSERS is inherently plural, this is not the case for the NGT sign.

[14] This only applies to symmetrical two-handed signs. For asymmetrical ones, the different handshapes or locations of the two hands would not allow for a simultaneous articulation. A more detailed OT-analysis would account for this with separate IDENT constraints for the features of the two hands.

TRAIN $\begin{bmatrix}\text{2H}\\ \text{rep}\end{bmatrix}$ + RED$_{PL}$	MAX-RED$_{PL}$	RED$_{PL}$ = σ	PLURAL-L	IDENT-BR-PLACE	IDENT-IO-[1H]	*[lat, 1H]
a) $\begin{bmatrix}\text{2H}\\ \text{rep}\end{bmatrix}$	*!					
b) $\begin{bmatrix}\text{2H}\\ \text{rep}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\ \text{lat}\end{bmatrix}$			*	*!		
☞ c) $\begin{bmatrix}\text{2H}\\ \text{rep}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\ \text{rep}\end{bmatrix}$			*			

Tableau 5.4. Pluralization of the two-handed comp-noun TRAIN.

Candidate b) violates IDENT-BR-PLACE as the reduplicant has the place feature [lat], while the base does not.

One-handed comp-nouns in NGT (e.g., SIREN) are predicted to behave the same with respect to pluralization, based on these constraints and their ranking, though we cannot confirm this as we did not include such signs in our data collection (and no such signs were extracted from the corpus).

For mid-nouns, the present analysis would also predict simple reduplication as winning candidate. However, our data showed that mid-nouns sometimes exhibited additional sideward reduplication, which would incur a violation of IDENT-BR-PLACE, similar to the one by the sideward reduplicant candidate b) in Tableau 5.4. We can also see from Tableau 5.4 that candidate b) with sideward reduplication is harmonically bounded by candidate c) with simple reduplication, i.e., that, independent of the ranking, candidate c) would always win with the current constraints. For mid-nouns, we thus need to introduce an additional constraint that disfavors simple reduplication, and instead prefers non-identity in the location features of base and reduplicant.

For spoken languages, it has been observed that non-identity between base and reduplicant may be preferred. For instance, Yip (1995: 241) discusses "identity avoidance in morphology", which she divides into four categories, one of which is "the output of reduplication cannot be total identity". An example is "echo-words", for instance, English *table-schmable*. Yip (1995) poses that this results from a tension between a constraint that requires repetition (REPEAT), and one that prevents repetition, i.e., that avoids identity (*REPEAT). If the latter outranks the first, we get an output such as *table-schmable*, that is, reduplication without complete identity.[15] Similarly, see also Kentner (2017) for constraints preferring non-identity in German reduplication.

A markedness constraint against BR-FAITH for reduplicated mid-nouns is provided in (8), though we have to admit that, at least for now, we cannot offer a perceptual or physiological motivation for this constraint, except for a general tendency to avoid identity in morphology (Yip 1995). It is not clear why this tendency would specifically apply to NGT mid-nouns, however, and therefore the constraint is of an ad-hoc nature.

(8) *BASE [mid] – RED [mid]: Assign a violation mark to any output of base and reduplicant both being realized as [mid].

Tableau 5.5 illustrates the workings of this constraint with the example of the two-handed mid-noun BOOK. Recall from footnote 4 that in NGT, one-handed mid-nouns are all body-anchored (such as, e.g., APPLE), and therefore fall into the body-noun category in our categorization.

BOOK $\begin{bmatrix}\text{2H}\\ \text{mid}\end{bmatrix}$ + RED_{PL}	MAX- RED_{PL}	$\text{RED}_{\text{PL}} = \sigma$	PLURAL-L	IDENT-BR-PLACE	*BASE[mid] RED[mid]	IDENT-IO-[1H]	*[lat, 1H]
a) $\begin{bmatrix}\text{2H}\\ \text{mid}\end{bmatrix}$	*!						
☞ b) $\begin{bmatrix}\text{2H}\\ \text{mid}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\ \text{lat}\end{bmatrix}$			*	*			
☞ c) $\begin{bmatrix}\text{2H}\\ \text{mid}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\ \text{mid}\end{bmatrix}$			*		*		

Tableau 5.5. Pluralization of the two-handed mid-noun BOOK.

[15] In fact, REPEAT has the same effect as McCarthy & Prince's (1993b et seq.) IDENT-BR and MAX-BR, as Yip (1995) points out. Yip (1995) makes clear that the REPEAT constraint forces reduplication by itself, and does not presuppose RED in the input. We do postulate RED in our input, and thus we do not assume (*)REPEAT constraints.

The newly introduced constraint (8) and its ranking at the same height as IDENT-BR-PLACE ensures the observed two reduplication forms for mid-nouns but does not change the outcome of any of the earlier tableaux, as none of them had a mid-noun as base.

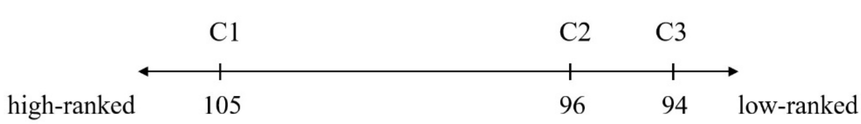
5.3.3 Ranking values to replicate the variation in output forms

Up to now, we have introduced the relevant constraints and demonstrated how they are violated by the different noun types, assuming a preliminary ranking that could account for some variation in Tableaux 5.2 and 5.5 by predicting two winners, both occurring 50% of the time. This preliminary ranking, however, did not allow for zero-marking to win. We now turn to the question whether the constraints can be ranked in such a way that they replicate all the variation in output forms that we observed in our data, including zero marking and a distribution of winners that is more in line with the actually occurring distribution.

The availability of different reduplication types for one and the same noun, as observed in NGT, is also attested in some spoken languages. Hayes & Abad (1989) report that in Ilokano (Austronesian), reduplication can take different forms when the stem starts with a consonant plus glide cluster. For instance, three options are available for plural reduplication of [rwáŋan] 'door', as illustrated in (9) (for more details, see Hayes & Abad 1989).

(9) *rwá.ŋan* → *ruː.rwá.ŋan ~ ruŗ.wá.ŋan ~ rwaŋ.rwá.ŋan*
'door' 'doors' [Ilokano; Hayes & Abad 1989: 365]

In order to account for such variation in forms, Boersma (1997) and Boersma & Hayes (2001) developed stochastic OT. In this framework, constraints do not show categorical ranking, but are ranked along a continuous ranking scale with arbitrary units, as exemplified with three constraints and their ranking values in (10) (based on Boersma & Hayes 2001: 47).

(10)


In (10), the distance between constraints C1 and C2 is larger than that between C2 and C3, indicating that the relative ranking between C1 and C2 is more fixed than that between C2 and C3. At every instance when a winner of an OT tableau has to be determined, that is, at evaluation time, some small noise is added to the ranking value of each constraint, resulting in a so-called selection point for each constraint. The constraints are then ordered according to their selection points, and the winning candidate is determined. The value of the noise added to the ranking value at evaluation time is drawn from a Gaussian distribution of values that is based on previously determined evaluation noise: a small value on the ranking scale, which is the same for all constraints. For instance, if we assume an evaluation noise of 3, the selection points for C1 in (10) would lie between 105 ± 3, i.e., 102–108, with values towards the edges of this range much less likely than values close to its center. Two constraints like C2 and C3 that are fairly closely ranked with respect to each other on the ranking scale can have a reverse ranking C3 >> C2 at a specific evaluation time, e.g., if C2 has added noise of –1.6 and a resulting selection point of 94.4, and C3 has added noise of 0.7 and a resulting selection point of 94.7. Over many evaluations, such cases result in multiple outputs for a single underlying form. In this way, stochastic OT allows for the inclusion of variation, and more specifically, it enables us to determine the exact occurrence frequency of specific output forms.

With the Gradual Learning Algorithm (Boersma & Hayes 2001), the ranking values of involved constraints can be acquired on the basis of the distributions of observed output forms. This acquisition process can be simulated: for this purpose, we used OTMulti grammar in Praat (Boersma & Weenink 2020).

We defined all constraints, the output candidates for the noun types, and their constraint violations, as given in Sections 5.3.1 and 5.3.2, in an OTMulti grammar, which is provided in Appendix 5-B1. The initial grammar had the ranking values of all constraints set at 100 (no inherent ranking yet). This grammar then learned the ranking values of its constraints, that is, changed these values on the basis of the data it was given. This data consisted of input-output pairs, where the input was one of the four NGT noun types, and the output one of the occurring plural realizations for the given input. These pairs were drawn from a distribution we defined on the basis of our observed forms (Table 5.1), repeated here (without overall amounts and shading) in Table 5.2.

Table 5.2. Pluralization strategies and their occurrence frequencies as defined in the input of our simulation (red. = reduplication; sim. = simultaneous).

Type	**Zero marking**	**Simple red.**	**Sideward red.**	**Sim. articulation**	**Sideward and sim. red.**
body	40.2%	55.7%	3.2%	1.1%	0%
comp	57.5%	37.5%	5%	0%	0%
lat	15.6%	1.8%	67.9%	1.8%	12.9%
mid	43.2%	29.7%	21.6%	0%	0%

We also included all cases that occurred less than 5% of the time in our real data, meaning that in Table 5.2, we do not make a distinction anymore between white and shaded cells as we did in Table 5.1. For the input body-noun, for instance, the output we provided to our grammar was thus 40.2% zero marking, 55.7% simple reduplication, 1.1% simultaneous articulation, and 3.2% sideward reduplication. The full input-output pair distributions are provided in Appendix 5-B2.

From these pair distributions, one input-output pair was drawn at a time and fed to the grammar. For each pair, the grammar produced an output on the basis of its current constraint ranking, and compared the produced output to the expected output that was provided as part of the input-output pair. If the two were identical, then the constraint ranking stayed the same. If there was a discrepancy between actually produced input and expected output (as provided in the input-output pair), then the constraint ranking was adjusted. This adjustment is illustrated in Tableau 5.6 below with an intermediate learning stage for an input comp-noun. All constraints that were violated by the candidate that did win in the actual production (indicated by ☞) were promoted (indicated by the left arrow), and all constraints that were violated by the candidate that should have won according to the input-output pair (indicated by ✓) were demoted (indicated by the right arrow). Promotion and demotion on the ranking scale was performed by a previously defined learning step.

	100.76	100.61	100.56	99.53	99.18	98.77	97.73
$\begin{bmatrix}\text{2H}\\\text{rep}\end{bmatrix}$ + RED$_{PL}$	PLURAL-L	RED$_{PL}$ = σ	IDENT-BR-PLACE	MAX-RED$_{PL}$	*BASE[mid] RED[mid]	IDENT-IO-[1H]	*[lat, 1H]
☞ a) $\begin{bmatrix}\text{2H}\\\text{rep}\end{bmatrix}$				← *			
b) $\begin{bmatrix}\text{2H}\\\text{rep}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\\text{lat}\end{bmatrix}$	*!		*				
✓ c) $\begin{bmatrix}\text{2H}\\\text{rep}\end{bmatrix}$ $\begin{bmatrix}\text{2H}\\\text{rep}\end{bmatrix}$	*! →						

Tableau 5.6. Learning tableau for a comp-noun with ranking values plus small evaluation noise at evaluation time given on top of each constraint. ☞ indicates the candidate that did win according to the current constraint ranking, and ✓ the candidate that should have won according to the provided input-output pair. The left arrow next to the violation mark indicates that this constraint will be promoted, the right arrow that the constraints will be demoted.

This stepwise promotion and demotion of constraints is the basic characteristic of the Gradual Learning Algorithm (GLA; Boersma & Hayes 2001), which differs, e.g., from Error-Driven Constraint Demotion (EDCD), an algorithm for OT learning proposed by Tesar & Smolensky (1996). The latter only allows the demotion of constraints and is not gradual, which means that each data point results in a change in the absolute ranking of the constraints. In contrast to EDCD, the GLA enables the learner to acquire a grammar that can account for variation, as illustrated by Boersma & Hayes (2001).

In total, 100,000 tokens of input-output pairs were fed to our grammar, and the grammar stepwise acquired a constraint ranking that attempts to replicate the given input distribution (with all specifications set to the standards in Praat). The newly learned grammar was then evaluated by feeding it 100,000 times input candidates, i.e., one of the four noun types at a time, all four equally often. We repeated this learning procedure 100 times (100 different learners). The ranking of the constraints and their mean ranking values is given in Table 5.3, and the mean output frequencies for all four possible input forms are summarized in Table 5.4.

Table 5.3. Ranking of the constraints in the 100 grammars, with their mean ranking values in the second row.

RED$_{PL}$ = σ	MAX-RED$_{PL}$	PLURAL-L	IDENT-IO-[1H]	*[lat, 1H]	IDENT-BR-PLACE	*BASE[mid] RED[mid]
102.0	98.2	98.0	78.2	76.1	-336.8	-336.8

Table 5.4. Pluralization strategies per noun type. Left columns: observed frequency (cf. Table 5.2), right columns: mean occurrence frequencies in the output of our simulations. Color indicates how far these frequencies depart from the observed frequencies: white = ±5%, light grey ±10%, dark grey >10%.

Type	**Zero marking (%)**		**Simple red. (%)**		**Sideward red. (%)**		**Sim. articulation (%)**		**Sideward and sim. red. (%)**	
body	40.2	39.7	55.7	59.1	3.2	0	1.1	1.9	0	0
comp	57.5	40.3	37.5	59.7	5	0	0	0	0	0
lat	15.6	39.4	1.8	0	67.9	45.6	1.8	1.9	12.9	13.0
mid	43.2	40.3	29.7	29.9	21.6	29.8	0	0	0	0

A comparison of the output frequencies produced by our grammar (right columns for each strategy) and the observed frequencies in the data (left columns) shows that the overall variation in forms is represented correctly via the learned constraint ranking: the noun types exhibit the plural markings that we observed in the data.

For body- and mid-nouns, the results of the simulation are in line with the observed distribution of the strategies, while for lat- and comp-nouns this is not the case. For comp-nouns, the discrepancy between observed distribution and the distribution predicted by our formalization might be caused by the fact that the real data is skewed: comp- and mid-nouns, with 40 and 37 tokens, respectively, are underrepresented in our data compared to body-nouns with 185 and lat-nouns with 224 tokens. A larger database with a more balanced distribution of types, i.e., more comp-nouns, might provide frequencies that are more in line with the distributions predicted for this noun type. For lat-nouns, this explanation does not apply, and we cannot currently account for the discrepancy in occurrences apart from pointing out that with the constraint set that we employ (especially the general constraints $\text{RED}_{\text{PL}} = \sigma$, PLURAL-L and MAX-$\text{RED}_{\text{PL}}$ that do not distinguish between the noun types), we predict a similar occurrence of zero marking for all four noun types.

It is important to note that when accounting for the variation in our data by one grammar, we assume that the signers all show the same variation and that their behavior can indeed be captured by a single grammar. However, we did not only observe intra-signer variation in the data, but also different patterns across signers (as mentioned in Section 5.2). These patterns across signers could in principle be so radically different that they are better described by two (or more) different grammars. As an example, one group of signers could use sideward reduplication of lat-nouns very frequently while another group could not use it at all, requiring two grammars with fundamentally different rankings of the respective constraints. Future work should investigate such intra-signer variation and possible user types, in order to determine how such variation can be captured with different grammars (for an example from L2 acquisition, see Hamann 2009).

5.4 Discussion

5.4.1 The modality-(in)dependence of OT-constraints

With the constraints that we introduced in Section 5.3, we successfully captured the patterns of pluralization in NGT as observed in Chapter 2, and by using stochastic OT, we could, to a large degree, also account for the variation found in the use of plural allomorphs. In our formal analysis, we motivated the choice of constraints that have previously been used in formalizations of spoken language, that is, constraints that are maximally modality-independent. Indeed, on the one hand, it is clear that OT and the constraint types proposed for spoken language reduplication work for sign language data as well. We employed IO-FAITH, BR-FAITH, ALIGNMENT constraints, and a constraint on the form of the reduplicant, together with phonologically- and phonetically-motivated co-occurrence restrictions, all of which are commonly used in formal accounts of reduplication in spoken languages and are shown to work equally well for NGT. The constraints MAX-RED, ALIGN and $\text{RED}_{\text{PL}} = \sigma$ involve completely modality-independent notions, such as the reduplicant plural morpheme and the syllable.

Yet, on the other hand, the fact that we formalize *sign language* data has the unavoidable consequence that some of the constraints involve modality-specific features, in other words, the featural implementation is modality-specific (see Section 5.2.3). While our IO- and BR-FAITH constraints are of the same *type* as those proposed for spoken languages, they involve, for example, the features [mid] and [1H], both of which are clearly modality-specific. The same applies to *[lat, 1H]: while some spoken language accounts also involve constraints motivated by perceptual salience, our constraint is necessarily motivated by *visual* rather than auditory salience, employing features that simply cannot exist in the spoken language modality. Even a general ALIGNMENT constraint comes with a modality-specific flavor: simultaneous alignment in a sign language is, of course, modality-specific and not the same as spoken language phenomena formalized by ALIGNMENT, such as infixation of the reduplicant (recall Riggle 2006). We thus used modality-independent constraint types (that are properties of the OT framework) and stochastic OT to handle modality-specific features.

Taking a more general perspective on the subject matter, Chomsky (2007: 22) claims that sign language research actually provides us with evidence "that externalization appears to be independent of sensory modality" (cf. also Chomsky 1965, 2000). Sandler (2017), however, does not fully agree with this generalization, as this would imply that phonology is essentially the same in both modalities. While she agrees that both modalities have a phonological level, suggesting in some sense a shared cognitive system, she emphasizes that "ubiquity can be deceptive if it prevents us from looking further to understand the nature of this commonality, as well as the nature of the differences" (Sandler 2017: 58). Indeed, phonological features, being tied to articulatory systems, are clearly not universal (Sandler 2017), and previous studies have repeatedly shown that the modality of signal transmission shapes language (e.g., MacNeilage 2008; Sandler 2013, 2017, among others). Our study adds to this, as we show that the specific motor system a language relies on has consequences for analyses within the OT framework, too – not necessarily on the general level of constraint types, but rather for the featural implementation.

We are not the first to formalize sign language plural reduplication in OT – Pfau & Steinbach (2005a) present an OT-analysis of pluralization in DGS, a language which also employs simple and sideward reduplication in pluralization. They introduce six constraints, the ranking of which successfully derives the patterns observed for DGS. Still, when comparing our formal account to that of Pfau & Steinbach, it is clear that they employ more modality-specific notions in their constraints. For instance, our ALIGNMENT constraint does away with their modality-specific constraint *MOVE that blocks the addition of a sequential movement to the input. Moreover, Pfau & Steinbach formulate several faithfulness constraints, but they only take into account IO-FAITH; notably, the potential role of BR-FAITH is ignored. A further difference to the analysis by Pfau & Steinbach is that while they assumed sideward reduplication as default realization of the plural, our analysis with the high-ranked constraint MAX-RED$_{PL}$ only requires some kind of reduplication, and high-ranked RED$_{PL}$ = σ demands that the reduplicant is a syllable on its own. The ranking of these two together with BR-FAITH and IO-FAITH and two noun-type specific markedness constraints determines the optimal reduplication strategy for each noun type. Our formalization is thus innovative in that it shows that notions from formalizations of spoken language reduplication can be integrated in a formal account of sign language data.

While the analysis by Pfau & Steinbach only accounts for obligatory, categorical patterns, we also account for the variation in our data. We are convinced that the categorical nature of Pfau & Steinbach's data can be explained by different methodologies. Pfau & Steinbach based their analysis only on elicited plural forms from DGS signers. In contrast, our point of departure were naturalistic corpus data, and it is a well-known fact that corpus data commonly present us with more variation than one might expect – as Johnston et al. (2007) aptly put it in their title: "real data are messy". In fact, such, often unexpected, variation has been documented for NGT, based on data extracted from the Corpus NGT, for various grammatical domains (e.g., Bank 2015; Legeland 2016; Oomen & Pfau 2017; Klomp 2019). We are the first to analyze sign language variation using stochastic OT, and we did this in the same way as Boersma & Hayes (2001), who formalize free variation in Ilokano (see Section 5.3.3). Indeed, as they point out referring to Labov (1974, 1994), the field of sociolinguistics has often shown that free variation is ubiquitous in natural language use. Boersma & Hayes show that the Gradual Learning Algorithm is capable of simulating such variation in a spoken language, and our study shows that exactly the same is true for sign language data.

5.4.2 Reflections on the formalization in light of typological variation

The present analysis shows that constraint types introduced to formalize spoken language reduplication can be used to formalize data from NGT. However, to gain stronger evidence for the modality-independence of constraint types, formalizations of reduplication in other sign languages are necessary. We will not offer such evidence here, but our formalization does make certain predictions with respect to (sign) language typology – after all, one of the hallmarks of OT is that the theory strives to account for cross-linguistic variation by means of language-specific constraint rankings. It is therefore worthwhile to briefly consider how our account fares when it comes to intra-modal variation. It is well-known that sign languages display striking similarities in the realm of morphology (Aronoff, Meir & Sandler 2005; Meir 2012). Still, even when it comes to simultaneous morphological processes, we do find some variation: a certain morphological process may simply not be attested in a given sign language or be very infrequent, or it is attested but applies in a different way or to a different class of signs; see, for instance, Zeshan (2003b) and Nyst (2007) for classifiers in Indopakistani Sign Language and Adamorobe Sign Language (Ghana), and Padden et al. (2010) and Bauer (2014) for spatial agreement in Al-Sayyid Bedouin Sign Language (Israel) and Yolngu Sign Language (Australia). As already briefly alluded to in Section 5.2.2, such cross-linguistic variation is also attested in the domain of pluralization (see also Pfau & Steinbach 2006).

Let us consider DGS again, and let us assume that the DGS patterns are in fact as categorical as Pfau & Steinbach (2005a) report. Ranking the constraints that we introduced differently could derive most of these patterns in a straightforward way. First, DGS lat- and mid-nouns are always overtly marked for plurality, suggesting that MAX-RED$_{PL}$ is high-ranked in this language. As DGS mid-nouns undergo simple but not sideward reduplication, the constraint *BASE[mid]-RED[mid] would be very low ranked. Recall also that in DGS, body- and comp-nouns are always zero-marked. This suggests that our analysis would need to be supplemented by a further constraint banning any kind of reduplication for body- and comp-nouns. In fact, body- and comp-nouns have also been found to undergo zero marking in other sign languages (e.g., Pizzuto & Corazza 1996 for Italian Sign Language; Sutton-Spence & Woll 1999 for British Sign Language), supporting this assumption.

Furthermore, the constraint MAX-RED$_{PL}$ and the ALIGNMENT constraint PLURAL-L are closely-ranked in our account, allowing for alternation between zero-marking and plural marking via reduplication. A higher ranking of MAX-RED$_{PL}$ would predict languages without zero marking, and a lower ranked MAX-RED$_{PL}$ would yield languages in which the plural does not have to be marked at all. While we are not aware of a sign language of the former type, the latter pattern has been described for Indopakistani Sign Language, where Zeshan (2000) observes that no distinction is made between the singular and plural of nouns, that is, only the zero-marking strategy is applied, independent of noun type.[16]

[16] Zeshan further notes that the only noun that undergoes morphological plural marking with some frequency is CHILD. This sign is identical to the NGT sign (see Figure 5.4a), and just as in NGT, it is pluralized by means of sideward reduplication. Still, for IPSL, we have to

Finally, IO-FAITH for other features than handedness were not included in our analysis but assumed to be ranked very high, predicting languages where IO-FAITH is lower ranked, particularly below ALIGNMENT constraints like PLURAL-L, which would allow changes in the stem features of the noun.[17] This is in fact found in certain spoken languages, for instance, languages that allow for morphological tones or vowel fronting (umlaut) to mark the plural.

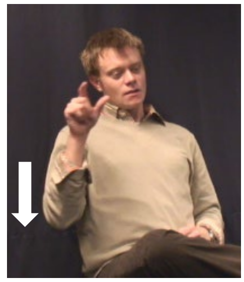
5.4.3 Topics for future research

While Section 5.3 makes clear that our data – including the variation we find – can successfully be formalized in OT, some observations were not accounted for. These data points merit some discussion.

Our analysis focuses on the main pluralization strategies in NGT, that is, the strategies described in Section 5.2.2 that occur most regularly. Still, two nouns – lat-noun PERSON and body-noun HUMAN – show alternative pluralization strategies that were not taken into account in our formalization. PERSON (Figure 5.4b in Section 5.2.2, but also shown here with a still from the Corpus NGT in Figure 5.14a) is a one-handed noun and commonly undergoes (simultaneous) sideward reduplication, like other lat-nouns. However, recall from footnote 3 that under simultaneous sideward reduplication of this specific noun, the hands move alternately rather than in parallel (N = 3, by three different signers in the corpus data), illustrated already in Figure 5.9c, but also shown here with stills from the Corpus NGT in Figure 5.14b. In our analysis above, we did not differentiate the alternating movement, and we consider this an avenue for future research, as it is yet unclear whether this strategy can also apply to other (lat-)nouns in NGT. Recall from Section 5.2.2 that simultaneous reduplication may also involve alternating movement in ASL (Wilbur 1987) and Austrian Sign Language (Skant et al. 2002).

assume that this a lexicalized, i.e., idiosyncratic, plural form (comparable, for instance, to English *mouse – mice*).

[17] Such changes in the features of the stem do occur for verbs under iterative (or, more generally, perfective) aspect marking in NGT (see Chapter 3).

a. 

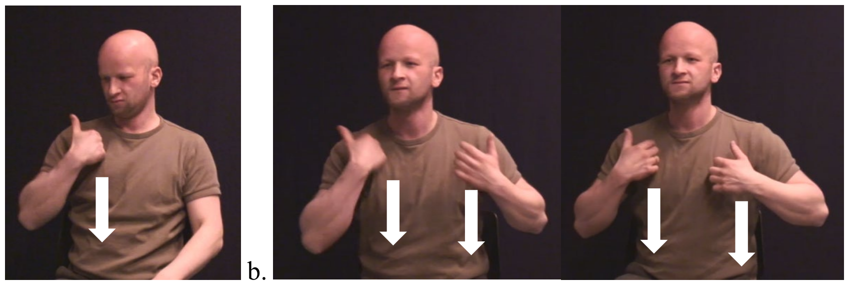
PERSON

b. 

PERSON$_{2H/alt}$>+>+>+

Figure 5.14. Lat-noun PERSON (a) [CNGT0833; S035; 03:04.64] undergoing simultaneous sideward reduplication with alternating movement (b) [CNGT0862; S040; 03:57.36].

The second noun, the one-handed noun HUMAN (already illustrated in Figure 5.2b, and here also with a still from the Corpus NGT in Figure 5.15a), is articulated on the lateral side of the chest; the hand moves downward while maintaining contact with the chest. While this noun – like the other body-nouns in our study – can undergo simple reduplication and zero marking, it also shows an additional strategy: simultaneous reduplication, i.e., there is not only simultaneous articulation, but both the dominant and the non-dominant hand simultaneously and repeatedly perform the downward movement as in Figure 5.15b (N = 24).



a. b.

HUMAN HUMAN$_{sim}$+

Figure 5.15. Body-noun HUMAN (a) [CNGT0208; S012; 05:47.88] undergoing simultaneous reduplication (b) [CNGT0208; S012; 05:42.96].

Simultaneous reduplication was not attested for any of the other nouns. Two potential explanations can be offered: (i) for some signers, the base-form of HUMAN is not one-handed (as in Figures 5.2b and 5.15a) but two-handed or has a two-handed variant, or (ii) simultaneous reduplication is an additional strategy. In our analysis we assumed explanation (i) and included this strategy under 'simple reduplication'. Yet, since we could not check the base-form of HUMAN for each signer – it was not a target noun in the elicitation – we should not completely rule out the second explanation that HUMAN can undergo simultaneous reduplication. HUMAN may be a lexical exception and thus the only noun (or one of few nouns) in NGT of which the plural is marked in this way. Such exceptions also occur in spoken languages, for instance in English: although the language has phonologically triggered allomorphy in pluralization, the plural of specific nouns is lexically determined, i.e., idiosyncratic (for instance, zero marking for *sheep* and the vowel alternation for *mouse* – *mice*). Still, for NGT, we cannot exclude the possibility that simultaneous reduplication applies to more nouns since not all nouns were included in our data set.

If simultaneous reduplication is indeed an additional strategy, we can hypothesize which phonological features trigger it. Recall that we follow Pfau & Steinbach (2005a) in assuming the hierarchical feature classification in Figure 5.1 (Section 5.2.1). Following this hierarchy, body-noun HUMAN is only specified for [body] and [contact]. Yet, if we forget about the hierarchy for a moment and further look at the features of this noun, we note that it is articulated at the lateral side of the chest. The two-handed realization is then not surprising, since pluralized lateral nouns prefer a simultaneous articulation by the second hand, as we implemented with the markedness constraint *[lat, 1H]. This shows that by assuming the feature classification in Figure 5.1, some more specific feature specifications are lost. This clearly applies to comp-nouns as well, where we assume no place features altogether.

This latter point made us wonder whether we should let go of the hierarchical structure of features, and instead evaluate all possible place and movement features for each noun. Yet, looking at the data more closely suggests that this may not be necessary. First, unlike lat-nouns, simultaneous reduplication of HUMAN did not involve sideward movement. Apparently, the noun adheres to our constraint IDENT-BR-PLACE in such a way that the (main) place of articulation in the reduplicant is [body] and not [lat], suggesting that the first is indeed the more prominent feature. As for comp-nouns, our current OT formalization predicts that sideward reduplication is never preferred when the noun has inherent repetition, regardless of its exact place of articulation. Indeed, we asked a deaf signer if sideward reduplication of the one-handed noun AGE – which has a repeated movement and is articulated laterally – would be possible, but she indicated that this is definitely not the case. This suggests that the underlying place of articulation feature is irrelevant in pluralization of comp-nouns, and therefore – as a result of our IDENT-BR-PLACE constraint – that the reduplicant can never have a feature [lat]. In other words: if comp- and body-noun types were specified for [lat], we would expect a copy of that feature in the reduplicant, resulting in sideward reduplication – this does not happen, however. Finally, when trying out this alternative classification, the four noun types identified in the hierarchical structure (Pfau & Steinbach 2005a) still grouped together with respect to the pluralization strategies they undergo. For these reasons, we decided to maintain the original classification.

5.5 Conclusion

OT-formalizations have been fruitfully applied to a wide range of reduplication patterns in typologically diverse spoken languages, taking into account the amount of material that is copied in the process, the degree to which this material is identical to or different from the base, and the exact position of the reduplicated material. Moreover, two previous studies have attempted to capture reduplication phenomena in a sign language, viz. DGS (Pfau & Steinbach 2003, 2005a). In the present study, we offered a detailed investigation of plural reduplication in NGT, aiming to include modality-independent notions in our formalization.

Our data show that pluralization in NGT involves phonologically triggered allomorphy. However, there is no one-to-one relation between a specific noun type and the allomorph it selects. Rather, each noun type may combine with two to three different allomorphs, and for all noun types, one of these allomorphs is zero marking. By means of several constraints and a formulation and simulation within stochastic OT, we can account for the attested patterns as well as most of the variation. Importantly, the constraint types we employ in our formalization are modality-independent, as they concern input-output and base-reduplicant faithfulness, marked feature combinations, and alignment. What is, of course, specific to the visual-spatial modality of sign languages are the phonological features that the constraints refer to (e.g., [lat], [mid], [1H]) (see also Chapter 7 for further discussion).

Future studies on NGT should address the gaps in our data set that we acknowledged, as well as the few exceptions that we reported. Also, it is hoped that a similar approach will be applied to other sign languages, in order to broaden our understanding of intra-modal typological variation and, subsequently, to test in how far modality-independent constraint types and their (re)ranking are able to capture this variation. For the case of mid-nouns and the ad-hoc constraint BASE[mid]-RED[mid], we hope that future studies on NGT, as well as other sign languages, will provide motivations for this constraint, thereby contributing to the still rather small but growing number of OT-accounts of sign languages.

Chapter 6 | Extending the OT-analysis to predicate reduplication in Sign Language of the Netherlands

6.1 Introduction

Chapter 5 presented a formalization of NGT nominal pluralization within the framework of Optimality Theory (OT). Since Chapters 3 and 4 showed that the predicate of the sentence can be reduplicated under aspectual and reciprocal marking in NGT, the current chapter explores how the account proposed for plurals can be extended to verbal reduplication. To this end, a formalization of NGT aspectual reduplication is presented. While the focus of this chapter is on the formalization of aspect marking, the possibilities for a formalization of NGT reciprocal reduplication are also briefly addressed.

The remainder of this section summarizes the relevant findings on aspect presented in Chapter 3 and specifies the phonological features that will be relevant for the analysis (6.1.1). Both similarities with and differences to nominal reduplication will be highlighted (6.1.2), in order to anticipate the adaptations necessary for an OT-account of aspectual reduplication. Then, Section 6.2 proposes specific constraints and presents ranking values that can account for not only the patterns, but also the variation observed in the data. Section 6.3 first discusses how the formalization of aspectual reduplication ties in with that of plural reduplication (6.3.1), and then considers how the formalizations could be extended to account for NGT reciprocal reduplication (6.3.2). Section 6.4 concludes.

6.1.1 Aspectual reduplication: patterns and features

Recall from Chapter 3 that a corpus data set and an elicited data set were analyzed in order to investigate the marking of habitual, continuative, and iterative aspect in NGT. Given that no formal difference could be identified between the habitual and continuative aspect, they have been subsumed under imperfective aspect, while the iterative has been categorized as perfective aspect. Several types of aspect markers have been attested, but in the present chapter, the focus is on predicate reduplication. The relevant patterns in the two data sets combined are summarized in Table 6.1, where ‘zero marking’ implies that there is no marking on the predicate, but other types of marking may be present in the sentence.

Table 6.1. Patterns of reduplication and zero marking in the corpus and elicited data for aspectual reduplication (as reported on in Chapter 3).[a]

	Imperfective aspect		**Perfective aspect**	
Verb properties	**Predicate reduplication (N, %)**	**Zero marking (N, %)**	**Predicate reduplication (N, %)**	**Zero marking (N, %)**
Handshape change	0	18 (100%)	4 (36%)	7 (64%)
Location [trunk]	0	28 (100%)	14 (100%)	0[b]
No potentially constraining features	105 (49%)	108 (51%)	38 (70%)	16 (30%)
Total	*105 (41%)*	*154 (59%)*	*56 (71%)*	*23 (29%)*

[a] These are the frequencies from the corpus and the elicited data together (excl. elicited verbs that could not be annotated for reduplication). The table shows how many predicates are inflected by reduplicating their movement, only marking aspect (i.e., the three instances of reduplicated HUG in the elicited data, shown in Table 3.8 in Chapter 3, are subsumed under 'zero marking' here, and so are eleven instances with hand opening/closing in the corpus that are reduplicated, but where the reduplication has multiple functions). Sentences where the predicate is unclear or where there is predicate ellipsis have been excluded from this table (24 instances for the imperfective and one instance for the perfective).

[b] It is striking that all 14 instances of verbs with a location [trunk] in the perfective are reduplicated. However, it should be noted here that 11 of those involve the verb HUG – it could be the case that this verb is always reduplicated in the perfective, but a larger data set would be required to investigate this possibility further.

Recall from Chapter 3 that the two aspect types employ different types of reduplication. For perfective aspect, there is a break in between each reduplication cycle, i.e., the sign is held briefly after each cycle. In contrast, for imperfective aspect, the movement cycles are continuous, without any break or hold in between. Further, we observed that in the imperfective aspect, not all verbs were reduplicated: verbs that have an opening/closing handshape change and verbs that have the trunk as their major location are never reduplicated in the data, as is also clear from Table 6.1. For perfective aspect, these constraints do not seem to apply, given the fact that verbs specified for either of these features are reduplicated in the data for this aspect type. Still, reduplication does alternate with zero marking in the perfective and for unconstrained verbs in the imperfective, suggesting that it is optional (similar to what we observed for plural reduplication).

Given these patterns, two types of features are of importance for the formalization: movement and location features. For movement, recall from Chapter

1 that we can distinguish path movement from internal movement. Relevant for the imperfective is internal movement, specifically handshape change. As mentioned in Chapter 3, handshape change has been represented differently in different phonological models.[1] Here, I refrain from taking a theoretical standpoint, given that the exact representation is not crucial to the present formalization. Handshape change is, therefore, represented in the OT formalization as 'hs change'. When a sign involves path movement, this is represented by a feature [path]. Since only those features that are relevant to the observed patterns are included in the OT-analysis (as in Chapter 5), other types of internal movement (e.g., trilled movement or orientation changes, cf. Chapter 3) and the manner of the path movement are not included in the formalization. Moreover, signs may be inherently specified for a final hold, implying that the handshape is briefly held at the final location (see, e.g., Liddell & Johnson 1989; Perlmutter 1992). Such holds also occur at the end of each reduplication cycle in the perfective aspect. Inherent final holds and the holds in between perfective reduplication cycles are indicated in the formalization with a feature [hold].[2] As for location, recall that major location has to be distinguished from setting (Sandler 1989; Brentari 1998; see also Chapter 1). Since predicates articulated on the trunk appear to be constrained in the imperfective, this major location is indicated by a feature [trunk]. Setting is not specified in the analysis, and neither are other major locations.

6.1.2 Aspect and pluralization compared

The starting point for the present OT-analysis is a comparison of the patterns in the aspect data to those in the plural data, in order to anticipate (i) which aspects of the formalization of plurals can be adopted based on any similarities, and (ii) which consequences any differences have for the formalization of aspectual reduplication.

The two functions are similar in that reduplication alternates with zero marking, even for signs which are in principle unconstrained (to the extent that constraints on reduplication could be identified in the data), which implies that reduplication might be optional. For nominal plurals, this type of variation was accounted for by employing stochastic OT (Boersma 1997; Boersma & Hayes 2001), ranking the OT-constraints on a continuous ranking scale rather than

[1] Specifically, Chapter 3 mentions that a change in finger position is represented by branching at the finger position node in the Hand Tier model (Sandler 1993), while in the Prosodic model (Brentari 1998), one underlying handshape is specified, while the other handshape can be predicted from the opposing value of the underlying shape at the aperture node.

[2] Alternatively, one could distinguish $[\text{hold}]_{\text{verb}}$ from $[\text{hold}]_{\text{red}}$. The present formalization, however, assumes one feature [hold] for the verb and for the reduplicative morpheme. Future studies could investigate whether it is favorable to distinguish separate [hold] features.

categorically, thus allowing for variation in output forms (cf. Chapter 1 and Chapter 5). This will also turn out to be important for the formalization of aspectual reduplication.

Yet, for both functions, the variation between reduplication and zero marking is not completely free. A commonality between imperfective aspect specifically and nominal plurals is that reduplication is to some extent governed by phonological features of the base sign. Still, the two functions do differ, since for imperfective aspect, verbs with location [trunk] or a handshape change are never reduplicated, i.e., the process appears to be completely blocked, while for plurals, the data displayed tendencies rather than categorical patterns (see Chapter 2). Markedness constraints governing which features block reduplication clearly play a role for both functions, but the interpretation of those for imperfective aspect need to be more strict. The patterns thus cannot be captured by one general set of markedness constraints. For perfective aspect, no constraints on reduplication have been identified, and thus markedness constraints referring to this aspect type likely do not play a role, or are very low-ranked in the language.

There are at least two other, more fundamental, differences between aspectual and plural reduplication. The first difference has to do with the choice between available reduplication types. For nominal plurals, I observed four different reduplication types, which do not encode meaning differences. Nominal reduplication was, therefore, assumed to be the default pluralization strategy, while the type of reduplication was formalized to be a result of noun-specific phonological features. For aspect, I observed that perfective aspect and imperfective aspect are marked by a single reduplication type each, namely with and without holds in between cycles, respectively. While reduplication is taken to be the default strategy for aspect marking, too, the type of reduplication is governed by the morpheme in the input, i.e., the imperfective vs. perfective morpheme, rather than by specific inherent phonological features of verbs.

The second difference has to do with phonological changes imposed on the base sign. None of the reduplication types attested for nominal plurals result in obvious changes to the base noun, while aspectual reduplication can result in such changes (in the sense of back copying, cf. Kenstowicz & Banksira 1999 on reduplicative identity in Chaha, where reduplication also triggers a change in the base). Specifically, under imperfective reduplication, any inherent final hold of the base is deleted to allow for the continuous realization of reduplication cycles, while under perfective reduplication, a final hold (if not inherently present) is added to the base, to ensure that there is a pause in between each cycle. The formalization of aspectual reduplication should account for this.

6.2 OT-analysis of aspectual reduplication in NGT

This section presents the OT-formalization of aspectual reduplication in NGT, building on the constraints proposed in Chapter 5 for nominal pluralization, and taking into account the differences and similarities between the two functions as described in Section 6.1.2. Again, constraint types that have been proposed for spoken language reduplication are employed, including (i) a distinction between input-output faithfulness (IO-FAITH) and base-reduplicant faithfulness (BR-FAITH), (ii) an ALIGNMENT constraint, and (iii) systematic implementations of phonological features.

Section 6.2.1 starts with the implementation of the aspectual morpheme, adopting a constraint requiring reduplication and an ALIGNMENT constraint. Section 6.2.2 then addresses how the different reduplication strategies emerge. Section 6.2.3, finally, presents the ranking values accounting for the patterns and variation observed in the data.

6.2.1 Implementing the aspectual morpheme

Reduplication was observed to be the phonological realization of both imperfective and perfective aspect, and is assumed to be the default strategy for realizing the aspectual morpheme in NGT. This is implemented by employing the MAX constraints in (1).

(1a) MAX-RED$_{IPFV}$: Assign a violation mark if the reduplicant imperfective morpheme has no correspondent in the output.

(1b) MAX-RED$_{PFV}$: Assign a violation mark if the reduplicant perfective morpheme has no correspondent in the output.

Further, recall from Chapter 1 and Chapter 5 that in sign languages, it is possible to align the reduplicant and the base, given the predominantly simultaneous nature of sign language phonology and morphology. Therefore, the ALIGNMENT constraints in (2) are adopted here (McCarthy & Prince 1993a).

(2a) ALIGN (STEM, L, IMPERFECTIVE, L), short IPFV-L:
Assign a violation mark for every instance of the imperfective morpheme that is not aligned with the left edge of a stem.

(2b) ALIGN (STEM, L, PERFECTIVE, L), short PFV-L:
Assign a violation mark for every instance of the perfective morpheme that is not aligned with the left edge of a stem.

While simultaneous reduplication by the non-dominant hand would in principle be an option satisfying ALIGN for one-handed verbs in the data (e.g., SLEEP, CLEAN, TALK, a.o.), this output form was not observed for aspectual reduplication, in contrast to plural reduplication. Candidates with a simultaneous aspectual reduplicant appear to violate a constraint that is high-ranked in NGT. For now, I exclude such candidates at the outset, but will get back to them and the constraint they violate in Section 6.3.

6.2.2 The choice of reduplication strategy

We are dealing with two different types of aspectual reduplication: with and without holds in between reduplication cycles. This section illustrates that the reduplication type results from the aspectual morpheme in the input and base-reduplicant identity. This is reflected in the formalization by specific IO-FAITH and BR-FAITH constraints.

First, under perfective reduplication, a final hold, if not inherently present, is added to the base such that there are holds at the end of each reduplication cycle. I assume that the perfective morpheme is specified for a final hold in the input. The constraint proposed in (3) then ensures that this hold is realized in the output reduplicant. Further, under perfective reduplication, the features of the base verb are copied, and the hold in the perfective reduplicant is copied to the base in order to ensure base-reduplicant identity, as captured in the constraint in (4). The constraint in (4) is trivially satisfied if the input verb is inherently specified for a final hold.

(3) MAX-IO-[hold]$_{\text{PFV}}$: Assign a violation for every hold in the input perfective morpheme without a correspondent in the output perfective morpheme.

(4) DEP-BR-[hold]: Assign a violation mark for every hold in the reduplicant without a correspondent in the base.

Second, under imperfective reduplication, any inherent final hold in the base is deleted. Under imperfective reduplication, base features are copied, and the constraint in (5) ensures that the reduplicant does not contain a hold. To ensure base-reduplicant faithfulness, any inherent hold is deleted from the base, as captured by the constraint in (6). This ensures continuous repetition cycles. No features are assumed for the input imperfective morpheme.

(5) DEP-IO-[hold]$_{\text{IPFV}}$: Assign a violation mark for every hold in the output imperfective morpheme without a correspondent in the input imperfective morpheme.

(6) MAX-BR-[hold]: Assign a violation for every hold in the base without a correspondent in the reduplicant.

Note that phonological changes to the base resulting from reduplication have been observed and formalized for spoken languages, too (see, for instance, the formalization of reduplication in Chaha by Kenstowicz & Banksira 1999, who rank BR-FAITH above IO-FAITH in order to account for reduplicative identity in the language; see also Wilbur 1973). Moreover, it should be kept in mind that the input-output constraints related to the hold in the aspectual morpheme, given in (3) and (5), only compare the output realization of the aspectual morpheme to the input when there is an output realization; that is, zero marking does not violate these constraints.[3]

The working of these constraints, together with the MAX and ALIGN constraints proposed in (1) and (2), is illustrated in Tableaux 6.1 and 6.2. In Tableau 6.1, the input consists of the verb SLEEP with its relevant features and the reduplicant aspectual morpheme RED$_{\text{IPFV}}$ for imperfective aspect, which is not specified for any features. In Tableau 6.2, the input is the verb SWIM with its relevant features and the reduplicant aspectual morpheme RED$_{\text{PFV}}$ for perfective aspect, which is specified for a final hold. Both RED$_{\text{PFV}}$ and RED$_{\text{IPFV}}$ require a copy of the verb's features. For the input and output candidates, only the features relevant to the present analysis are specified, i.e., those that are sufficient to distinguish the relevant verb and reduplication types; these are: (i) the presence of a path movement (feature [path]) and/or a handshape change ('hs change'); (ii) the presence of a final hold (feature [hold]); (iii) the specification of the trunk as the major location (feature [trunk]).

[3] Logically, two other input-output constraints exist: MAX-IO-[hold]$_{\text{IPFV}}$ (assign a violation for every hold in the input imperfective morpheme without a correspondent in the output imperfective morpheme) and DEP-IO-[hold]$_{\text{PFV}}$ (assign a violation mark for every hold in the output perfective morpheme without a correspondent in the input perfective morpheme). Since I assume that the imperfective morpheme *never* has a hold in the input, while the perfective morpheme *always* has a hold in the input, I do not include these constraints in the formalization, as they would never be violated given the input assumed here.

		SLEEP $\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	+ RED$_{\text{IPFV}}$	IPFV-L	MAX-RED$_{\text{IPFV}}$	MAX-BR-[hold]	DEP-BR-[hold]	MAX-IO-[hold]$_{\text{PFV}}$	DEP-IO-[hold]$_{\text{IPFV}}$
☞	a)	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$			*				
☞	b)	[path]	[path]	*					
	c)	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	*					*!
	d)	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	[path]	*		*!			
	e)	[path]	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	*			*!		*

Tableau 6.1. Formalization of the verb SLEEP, which has an inherent final hold, in the imperfective aspect.

In Tableau 6.1, Candidate a) corresponds to zero marking: there is only one feature bundle, that of the base. This candidate violates the MAX-RED$_{\text{IPFV}}$ constraint, given that there is no reduplicant. All other candidates b) – e) have a separate, sequential feature bundle for the reduplicant, thus violating the ALIGNMENT constraint. Candidate b) satisfies DEP-IO-[hold]$_{\text{IPFV}}$, since no hold is added to the reduplicant, as well as the BR-[hold] constraints, since there also is no hold in the base.[4] Candidate c) also has a reduplicant fully faithful to the base, but it violates DEP-IO-[hold]$_{\text{IPFV}}$, given that a hold has been added to the imperfective reduplicant morpheme. Candidates d) and e) violate the BR-FAITH constraints, since the base is specified for [hold] but the reduplicant is not in d), and vice versa in e). Candidate e)

[4] In this and the following Tableaux, I assume that MAX- and DEP-IO-[hold] for the base verb are ranked very low, and that NGT thus allows for a discrepancy between input and output in terms of the [hold] feature in the base verb. I did not include these constraints for the sake of simplicity and readability of the OT-tableaux. Note that adding such constraints to the current ranking as presented in Tableaux 6.1–6.6 would result in the zero-marked candidate a) being the only optimal candidate, but this ranking is not yet final (most importantly, the ALIGNMENT and MAX-RED constraints are not yet ranked with respect to each other). The final ranking accounting for the fact that the reduplicated candidate is also optimal at some evaluation times will be based on simulations as described in Section 6.2.3.

additionally violates DEP-IO-[hold]$_{\text{IPFV}}$, since a hold has been added to the reduplicant.[5]

	SWIM [path]	+ RED$_{\text{PFV}}$ [hold]	PFV-L	MAX-RED$_{\text{PFV}}$	MAX-BR-[hold]	DEP-BR-[hold]	MAX-IO-[hold]$_{\text{PFV}}$	DEP-IO-[hold]$_{\text{IPFV}}$
☞ a)	[path]			*				
b)	[path]	[path]	*				*!	
☞ c)	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	*					
d)	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	[path]	*		*!		*	
e)	[path]	$\begin{bmatrix}\text{path}\\\text{hold}\end{bmatrix}$	*			*!		

Tableau 6.2. Formalization of the verb SWIM, which has no inherent final hold, in the perfective aspect.

Tableau 6.2 illustrates that the constraints work in largely the same way for the perfective aspect. The crucial difference with imperfective aspect is that candidate b), where base and reduplicant are identical, but neither contains a final hold, violates MAX-IO-[hold]$_{\text{PFV}}$, as the hold in the input perfective morpheme has been deleted. Candidate c) satisfies this constraint, as well as the BR-[hold] faithfulness constraints, since the base also contains a hold.

Tableaux 6.3 and 6.4 illustrate that these constraints also yield the correct output candidates for verbs where there is no hold to be deleted from the input verb

[5] In Tableau 6.1, a logically possible candidate is missing, where the base verb, in this case SLEEP, is articulated without its hold and without a reduplicant, i.e., with only a path movement. In this tableau and the ones to follow, I exclude such candidates at the outset, given that articulating such a sign without its inherent final hold would be articulatorily unlikely when no reduplicant is following it. I actually tried adding a constraint prohibiting this, i.e., an IO-FAITH constraint protecting the hold of the base alone. It turned out, however, that adding such a constraint and the relevant candidate to the formalization does not drastically change the output distributions resulting from the simulation as reported in Table 6.4.

in the imperfective (SWIM; Tableau 6.3) and for verbs where no hold needs to be added to the verb in the perfective (HUG; Tableau 6.4).

	SWIM [path]	+ RED_{IPFV}	IPFV-L	$MAX\text{-}RED_{IPFV}$	MAX-BR-[hold]	DEP-BR-[hold]	$MAX\text{-}IO\text{-}[hold]_{PFV}$	$DEP\text{-}IO\text{-}[hold]_{IPFV}$
☞ a)	[path]			*				
☞ b)	[path]	[path]	*					
c)	[path hold]	[path hold]	*					*!
d)	[path hold]	[path]	*		*!			
e)	[path]	[path hold]	*			*!		*

Tableau 6.3. Formalization of verb SWIM, which has no inherent final hold, in the imperfective aspect.

Tableau 6.3 has as input the verb SWIM, with a path movement and without hold, and the imperfective reduplicant morpheme. It illustrates that, again, all candidates with reduplication, i.e., candidates b) – e), violate the ALIGNMENT constraint, while the zero-marked candidate a) violates the MAX-RED constraint. Additionally, candidates c) and e), with a hold in the reduplicant, violate DEP-IO-$[hold]_{IPFV}$, and candidates d) and e) violate the BR-FAITH constraints, given that base and reduplicant are not identical with respect to the presence of holds. This is not the case for candidate b), where a hold is neither added to the reduplicant nor to the base.

	HUG [path, trunk, hold]	+ RED$_{PFV}$ [hold]	PFV-L	MAX-RED$_{PFV}$	MAX-BR-[hold]	DEP-BR-[hold]	MAX-IO-[hold]$_{PFV}$	DEP-IO-[hold]$_{IPFV}$
☞ a)	[path, trunk, hold]			*				
b)	[path, trunk]	[path, trunk]	*				*!	
☞ c)	[path, trunk, hold]	[path, trunk, hold]	*					
d)	[path, trunk, hold]	[path, trunk]	*		*!		*	
e)	[path, trunk]	[path, trunk, hold]	*			*!		

Tableau 6.4. Formalization of verb HUG, which has an inherent final hold, in the perfective aspect.

The ALIGNMENT and MAX-RED constraints in Tableau 6.4 have the exact same workings as before, where the input is the verb HUG, which is specified for a path movement and a final hold on the trunk, together with the perfective reduplicant morpheme. In this tableau, candidates without a hold in the reduplicant, i.e., candidates b) and d), violate MAX-IO-[hold]$_{PFV}$, and candidates d) and e) violate the BR-FAITH constraints. Candidate c) violates none of those constraints, given that both base and reduplicant contain a hold.

While the type of aspectual reduplication does not depend on phonological features of the base sign, there are phonological features that appear to block imperfective reduplication. Therefore, some markedness constraints have to be added to the formalization. Specifically, verbs specified for [trunk] and verbs with a handshape change are never reduplicated in the imperfective data. In Chapter 3, it has been hypothesized that combining a change in finger position with movement repetition might be too complex when the movement cycles are uninterrupted, and it has been pointed out that the resistance of body-anchored signs to undergo reduplication is observed more generally – not only for NGT plural reduplication (see Chapter 2), but also in other sign languages (Pizzuto & Corazza 1996 for Italian Sign Language; Sutton-Spence & Woll 1999 for BSL; Pfau & Steinbach 2005a for

German Sign Language). The relevant markedness constraints are provided in (7) and (8), and their workings are illustrated in Tableaux 6.5 and 6.6.

(7) *RED$_{\text{IPFV}}$, [trunk]$_{\text{V}}$: Assign a violation mark for every instance of imperfective inflection of a verb that is specified for [trunk] as its major location.

(8) *RED$_{\text{IPFV}}$, HANDSHAPE CHANGE$_{\text{V}}$:
Assign a violation mark for every instance of imperfective inflection of a verb that has a handshape change.

HUG [path trunk hold] + RED$_{\text{IPFV}}$			*RED$_{\text{IPFV}}$, [trunk]$_{\text{V}}$	*RED$_{\text{IPFV}}$, HS CHANGE$_{\text{V}}$	IPFV-L	MAX-RED$_{\text{IPFV}}$	MAX-BR-[hold]	DEP-BR-[hold]	MAX-IO-[hold]$_{\text{PFV}}$	DEP-IO-[hold]$_{\text{IPFV}}$
☞ a)	[path trunk hold]					*				
b)	[path trunk]	[path trunk]	*!		*					
c)	[path trunk hold]	[path trunk hold]	*!		*					*
d)	[path trunk hold]	[path trunk]	*!		*		*			
e)	[path trunk]	[path trunk hold]	*!		*			*		*

Tableau 6.5. Formalization of constrained verb HUG (location [trunk]) in the imperfective aspect.

	MELT [path] *hs change*	+ RED$_{\text{IPFV}}$	*RED$_{\text{IPFV}}$, [trunk]$_{\text{V}}$	*RED$_{\text{IPFV}}$, HS CHANGE$_{\text{V}}$	IPFV-L	MAX-RED$_{\text{PFV}}$	MAX-BR-[hold]	DEP-BR-[hold]	MAX-IO-[hold]$_{\text{PFV}}$	DEP-IO-[hold]$_{\text{IPFV}}$
☞ a)	[path] *hs change*					*				
b)	[path] *hs change*	[path] *hs change*		*!	*					
c)	[path hold] *hs change*	[path hold] *hs change*		*!	*					*
d)	[path hold] *hs change*	[path] *hs change*		*!	*		*			
e)	[path] *hs change*	[path hold] *hs change*		*!	*			*		*

Tableau 6.6. Formalization of constrained verb MELT (handshape change) in the imperfective aspect.

Tableau 6.5 illustrates that any type of imperfective reduplication (candidates b) – e)) violates the constraint in (7) when the verb is specified in the input and output for major location [trunk]. Tableau 6.6 illustrates that any type of imperfective reduplication (candidates b) – e)) violates the constraint in (8) when the verb is specified for a handshape change. Zero marking (candidate a) in both tableaux) does not violate those constraints. These two markedness constraints do not have any consequences for verbs without these features in the imperfective aspect, as these verbs never violate them. They are also never violated by verbs in the perfective aspect, regardless of their inherent phonological features.

6.2.3 Ranking values

When demonstrating the workings of the constraints introduced above, I assumed a preliminary ranking. This ranking could account for the variation observed in the data to a certain degree, as illustrated by Tableaux 6.2–6.4, where two winners are predicted (the zero-marked candidate and the candidate with the relevant reduplication type). However, reduplication and zero-marking do not always each occur 50% of the time (cf. Table 6.1). The question remains whether these constraints can be ranked such that they replicate the actual variation (i.e., distribution of output forms) in the data. To answer this question, I employ stochastic OT (Boersma 1997; Boersma & Hayes 2001), a model which assumes that constraints are ranked on a continuous ranking scale, and that a small noise, which is added to the ranking value of each constraint at evaluation time, may result in a slightly different ranking of constraints at different evaluation times (see Chapter 1 and Chapter 5).

The procedure I applied is the same as reported for the nominal plurals in Chapter 5: I used the Gradual Learning Algorithm (Boersma & Hayes 2001) to obtain the ranking values of the constraints based on the distributions of observed output forms. The acquisition process was simulated using OTMulti grammar in Praat (Boersma & Weenink 2023). I defined all constraints, the output candidates, and constraint violations (as presented in Sections 6.2.1 and 6.2.2) in an OTMulti grammar, which is provided in Appendix 6-A1. The initial grammar had the ranking values of all constraints set at 100, and these values were changed on the basis of the data. The data consisted of input-output pairs, where the input was an NGT verb (with or without internal movement or location feature [trunk]) and either the imperfective or the perfective morpheme. The output involved reduplication, with or without holds, or zero marking, depending on the given input. These pairs were drawn from a distribution that was defined on the basis of the forms observed in our data (Table 6.1): the distribution is shown in Table 6.2, where (i) a distinction is made between reduplication with and without holds, (ii) no distinction is made between verbs with or without [trunk] or handshape change for the perfective aspect, given that these phonological features do not play a role in the choice of strategy for this aspect type, and (iii) instances with predicate ellipsis or an unclear predicate are excluded. The full input-output pair distributions are given in Appendix 6-A2.

Table 6.2. Occurrence frequencies of reduplication and zero marking as defined in the input for the simulation.

	Verb properties	Output forms		
		Predicate reduplication with hold (%)	Predicate reduplication without hold (%)	Zero marking (%)
Imperfective	Handshape change	0%	0%	100%
	Location [trunk]	0%	0%	100%
	No potentially constraining features	0%	49%	51%
Perfective	All verbs	71%	0%	29%

Recall from Chapter 5 that one input-output pair was drawn from the input-output distributions at a time and fed to the grammar. Based on its current constraint ranking, the grammar produced an output for each pair. This output was compared to the expected output that was provided as part of the input-output pair. If the two were identical, the constraint ranking stayed the same, but if there was a discrepancy between the two, the constraint ranking was adjusted (see Chapter 1 and Chapter 5 for details, and see also Boersma & Hayes 2001). In total, 100,000 tokens of input-output pairs were fed to the grammar. The constraint ranking acquired based on this aims at replicating the input distributions (specifications set to the standards in Praat). This grammar was then evaluated by feeding it 100,000 times input candidates. The whole simulation was repeated 100 times (again, the same procedure as followed for the plural data in Chapter 5). The mean ranking values of the constraints that resulted from these simulations are given in Table 6.3, and the mean output frequencies for all input forms are given in Table 6.4.

Table 6.3. Ranking of the constraints in the 100 grammars, with their mean ranking values in the right column.

*RED$_{IPFV}$, [trunk]$_{V}$	112.4
*RED$_{IPFV}$, HS CHANGE$_{V}$	112.3
MAX-RED$_{PFV}$	100.8
IPFV-L	100.04
DEP-BR-[hold]	100.0
DEP-IO-[hold]$_{IPFV}$	100.0
MAX-BR-[hold]	100.0
MAX-IO-[hold]$_{PFV}$	100.0
MAX-RED$_{IPFV}$	99.96
PFV-L	99.2

Table 6.4. Aspect marking strategies per aspect type: left columns under output forms: observed frequency (cf. Table 6.2), right columns under output forms: mean occurrence frequencies in the output of the simulations.

	Verb properties	**Output forms**					
		Predicate reduplication with hold (%)		**Predicate reduplication without hold (%)**		**Zero marking (%)**	
Imperfective	Handshape change	0%	0%	0%	0.00089%	100%	99.99911%
	Location [trunk]	0%	0%	0%	0.00085%	100%	99.99915%
	No potentially constraining features	0%	0%	49%	49%	51%	51%
Perfective	All verbs	71%	71%	0%	0%	29%	29%

The mean ranking values in Table 6.3 show that all constraints stayed relatively close together, with ranking values ranging between 112.4 and 99.2, compared to a range of 102 to -337 in the simulation of plural reduplication in Chapter 5. This closeness of ranking values is due to the fact that all three output forms occur frequently in the data (overall large variation), even though their distribution is distinctively tied to the properties of the verb for the imperfective and to the distinction between perfective and imperfective marking in general. The constraints shifted such that they could account (i) for the fact that reduplication never occurs for constrained verbs in the imperfective, hence the relatively high ranking of the two markedness constraints, and (ii) for the fact that reduplication with holds is more frequent than zero marking in the perfective, hence the higher ranking of MAX-RED$_{PFV}$ and the lower ranking of PFV-L compared to the same constraints for the imperfective. Moreover, the four constraints in between (i.e., two general DEP- and MAX-BR-[hold] constraints, plus MAX-IO-[hold]$_{PFV}$ and DEP-IO-[hold]$_{IPFV}$) did not move at all during the simulation and remained at a ranking value of 100, because all four were violated only by non-winning candidates, which at the same time violated one of the alignment constraints (i.e., PFV-L or IPFV-L, depending on the aspect type). These candidates could never win, as they were harmonically bounded by the candidate with simple reduplication with hold for the perfective and without hold for the imperfective, both of which only violated the relevant alignment constraint (see, e.g., Samek-Lodovici & Prince 1999 for an elaboration on harmonic bounding).

A comparison of the output frequencies produced by the grammar (right columns under output forms in Table 6.4) to the frequencies observed in the data (left columns under output forms in Table 6.4) reveals that the learned constraint ranking represents the variation in forms accurately, that is, the verb types exhibit the aspect marking strategies as observed in the data, as well as the observed distribution between these strategies.[6]

6.3 Plural and aspectual reduplication: synthesis and comparison of the formalizations

The formalization of aspectual reduplication employs the same constraint types as those proposed for plural reduplication in Chapter 5; these constraint types are modality-independent, as they involve notions that have been shown to play a role in spoken language reduplication, too, such as marked feature combinations, input-output and base-reduplicant faithfulness, and alignment. At the same time, the

[6] In very rare instances (less than 0.001%), the simulation of imperfective aspect marking resulted in an output form that never occurred in the real data, namely, reduplication without hold for verbs with handshape change and for verbs with a [trunk] location. The candidate with this simple reduplication violates two different constraints than the expected winning candidate with zero marking, and is thus not harmonically bounded to the latter. Due to stochastic evaluation and the very close ranking of the relevant constraints, a reversal of ranking and a different resulting winner was possible.

present formalization confirms that some of the proposed constraints on NGT reduplication necessarily refer to features specific to the visual-spatial modality. In fact, the formalization of aspectual reduplication adds even more modality-specific features to the picture, i.e., the location feature [trunk], the movement features [path] and [hold], and specification for 'handshape change'.

Combining the constraints proposed for both functions into one OT-grammar provides us with a more general picture of the behavior of reduplication in NGT. Therefore, an overview of all constraints proposed in Chapter 5 and in the current chapter is shown in Figure 6.1. In the figure, constraints proposed for plural reduplication are presented in the left column, and constraints proposed for aspectual reduplication are presented in the right column. The relative height of the constraints reflects their ranking values, with higher-ranked constraints displayed higher in the figure; constraints with the same value are placed at the same height horizontally. The mean ranking values of 100 simulated grammars (as shown in Table 6.3 in the present chapter and Table 5.3 in Chapter 5) are also given on the left of each row.

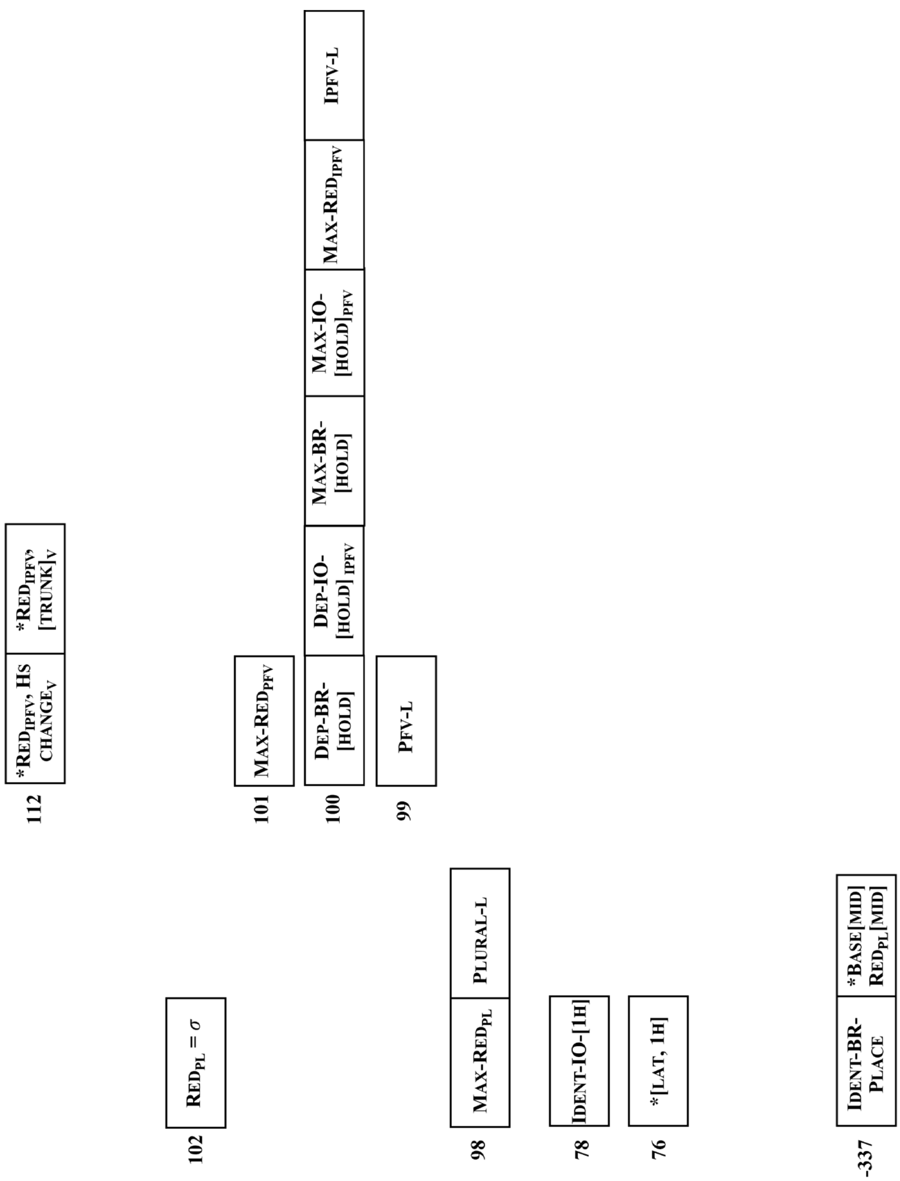


Figure 6.1. Overview of OT-constraints proposed for aspectual reduplication (right column) and plural reduplication (left column) in NGT and their mean ranking values of 100 simulated grammars.

For aspectual reduplication, Figure 6.1 shows that the two markedness constraints are ranked highest, dominating all other constraints. The other constraints are not necessarily ranked with respect to each other, except for MAX-RED$_{PFV}$ and PFV-L. For plural reduplication, Figure 6.1 shows that the constraints are more clearly ranked with respect to each other. A size-defining constraint on the reduplicant dominates the MAX-RED and ALIGNMENT constraints, which, in turn, dominate IO-FAITH and a markedness constraint. Finally, two BR-FAITH constraints are ranked very low for plural reduplication in NGT (cf. Chapter 5 for all details on the constraints).

Figure 6.1 allows us to compare the constraint rankings for aspectual and plural reduplication in NGT. First, it is clear that the implementation of the reduplicant morphemes is similar across the functions, as it is always achieved by means of a MAX-RED and an ALIGNMENT constraint. The current formalization distinguishes three MAX-RED constraints, and three ALIGNMENT constraints (i.e., for plural, imperfective, and perfective separately). This leads to the question whether we can assume a general MAX-RED constraint and a general ALIGNMENT constraint on all reduplicant morphemes in NGT, since the constraints actually play a very similar role across functions, and their mean ranking values are also very close. However, the data on aspectual reduplication suggest that the slight differences in ranking are crucial to account for differences between aspect types. As mentioned in the previous section, reduplication is more frequent than zero marking for perfective aspect, while the distribution is almost 50/50 for imperfective aspect (that is, for unconstrained verbs; cf. Table 6.1). If we assumed one general ALIGNMENT constraint and one general MAX-RED constraint for both aspect types, then the simulations and resulting grammar (as reported on in Section 6.2.3) would not be able to distinguish between aspect types, and the distribution between zero marking and reduplication would be exactly the same for both of them, which contradicts the patterns extracted from the data.[7]

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[7] Running a simulation with such general constraints, using, again, the Gradual Learning Algorithm (Boersma & Hayes 2001) and OTMulti grammar in Praat (Boersma & Weenink 2023), results in a simulated output distribution of 40% zero marking versus 60% reduplication for both aspect types. This does not reflect the distributions in the data set. An alternative explanation is that the real distribution between reduplication and zero marking actually is the same across aspect types (60% and 40%, respectively), but that the data are skewed. Indeed, once we exclude unclear verbs and ellipsis, 259 instances of imperfective aspect remain – of which 213 are unconstrained verbs – while perfective aspect is underrepresented with only 79 instances (see Table 6.1). A larger dataset with a better balance between the two aspect types may provide frequencies that are in line with the frequencies predicted by a constraint set with general MAX-RED and ALIGN constraints, but this I leave to future studies.

Thus, for now, separate MAX-RED and ALIGNMENT constraints are included in the analysis. Alternatively, if general constraints were assumed, a solution to derive the output distributions that the aspectual data predict would be to add an ad-hoc constraint which prohibits reduplication in the imperfective, leading to a lower occurrence of reduplicated output forms in the imperfective than in the perfective. However, there is no obvious motivation for such a constraint in NGT.

Further, an important difference between the analyses of plural and aspectual reduplication lies in the role of both markedness and BR-FAITH constraints. This is reflected in the ranking shown in Figure 6.1. Since verbs with specific phonological features are never reduplicated in the imperfective, markedness constraints concerning these features are high-ranked. For plurals, phonological restrictions on reduplication are less strict, leading to lower-ranked markedness constraints. Moreover, for plurals, base-reduplicant faithfulness constraints are ranked at the lower end of the scale, and indeed, phonological differences between base and reduplicant occur (cf. sideward reduplication). For aspect, a discrepancy between base and reduplicant was never observed in the data, and BR-FAITH constraints, together with IO-FAITH constraints, account for the surface form of the two aspectual reduplication types.

Finally, recall that for aspect, I did not consider candidates in which base and reduplicant are completely aligned, i.e., cases involving simultaneous reduplication. Section 6.2.1 indicated that such candidates were excluded at the outset, as they do not occur in the data and appear to violate a constraint that is high-ranked in NGT. There are at least two possibilities as to what kind of constraint this might be. One option is a constraint similar to the one proposed for nominal plurals in Chapter 5, namely $\text{RED}_{\text{PL}} = \sigma$: "Assign a violation mark if a correspondent of the reduplicant plural morpheme is present in the output but is not a syllable". Recall from Chapter 5 that simultaneous reduplicants do not involve a separate sequential movement and thus do not add a syllable to the base, violating this constraint. Indeed, Figure 6.1 shows that this constraint is ranked relatively high in NGT; it was assigned the highest mean ranking value in the simulations for plural reduplication (cf. also Table 5.3 in Chapter 5). It is thus possible that NGT has a general, high-ranked size constraint on the reduplicant (recall also from Chapter 5 that in American Sign Language, too, it is the syllable that is reduplicated under aspectual inflection; see Sandler 1989, 2008).

However, I decided not to include such a general size-defining constraint in the current formalization, since there is a second possible explanation for the lack of simultaneous aspectual reduplication: iconicity. In principle, the simultaneous reduplication of a one-handed verb such as CHOOSE could be interpreted iconically as 'two people choosing at the same time' or 'one person choosing two things' – and in fact, the NGT reciprocal data reported on in Chapter 4 confirm that simultaneous backward reduplication of a one-handed verb may yield a reciprocal interpretation, i.e., ‘two people (simultaneously) choosing each other’. Further, habitual, continuative, and iterative aspect necessarily involve sequential, rather than simultaneous, subevents (such as ‘choosing every week’). Sequential reduplication thus appears to be a convenient iconic strategy for expressing these aspectual distinctions, in contrast to simultaneous reduplication. For NGT verbs, the choice for or against simultaneous reduplication may therefore be better captured by an iconicity constraint (see, e.g., Eccarius 2011), rather than by the size constraint proposed for plurals. In fact, even for nominal plurals in NGT, an iconic interpretation of simultaneous reduplication has been noted, specifically when a one-handed noun is articulated with both hands without additional repetition: Harder et al. (2003) report that this strategy expresses the meaning ‘two’. A similar observation has been made for British Sign Language (Sutton-Spence & Woll 1999). Yet, recall from Chapter 5 that this strategy is attested only rarely in the present plural data set, and when it occurs, it usually does not express ‘two’ specifically, which lead me to assume a size-defining constraint in the first place. The current data do not allow me to draw final conclusions on this matter.

6.4 Outlook: extending the formalization to reciprocal reduplication

While it is not my aim to offer a complete OT-formalization of NGT reciprocal reduplication, this section elaborates on the factors that will be of importance for such a formalization, and how they tie in with the analyses presented in the present chapter and in Chapter 5.

First, recall the patterns for reciprocal reduplication identified in Chapter 4. Two types of reduplication have been observed, i.e., simultaneous and sequential backward reduplication, which alternate with zero marking. Two-handed verbs were never reduplicated in the data. To illustrate the patterns for one-handed verbs, Figure 4.15 from Chapter 4 is repeated here as Figure 6.2. It is clear from this figure that for one-handed verbs, the agreement properties as well as the reciprocal meaning play a role in the choice of reciprocal marking strategy.

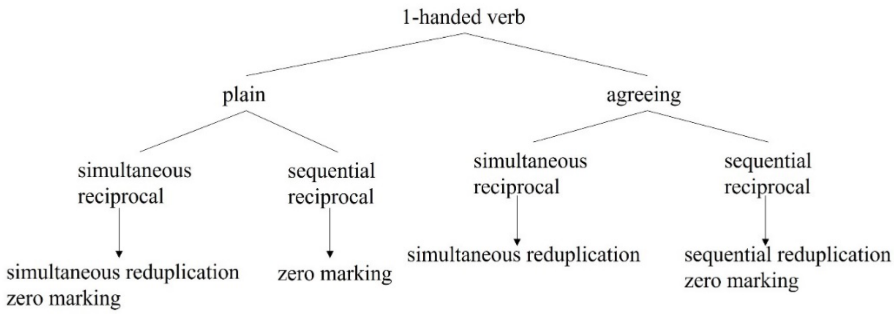

Figure 6.2. Patterns for one-handed verbs in the reciprocal data, as reported on in Chapter 4, Figure 4.15.

The formalization of reciprocal reduplication can largely follow the lines of the formalizations proposed for aspect and plurals; yet, some adaptations will be necessary, too. First, as for the implementation of the reciprocal morpheme, we can assume that – just like for the other two functions – reduplication is the default strategy. A MAX-RED$_{\text{REC}}$ constraint (or possibly a more general MAX-RED constraint, as discussed in the previous section), requiring the reduplicant reciprocal morpheme to have a correspondent in the output, is satisfied by all candidates involving reduplication. An ALIGNMENT constraint is also relevant, since in reciprocal reduplication (just as in plural reduplication), it is possible to align the reduplicant and the base, as already mentioned in the previous section. Candidates employing simultaneous reduplication will satisfy the ALIGNMENT constraint, while candidates employing sequential reduplication will violate it.

As for the choice of reciprocal marking strategy, reciprocals are in certain regards similar to plurals, and in others similar to aspect. On the one hand, they align with both nominal plurals and imperfective aspect, in that the choice between zero marking and reduplication depends to some extent on properties of the base sign: two-handed verbs are always zero-marked, which could be accounted for by a highly-ranked markedness constraint prohibiting the reciprocal inflection of two-handed verbs.

On the other hand, reciprocals behave similarly to aspectually modified verbs in that input-output faithfulness plays a role in the choice of strategy – mainly in the choice of reduplication type. Recall that not only phonological, but also morphosyntactic properties influence reciprocal marking: in Chapter 4, it was noted that plain verbs are zero-marked more often than agreeing verbs (at least in the elicited data), and from Figure 6.2, it is clear that when plain verbs are reduplicated, they tend to undergo simultaneous reduplication. Pfau & Steinbach (2003), in their OT-account of reciprocal reduplication in German Sign Language (DGS), assume that plain verbs are specified in the input for their beginning and end point, while agreeing verbs are not. They employ a very general input-output faithfulness constraint IDENT(F), according to which "features specified in the input may not be changed" (p. 28), and which is violated when a plain verb is reduplicated sequentially, as this process changes the beginning- and/or endpoint of the verb. Agreeing verbs, on the other hand, do not violate this constraint when undergoing sequential reduplication, since their beginning and end points are not specified in the input. This kind of input-output faithfulness appears to play a role for NGT reciprocals, too.

Moreover, different types of reciprocal reduplication have been found to express a difference in meaning. Sequential reduplication tends to express sequential reciprocal meaning, whereas simultaneous reduplication tends to express simultaneous reciprocal meaning. For aspect, it was also observed that different reduplication types express different meanings. Therefore, just like for aspect, it seems reasonable to already distinguish the two reciprocal types in the input, and then input-output faithfulness will play a role.

Finally, BR-FAITH constraints are expected to be ranked low for reciprocal reduplication, given that in both sequential and simultaneous backward reduplication, the movement of the verb is reversed in the reduplicant, causing the reduplicant to differ from the base in terms of location features. In this sense, reciprocal reduplication behaves like sideward reduplication in nominal pluralization.

Taken together, it appears that the constraint ranking proposed in Figure 6.1 can serve as a point of departure for formalizing reciprocal reduplication. Still, future research will have to sort out which further adaptations are necessary for an OT-formalization that can account for the patterns, as well as the variation, observed in the reciprocal data.

6.5 Conclusion

This chapter has offered an OT-analysis of aspectual reduplication in NGT. Building on the formalization of nominal plural reduplication in the same language, and by means of a simulation within stochastic OT, I was able to account for the patterns and variation in the aspect data. A comparison of the formalizations of NGT plural and aspectual reduplication, as well as speculations on how reciprocal reduplication would fit into the analysis, show that the same modality-independent constraint types, which involve notions such as markedness, IO- and BR-FAITH, ALIGNMENT, and MAX-RED, are relevant for all three functions. The general implementation of the reduplicant morpheme is similar across functions, reduplication being the default strategy for all three of them. Modality-specific features play a role in some constraints for all three functions.

At the same time, a consideration of the specific choice of reduplication type, as well as of the alternation between reduplication and zero marking, reveals that there are differences between the investigated functions in the ranking of specific constraint types. To give two examples, markedness constraints prohibiting the reduplication of certain features are ranked higher for verbal reduplication than for nominal plural reduplication, and base-reduplicant faithfulness constraints are ranked higher for aspectual marking than for reciprocals and plurals. Extending the OT-analysis of plural reduplication to other reduplicative functions in NGT has thus provided a broader and more comprehensive picture of the behavior of the process within the language.

Chapter 7 | General discussion: A typological and theoretical perspective on NGT reduplication

In the present dissertation, I have offered an overview of reduplication in Sign Language of the Netherlands (NGT), focusing on three morphosyntactic functions encoded by this word formation strategy: nominal pluralization, aspect marking, and reciprocal marking. This final chapter aims to bring together the results for all three functions, offering a general typological and theoretical perspective on NGT reduplication. I first summarize the main results of the study in Section 7.1, before turning to the broader typological and theoretical contributions of the study in Sections 7.2 and 7.3, respectively. Finally, Section 7.4 proposes some directions for future research on the topic.

7.1 Summary of main findings

The present study investigated NGT plural, aspectual, and reciprocal reduplication, based on data extracted from the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008), as well as elicited data. The combination of these methods allowed me to uncover variation in the language on the one hand, and to identify patterns on the other hand. Below, I summarize the findings for each investigated function of reduplication, addressing the three main goals of the dissertation, namely to provide (i) a description of NGT reduplication, identifying potential restrictions on its application; (ii) a typological perspective, comparing the present findings to what has previously been reported for reduplication in other signed and spoken languages; (iii) a theoretical perspective, formalizing the findings in stochastic Optimality Theory (OT).

7.1.1 Plural reduplication

(i) Description of NGT. Two general nominal reduplication types are used to pluralize NGT nouns: simple and sideward reduplication, both of which are sometimes executed simultaneously with the non-dominant hand. These reduplication types alternate with zero marking.[1] The choice of pluralization strategy

[1] As before, "zero marking" in this chapter describes instances where there is no marking on the noun or verb sign under analysis; yet, there may be marking elsewhere in the sentence.

largely depends on phonological properties of the base noun: (i) nouns with a lateral location tend to undergo sideward reduplication, and can be zero-marked; (ii) nouns that are body-anchored or have a complex (repeated) movement tend to be zero-marked, but may also undergo simple reduplication; (iii) nouns with a midsagittal location can undergo simple or sideward reduplication, or be zero-marked.

(ii) Cross-linguistic comparison. Plural reduplication in NGT appears to be optional, in line with what has been observed for other morphosyntactic processes in various sign languages (e.g., De Beuzeville et al. 2009; Legeland 2016 for agreement marking in Australian Sign Language (Auslan) and NGT, respectively). The phonological restrictions on reduplication in NGT are less strict than has been reported for other sign languages, where plural reduplication is either blocked completely by specific phonological properties, and/or nouns with specific features undergo only one type of reduplication (e.g., Pizzuto & Corazza 1996 on Italian Sign Language (LIS); Sutton-Spence & Woll 1999 on British Sign Language (BSL); Pfau & Steinbach 2005a, 2006 on German Sign Language (DGS)). In NGT, some phonological noun types are more likely to be zero-marked than others, but still, plural reduplication is never completely blocked, and some nouns can undergo multiple types of reduplication. In at least one spoken language, variation in the domain of pluralization, similar to what is attested in NGT, has been identified (cf. Hayes & Abad 1989 for variation between different plural reduplication types in Ilokano).

(iii) Theoretical analysis. The OT-analysis of NGT nominal pluralization successfully implements general, modality-independent constraint types that have previously been proposed for spoken language reduplication, distinguishing input-output faithfulness (IO-FAITH) from base-reduplicant faithfulness (BR-FAITH), employing an ALIGNMENT constraint, and relying on the systematic implementation of phonological features. Most of the relevant phonological features, however, are necessarily modality-specific (e.g., [2H] or [body]). The ranking values of the proposed constraints have been acquired by employing stochastic OT (Boersma 1997; Boersma & Hayes 2001) and the Gradual Learning Algorithm (Boersma & Hayes 2001), using OTMulti grammar in Praat (Boersma & Weenink 2020) to simulate the acquisition process. The learned constraint ranking represents the overall variation in forms correctly, but for a few phonological noun types, the distribution of pluralization strategies is not completely in line with what is observed in the data.

7.1.2 Aspectual reduplication

(i) Description of NGT. The data reveal two aspectual reduplication types: (i) simple reduplication of the verb, which marks imperfective aspect (continuative/habitual), and (ii) simple reduplication with pauses or holds in between movement cycles,

which marks perfective aspect (iterative). Both types alternate with zero marking. Phonological restrictions only appear to apply with regard to the first reduplication type, since verbs with specific phonological properties – a major location on the trunk or a handshape change – are always zero-marked in the data. For verbs lacking those properties, and for perfective aspect, no restrictions were identified, but reduplication appears to be optional.

(ii) Cross-linguistic comparison. The variation and optionality identified in the data is in line with studies on aspect marking in some other sign languages, where similar variation has been observed (Gray 2013; Johnston et al. 2015 on Auslan; Palfreyman 2019 on the urban sign language varieties of Solo and Makassar). Yet, it is striking that NGT does not further distinguish between the habitual and the continuative by means of different reduplication types, given that specific verbal modulations for habituals or continuatives have been described for other sign languages (e.g., Cabeza Pereiro & Fernández Soneira 2004 for Spanish Sign Language (LSE); Rathmann 2005 for American Sign Language (ASL)). At the same time, from a cross-modal perspective, this finding is less surprising, since Bybee (1985) reports that most spoken languages in her sample distinguish only the imperfective and the perfective inflectionally (see also Dahl & Velupillai 2013). NGT does distinguish between the imperfective and perfective by means of different reduplication types. This strategy is not only attested in sign languages; for some spoken languages, too, it has been observed that different reduplication types can distinguish different aspect types (Frachtenberg 1922 on Coos; Mithun 1999 on Salish; Harley & Leyva 2009 on Hiaki). Finally, in NGT, the phonological constraints on aspectual reduplication are specific to the imperfective morpheme. Similar interactions between phonology, morphology, and reduplication type also exist in spoken languages (Harley & Leyva 2009 for Hiaki).

(iii) Theoretical analysis. The formalization of the aspect data shows that the same general, modality-independent constraint types as those proposed for plural reduplication are relevant. At the same time, the constraints on aspectual reduplication add further modality-specific features to the picture (e.g., [trunk]). Following the same procedure as for plural reduplication, the acquisition process was simulated employing stochastic OT (Boersma 1997; Boersma & Hayes 2001), and the learned constraint ranking correctly accounts for both the overall variation in forms, as well as the distribution of aspect marking strategies. The OT-analysis of the aspect data brings to light some differences compared to the nominal plurals. For instance, the choice between reduplication types is governed by the aspectual morpheme in the input rather than by phonological features. Moreover, for aspect, markedness and BR-FAITH constraints are ranked higher than for plurals, since restrictions on reduplication are stricter, and the data never display complex reduplication.

7.1.3 Reciprocal reduplication

(i) Description of NGT. NGT reciprocals can be marked by simultaneous or sequential backward reduplication, alternating with zero marking. Three types of features appear to influence the choice of reciprocal marking strategy: (i) the *phonological* feature handedness, since two-handed verbs are always zero-marked in the data; (ii) the *morphosyntactic* feature agreement, since plain verbs tend to be zero-marked, but can also undergo simultaneous reduplication, while agreeing verbs can undergo all three possible strategies; and (iii) a *semantic* feature regarding the reciprocal meaning, since simultaneous reciprocals tend to be marked by simultaneous reduplication, while sequential reciprocals tend to be marked by sequential reduplication.

(ii) Cross-linguistic comparison. A comparison of NGT reciprocal reduplication to spoken language reciprocal marking in particular illuminates the unique possibilities afforded by the visual-spatial modality, as NGT reduplication commonly involves the simultaneous addition of the non-dominant hand as well as backward movement. Moreover, the fact that the choice between simultaneous and sequential backward reduplication largely depends on semantics is typologically interesting, given that for spoken languages, it has been explicitly claimed that different reciprocal semantics do not have consequences for the distributional properties of reciprocals (Everaert 2000: 78). Taking an intra-modal perspective, it becomes clear that the allomorphy described here also plays a role in other sign languages, such as DGS (Pfau & Steinbach 2003, 2005ab, 2016), Turkish Sign Language (TİD; Kubus 2008), and Indo-Pakistani Sign Language (IPSL; Zeshan & Panda 2011). Still, those studies suggest that it is the morphosyntactic verb type that is usually decisive in the choice between reduplication and zero marking, and they describe clear-cut patterns. In contrast, in NGT, other (phonological and semantic) factors also influence the choice between zero marking and reduplication, and even verbs that in principle could be reduplicated are sometimes zero-marked. Thus, as described for the other two investigated functions, the NGT data display considerable variation.

(iii) Theoretical analysis. No complete OT-formalization of the reciprocal data has been offered in the present study. Still, the analyses of aspectual and plural reduplication can be built upon, and, once again, the same general constraint types appear relevant. The implementation of the reciprocal morpheme can be achieved in the same way as the implementation of the plural and aspectual morphemes, assuming reduplication to be the default strategy. In line with what I proposed for aspect marking, markedness constraints dictating which signs cannot be reduplicated are likely high-ranked, and the choice of reduplication type is governed by the morpheme in the input. Reciprocal reduplication patterns with pluralization in that it

allows for discrepancies between base and reduplicant, i.e., BR-FAITH constraints are low-ranked.

Having summarized the main findings for each function separately, in the next two sections, I aim to bring these results together by going into the broader typological and theoretical contributions of the study.

7.2 Typological contributions

This section first offers a broader cross-modal perspective on NGT reduplication (Section 7.2.1), and then discusses how NGT reduplication can be situated with respect to the same process in other sign languages (Section 7.2.2). It will become clear that the NGT data shed light on both cross-linguistic patterns and variation in the domain of reduplication.

7.2.1 A cross-modal perspective on NGT reduplication

The three investigated reduplicative functions clearly show that multiple reduplication types are available in NGT. This is not unexpected from a cross-modal perspective, since in the oral-aural modality, too, a single language may display multiple types of reduplication. Spaelti (1997) observed that there are two basic types of systems regarding the choice of reduplication type if a spoken language has multiple types available. In the first system, each reduplication type has one or more function(s); the types do not overlap in which meanings they express. In order to express different meanings, one base can thus undergo different reduplication types, which Spaelti (1997: 7) refers to as "duplemes". In the second type of system, multiple reduplication types express the same function(s), but each base can only undergo one type of reduplication, i.e., the different types of reduplication are allomorphs. In other words: the choice of reduplication type depends not on the meaning, but on properties of the base. Such reduplication types are called "alloduples" by Spaelti (1997: 7).

Crucially, the two types of systems identified by Spaelti (1997) are not mutually exclusive, since they may co-occur within a language. Spaelti observes such a mixed system for Doka Timur West Tarangan (Doka Timur WT). In Doka Timur WT, reduplication as presented in (1) has several functions, for instance, it may express nominalization, subordination, and the formation of ordinal numbers. The example is presented as it is in the source, and shows different reduplication types (labelled as "Ci-", "CiC-", or "…C", where *C* stands for 'consonant', and *i* is a default vowel). The choice between these types depends not on the meaning, but rather on properties of the base: "(a) is chosen if there is only one consonant, or when the second consonant does not immediately follow the first vowel. If there is a second consonant immediately following the vowel, then (b) is chosen. Pattern (c) is appropriate, if there is an open syllable immediately preceding the main stress" (Spaelti 1997: 8). The example thus illustrates different alloduples expressing the same meanings.

(1) a. *Ci*: *ˈlɔir* → *liˈlɔir* 'clean-3s'

b. *CiC:* *ˈlet-na* → *litˈletna* 'male-3s'

c. *…C:* *ɛ-laˈjir* → *ɛlarˈjir* '3s-white'

[Doka Timur West Tarangan; Spaelti 1997: 8]

At the same time, Doka Timur WT also has a reduplication type which displays a so-called "Ca" pattern (*C* meaning, again, consonant, and *a* being the default vowel in this case), and is "restricted in use to plural agreement for stative predicates" (Spaelti 1997: 9). This reduplication type is consistent across stems, regardless of their form, as in (2) (the example is, again, presented as in the source). Here, we are dealing with a dupleme for which no different alloduples are distinguished.

(2) a. *kuran-ay* → *kakuranay* 'few-3p'

b. *balin* → *babalin* 'wet'

[Doka Timur West Tarangan; Spaelti 1997: 9]

NGT fits into this picture, since it also presents us with a mixed system. On the one hand, NGT uses different reduplication types in order to distinguish different functions. For instance, the NGT predicate GIVE may undergo (i) simple reduplication to express 'to give habitually, continuously'; (ii) simple reduplication with holds between cycles to express 'to give repeatedly'; (iii) sequential backward reduplication to express 'to give each other sequentially'; and (iv) simultaneous backward reduplication to express 'to give each other simultaneously'. This illustrates that there are different "duplemes" in NGT. At the same time, however, the data on NGT nominal pluralization show that multiple reduplication types can express the same meaning, and that these reduplication types are allomorphs, or, in the terms of Spaelti (1997: 7), "alloduples". For instance, the plural of the lateral noun CHILD is expressed by sideward reduplication, while the plural of the body-anchored noun GLASSES is expressed by simple reduplication.

Further, in NGT, not only phonological properties of the base may influence the choice of reduplication type, but morphological, morphosyntactic, and semantic factors are also sometimes important. In some spoken languages, too, different combinations of these different factors may play a role in the choice of reduplicant shape (see, e.g., Spaelti 1997 on Nakanai; Kennedy 2002 on Woleaian; Haugen 2005 on Uzo-Aztecan languages; Harley & Leyva 2009 on Hiaki). To give one example, for Hiaki, Harley & Leyva (2009) note that the morphophonological structure of the base in some cases predict the reduplication type. For instance, they observe that Hiaki displays light syllable reduplication, which involves copying the onset and first vowel of the verb stem, as in (3a), but "[w]hen a verb contains one of the transitivity-marking suffixes *-te* or *-ta*, attached either to a closed-syllable root or to a bisyllabic root followed (optionally) by a *-k* or *-h* coda consonant, reduplication copies the entire verb root" (p. 246), as exemplified in (3b) (where INTR = intransitive).[2] Harley & Leyva (2009) do not give specific translations for the reduplicated forms in (3ab), but they note that all reduplication types can express all three primary meanings of reduplication in the language (habitual, progressive/continuative, and emphatic meaning).

(3) a. *bwiika* → *bwibwika*
'sing' [Hiaki; Harley & Leyva 2009: 238]

b. *chak-te* → *chakchakte*
'drip-INTR' [Hiaki; Harley & Leyva 2009: 244]

However, the spoken languages mentioned above all display an alternation between different types of reduplication. Beyond this, in NGT, properties of the base sign sometimes result in zero marking, rather than a specific reduplication type. Zero marking, of course, also exists in spoken languages. In German, for instance, some nouns are zero-marked for plurality, and this zero marking can be morphologically triggered (e.g., in nouns ending in an agentive or diminutive suffix; see Pfau & Steinbach 2006). Moreover, it should be kept in mind that in NGT nominal plurals, the choice of strategy is not entirely dependent on base noun properties – recall that some phonological noun types can undergo multiple reduplication types. As noted in Chapter 2 and Chapter 5, such free variation is not unheard of in spoken languages, either. In Ilokano, for instance, nouns with specific phonological features can undergo three different types of reduplication in order to express plurality, and these

[2] Note that Hiaki displays more reduplication types than the ones exemplified in (3). While some can be predicted from the morphophonological structure of the base, this is not always the case. For the details, I refer to Harley & Leyva (2009).

three options are in free variation (Hayes & Abad 1989; see also Boersma & Hayes 2001).

Having discussed some issues related to the choice of reduplication type, I now turn to the specific form of reduplication. Recall from Chapter 1 that spoken languages distinguish between full reduplication – i.e., reduplication of an entire word, stem, or root – and partial reduplication, where only part of the base is repeated. It has previously been claimed that sign languages do not employ partial reduplication as a productive process (Wilbur 2009). Yet, the NGT data present us with a pattern that appears to contradict this claim: for nouns that are specified for an inherent repetition, the pluralized form is sometimes articulated with more movement repetitions than the singular form, yet not twice as many; clearly, this is an instance of partial reduplication, as some movement repetitions have been omitted in the reduplicant (cf. Chapter 2). This type of reduplication had already been analyzed as partial reduplication by Kimmelman (2018) for Russian Sign Language (RSL; based on Burkova & Filimonova 2014). Other instances of partial reduplication have been reported for Catalan Sign Language (LSC; Veiga Busto 2021) and DGS (Pfau & Steinbach 2021). The NGT data thus add further credibility to the claim that the distinction between full and partial reduplication is not specific to the oral-aural modality. Yet, partial reduplication does not appear to be widespread in NGT,[3] and the distinction between partial and full reduplication does not mark any difference in meaning.

Another contrast that has been observed for spoken languages is the one between simple reduplication, where base and reduplicant are identical, and complex reduplication, where base and reduplicant are non-identical (cf. Chapter 1). NGT confirms that this distinction also exists in the visual-spatial modality. Specifically, under sideward and backward reduplication, base and reduplicant are non-identical. For the functions investigated here, complex reduplication always involves changes affecting the location feature of the sign, and, consequently, the direction of the movement.[4] This is striking from a cross-modal perspective, given that for spoken languages, a much wider variety of changes has been noted, such as adding or

[3] Under NGT imperfective reduplication, phonological material is sometimes also deleted, since any inherently specified final hold is omitted (cf. Chapter 6). Here, however, the situation is slightly different, because not only the reduplicant, but also the base is reduced.

[4] Although recall that in Chapter 5 it is proposed that sideward reduplication in nominal pluralization results from inherent properties of the location feature [lat] (for [lateral]), which indicates a location relative to the base for a reduplicant. Consequently, a reduplicant with the feature [lat] automatically involves a further sideward movement with respect to the lateral base. Thus, complex reduplication in this case does not necessarily involve changes to the major location feature itself, but it does result in differences in the settings of base and reduplicant.

changing vowels and consonants, and even reversing the phoneme order (Rubino 2005, 2013; cf. also Chapter 1). It remains to be seen whether we are dealing with a more general pattern here, or whether other reduplication types, or other sign languages, allow for the adaptation of other features in the reduplicant under complex reduplication.

Finally, a commonality between signed and spoken languages is that reduplication in most of its uses is an iconic process (see Downing & Stiebels 2012; Kouwenberg & LaCharité 2015; Börstell to appear; cf. also Chapter 1 and Chapter 5). On a general level, in both modalities, the repetition in form often reflects a repetition in meaning (e.g., multiple entities or events), and reduplication yields a form that is both phonologically and semantically more complex than the base (see Downing & Stiebels 2012; cf. also Lǐ & Ponsford 2018, who present a gradual view on the iconicity of spoken language reduplication, identifying different iconic aspects). However, in NGT – and in other sign languages – the iconicity of the reduplicated form occasionally lies not only in the pure repetition of phonological material, but also in the specific reduplication type. For instance, in reciprocal reduplication, the backward movement and the potential simultaneity reflect the order of subevents, and for iterative aspect, the pauses in between reduplication cycles reflect that multiple events occur with potential breaks separating them. A spoken language parallel may be found in the Thao example (4), where an increase in intensity in (4c) compared to (4b) is reflected by adding another reduplicant, and hence, the use of reduplication vs. triplication iconically reflects a meaning difference. Indeed, for Thao, Blust (2001: 334) notes that "[…] triplication is necessarily iconic" and that it is "an elaboration of reduplication, in which verbs serve the purpose of adding a semantic nuance of intensity or continuation of an activity". Still, the NGT data illustrate that sign languages have more possibilities for different reduplication types to iconically reflect different meanings, since they can employ, for instance, movement reversal and simultaneity – phonological changes that are simply impossible in spoken languages.

(4) a. *ish*
'exclamation used to shoo off a chicken, express disgust, pain, etc.'

b. *ish-ish*
'exclamation of pain'

c. *ish-ish-ish*
'intensive exclamation of pain' [Thao; Blust 2001: 328]

This increased potential for iconicity, however, should not be taken to imply that reduplication looks exactly the same across sign languages, as will become clear in the next section.

7.2.2 An intra-modal perspective on NGT reduplication

A look at the available studies tells us that sign languages display clear cross-linguistic patterns with respect to which reduplication type expresses which function – for instance, sideward reduplication has often been found to express nominal plurality (e.g., Pizzuto & Corazza 1996 for LIS; Sutton-Spence & Woll 1999 for BSL; Pfau & Steinbach 2005a for DGS; Veiga Busto 2021 for LSC), and backward reduplication has often been described to express reciprocity (see Pfau & Steinbach 2016 for an overview and a cross-linguistic survey). Especially for the latter, this is not surprising, given the iconicity of the backward movement (cf. the previous section). Yet, the NGT data illustrate that sign languages also display differences in the reduplication types they employ. For instance, NGT plural reduplication does not seem to differentiate between punctuated repetitions, which involve clearly separable iterations of a sign, and unpunctuated repetitions, which involves less distinct iterations (see Schlenker & Lamberton 2019). Other sign languages do make this distinction (Schlenker & Lamberton 2019 for ASL; Veiga-Busto 2021 for LSC). Further, when marking aspect, NGT does not always modulate the rate and rhythm of reduplicated movements to distinguish aspect types (cf. the lack of differences between habitual and continuative reduplication), while such modulations have been shown to distinguish a wide variety of aspect types in, for instance, ASL (Klima & Bellugi 1979; Rathmann 2005). Finally, characteristics of NGT reciprocals illustrate that there are cross-linguistic differences in how the choice between simultaneous and sequential reduplication is made. NGT uses these reduplication types to iconically reflect a distinction in meaning (as has also been reported for Central Taurus Sign Language (CTSL; Ergin et al. 2020)), while for other sign languages, Pfau & Steinbach (2016) noted that the choice between these reduplication types depends on morphosyntactic and phonological properties of the verb – these also play a role in NGT, but they are certainly not the whole story.

It should thus be clear that the fact that the visual-spatial modality offers unique possibilities for reduplication, and that specific reduplication types may iconically express specific meanings, does not imply that all sign languages would display exactly the same patterns when it comes to reduplication types and their functions. Obviously, this finding has important implications for sign language typology, as it adds novel insights regarding the range of variation among sign languages. Similar observations have also been made for other domains of sign languages, where cross-linguistic differences exist in spite of the important role of iconicity (see, e.g., Padden et al. 2013 for iconic patterning in lexicons; Nyst 2018 for the iconic depiction of size; Nyst et al. 2021 for the distribution of handling and object depiction).

Having discussed reduplication types across sign languages, I now turn to another cross-linguistic pattern. We have seen that sign languages display constraints on reduplication, i.e., not all signs can be reduplicated. It is thus not surprising that I also identified such constraints on NGT reduplication. Yet, previous studies on other sign languages generally report clear, categorical patterns, with base sign features blocking reduplication altogether (e.g., for plural reduplication: Sutton-Spence & Woll 1999 on BSL; Pfau & Steinbach 2005a, 2006 on DGS; for reciprocal reduplication: Pfau & Steinbach 2016 on a variety of sign languages). In contrast to that, the present data suggest that within NGT, there is variation in how strict the constraints are. For both aspect and reciprocal marking, signs with specific phonological features are never reduplicated in the data, that is, the patterns appear to be categorical. However, when it comes to pluralization, nouns are reduplicated irrespective of their phonological make-up, although some phonological noun types are more likely to be zero-marked, and others are more likely to undergo a specific type of reduplication. Further, while previous studies on other sign languages have reported strict restrictions on plural and reciprocal reduplication, reports on similar restrictions on aspectual reduplication are scarce (but such restrictions have been suggested by Hoiting & Slobin 2001 for NGT). Hence, a comparison of the NGT constraints on reduplication to those reported for other sign languages reveals that there is intra-modal variation not only regarding the specific features that constrain reduplication, but also in terms of the reduplicative functions those constraints are relevant for, as well as how strictly they apply for each function.[5]

Signs that involve body-anchored features (such as [body] and [trunk], introduced in Chapters 2 and 3, respectively) deserve special attention here, as body-anchoredness appears to play a constraining role for all three investigated functions. First, body-anchored nouns are less likely to undergo plural reduplication. Second, when it comes to aspect marking, predicates with a location on the trunk are never reduplicated in the data. Third, findings reported in Chapter 4 suggest that one-handed verbs articulated on or close to the face are never reduplicated for reciprocity, although further research is required to verify this observation. Moreover, it has been shown that body-anchored signs cannot be reduplicated in

[5] In addition, as has been pointed out on several occasions throughout Chapters 2–5, methodology likely plays a role in the differences between what has been observed for other sign languages and what I observe for NGT. For instance, one important point that I have addressed is that the present study takes into account naturalistic corpus data, unlike many previous studies. Less clear patterns and more variation are to be expected in this case, because corpus data come closer to naturalistic language use than elicited data.

other sign languages, either (for plurality: Pizzuto & Corazza 1996 for LIS; Sutton-Spence & Woll 1999 for BSL; Pfau & Steinbach 2005a, 2006 for DGS; for reciprocity: Zeshan & Panda 2011 for IPSL). Beyond the domains investigated here, body-anchoredness also constrains other grammatical processes in sign languages. For instance, body-anchored verbs usually cannot be modified spatially to mark agreement, as this would require changing a lexically specified location feature (for NGT: Zwitserlood & van Gijn 2006). Finally, body-anchoredness often has an iconic motivation (e.g., Meir et al. 2007; Oomen 2017). While this was not the focus of the present study, one could speculate that the iconicity of many body-anchored signs influences, or even constrains, reduplication[6] – especially in the case of reduplication types that would result in changes to the location of the sign, i.e., reduce its iconicity (cf. also Chapter 5).[7]

According to van der Hulst & van der Kooij (2023), the prevalence of iconicity in sign languages has far-reaching consequences. Of relevance in the present context is their claim that sign languages in general lack grammatical phonological rules, and that all reported phonological processes in sign languages are actually part of the utterance phonology, i.e., the phonetic implementation system. While in spoken languages such implementational processes may grammaticalize into allomorphic rules, the authors argue that the same does not happen in sign languages, since grammatical phonological rules that blindly change phonological properties of a given sign would run the risk of removing or mutating the iconicity of the sign's phonological building blocks. Throughout the dissertation, I have taken on a different view, following Pfau & Steinbach (2005b, 2006), and I have assumed that allomorphy may surface whenever the choice between different types of reduplication and zero marking is determined by phonological or morphosyntactic properties of the base sign.

For instance, in my view, the NGT nominal pluralization data present us with a clear case of phonologically triggered allomorphy, as lateral nouns are the only noun type to undergo sideward reduplication. Recall from Chapter 5 that it is proposed that the location feature [lat] (for [lateral]) indicates a place of articulation that is relative to the midsagittal plane in the default case, and relative to the base for a reduplicant (see also footnote 4). A reduplicant with the feature [lat] therefore automatically involves a sideward movement with respect to the lateral base, and consequently, a candidate with simple reduplication is excluded by the inherent

[6] The iconicity of body-anchored verbs has also been found to play a role in the interpretation of null subjects in NGT and RSL (see Oomen & Kimmelman 2019 for more details).
[7] Recall, however, however, that in Chapter 2, I already checked whether a different type of iconicity, metonymy, constrains the reduplication of NGT nouns (including non-body-anchored nouns), which turned out to be not the case.

features of lateral nouns. This sideward reduplication even applies if it diminishes the iconicity of the sign: after all, the locations of the reduplicants do not (necessarily) reflect the real-life spatial arrangement of the referents (see van Boven 2020 for more details).[8] Indeed, van der Hulst & van der Kooij (2023) do not exclude the possibility that occasional cases of allomorphy might exist, they only state that it is rare in sign languages. However, it is not the goal of the present study to evaluate the frequency of allomorphy in sign languages.

7.3 Theoretical contributions

We now turn to the general theoretical contributions of the OT-formalization presented in the present dissertation. The study has aimed to provide insight into the OT-constraints that derive reduplication patterns in NGT, and possibly in sign languages more generally (discussed in Section 7.3.1). Further, the formalization of NGT reduplication has shown that there are some inevitable consequences of the modality of signal transmission for such formalizations, calling into question the true universality of OT-constraints (discussed in Section 7.3.2).

7.3.1 OT-constraints guiding reduplication in NGT and beyond

The present dissertation has shown that there are different pressures which influence NGT reduplication. The formalization has captured these pressures by means of different types of OT-constraints:

- The pressure to realize the plural, aspectual or reciprocal morphemes present in the input by repeating the base has been captured by MAX-RED and IO-FAITH constraints;
- The general tendency of sign languages to express morphemes simultaneously has been captured by ALIGNMENT constraints;
- The demand for the reduplicant to be a separate syllable in NGT has been captured by a size-defining constraint on the reduplicant;
- The requirement for base and reduplicant to be identical has been captured by BR-FAITH constraints;

[8] Similarly, recall also from Chapter 5 that nouns with a repeated movement, such as BICYCLE, undergo simple, but not sideward, reduplication, in spite of the fact that simple reduplication could be taken to reflect "to bike again and again" rather than "bicycles" – and yet, no sideward movement is added to avoid this potential confusion, and iconicity considerations do not overrule the application of simple reduplication.

- Finally, the observation that specific phonological features block reduplication has been captured by markedness constraints.

Clearly, some of these pressures and tendencies oppose each other, and favor different winning candidates. The three functions under investigation differ in the relative importance they assign to these different pressures. By ranking the general constraint types differently across reduplicative functions, the different patterns observed for NGT plural and aspectual reduplication could be formalized, to a large extent, successfully. The general constraint types employed here have been adopted from formalizations of spoken language reduplication, aiming at a formalization that is maximally modality-independent (as shown in Chapter 5; see Section 7.3.2 for further discussion).

The question remains whether the pressures I identified are also relevant for reduplication in other sign languages, and if so, how the different types of constraints are ranked cross-linguistically. This is an important area for future research. The present study can only demonstrate that by re-ranking the constraint types proposed for NGT, some of the patterns that have been described for other sign languages can be predicted. For instance, in sign languages for which strict restrictions on plural reduplication have been reported (cf. the previous section), markedness constraints on nominal reduplication are likely high-ranked. Moreover, in sign languages in which simultaneous reduplication fulfills several functions, such as RSL (Kimmelman 2018), ALIGNMENT constraints are likely high-ranked for those functions.

Further, once we reflect on a possible formalization of reduplication in IPSL, it becomes clear that the ranking of constraint types differs across reduplicative functions in other sign languages, too. In IPSL, nouns are zero-marked for plurality (Zeshan 2000), and thus a MAX-RED constraint for the plural morpheme is probably ranked at the lower end of the scale, as already pointed out in Chapter 5. However, in the same language, reduplication has been found to mark iterative aspect (Zeshan 2000) and reciprocity (Zeshan & Panda 2011), suggesting that MAX-RED constraints are ranked higher for these functions. Recall from Chapter 6 that such differences between reduplicative functions in NGT have been taken to suggest that we need to distinguish different MAX-RED constraints for different morphemes, instead of assuming a general MAX-RED constraint. Previous results reported for IPSL are thus in line with this suggestion. Of course, more thorough and complete formalizations of reduplication phenomena in other sign languages are necessary to draw definitive conclusions about the cross-linguistic OT-constraints on sign language reduplication and their rankings.

Sign language reduplication, specifically plural and reciprocal reduplication in DGS, has previously been formalized in OT by Pfau & Steinbach (2005b). Their account of pluralization has briefly been addressed in Chapter 5, where it became clear that the constraints they propose and the ranking of these constraints successfully derive the patterns observed for DGS. This is also true for their account of DGS reciprocals. However, for both functions, Pfau & Steinbach (2005b) only employ IO-FAITH and markedness constraints, while the present study has clearly demonstrated that additional constraint types play a role in sign language reduplication. This can be illustrated by one constraint they include: IDENT(F) "Features specified in the input, may not be changed" (p. 574). This constraint does not explicitly implement the phonological features that play a role in Pfau & Steinbach's analysis – from the authors' explanations it becomes clear that it is violated under various circumstances, namely when there is a change affecting (i) the midsagittal location feature in nouns under sideward reduplication; or (ii) the beginning and end points of plain verbs under backward reduplication; or (iii) the movement/orientation features of one hand in two-handed verbs under simultaneous reduplication. Each of these examples involves different types of features. Note further that all three examples involve discrepancies between base and reduplicant (i.e., complex reduplication), yet, under Pfau & Steinbach's (2005b) formalization, they only violate the IO-FAITH constraint. That is, the potential role of BR-FAITH is ignored for complex reduplication types (cf. Chapter 5). The present study has shown that OT-formalizations of sign language reduplication actually require a systematic implementation of features into constraints, as well as BR-FAITH constraints, much like formalizations of spoken language reduplication.

Finally, it is interesting to note that some of the constraint types employed in the present study also play a central role in another recent OT-formalization of sign language data, offered by Brentari et al. (2021). Their formalization is not about reduplication in general, but more specifically about expressing agency and plurality in single- and multiple-verb VPs (classifier predicates) in four sign languages (Hong Kong Sign Language (HKSL), ASL, BSL, and LIS). Brentari et al. (2021: 598) propose a set of five constraints, including (i) two FAITHFULNESS constraints dictating that plural events and all arguments must be represented in the VP's morphology (reminiscent of our MAX-RED constraints), (ii) a constraint that posits that morphology should be expressed simultaneously (comparable to our ALIGNMENT constraints), and (iii) a markedness constraint prohibiting the repetition of midsagittal movements. These correspondences between Brentari et al.'s account and ours suggest that some pressures and constraint types likely play a more general role in sign language morphology – something which is, for example, not unexpected for ALIGNMENT, given the prevalence of simultaneous morphology across sign languages (e.g., Aronoff, Meir & Sandler 2005).

7.3.2 The effect of modality on OT-formalizations

The present study sheds light on three aspects that are particularly relevant for the OT-formalization of sign language data: (i) the increased potential for iconicity afforded by the visual-spatial modality; (ii) the simulation of variation; and (iii) the implementation of modality-specific phonological features in the OT-constraints. Each of these aspects is addressed in turn.

First, given that iconicity is prevalent at all structural levels in the visual-spatial modality (e.g., Meir et al. 2013; Padden et al. 2013), iconicity constraints have been proposed in previous OT-formalizations of sign languages. For instance, in their formalizations of handshape, Eccarius & Brentari (2010) and Eccarius (2011) propose FAITHFULNESS constraints dictating faithfulness to (the visual characteristics of) external referents. The present formalization did not propose specific iconicity constraints, although, as has been shown, iconicity does play an important role in NGT reduplication. The possibility of an iconicity constraint was briefly discussed in Chapter 6, where I pointed out that simultaneous reduplication does not occur in aspectual reduplication, despite being an option satisfying ALIGNMENT constraints. To prohibit simultaneous reduplication in this case, an iconicity constraint might be implemented in the formalization of NGT aspect marking (e.g., 'assign a violation mark if the order of events is not reflected in the order of movement'). Alternatively, however, simultaneous reduplication could be prohibited by means of a more general constraint on the size of the reduplicant: the requirement that the reduplicant is a separate syllable is violated by simultaneous reduplication. Such a size-defining constraint has been proposed in Chapter 5 for plural reduplication, where the reduplicant usually constitutes a separate syllable.

Based on NGT aspect and plural reduplication alone, it is difficult to decide which of the two options is preferable, although an advantage of a size-defining constraint is that it can also account for non-simultaneous reduplication types that do not have a clear iconic motivation. In future work, the formalization of NGT reciprocal reduplication could shed more light on whether such a size-defining constraint is sufficient, or whether the formalization would benefit from the addition of one or more iconicity constraints. After all, iconicity clearly plays an important role in reciprocal reduplication, as simultaneous subevents are expressed by simultaneous reduplication, while sequential reduplication expresses sequential subevents. Exploring the potential role of such an iconicity constraint on reciprocals is also important from a cross-linguistic perspective, as the role of iconicity in encoding reciprocals is not unique to NGT; see, e.g., Lourenço & Borges de Figueiredo (2023), who show that the structure of subevents influences the movement type in inherent reciprocals in Brazilian Sign Language (Libras).

Second, given that various studies have shown that sign languages display variation in various domains of their grammars (e.g., Oomen & Pfau 2017 for negation in NGT; Fenlon et al. 2018 for verb modification in BSL; Palfreyman 2019 for aspect and negation in the urban sign language varieties of Solo and Makassar (Indonesia)), it is not surprising that the NGT data present us with a considerable amount of variation, too – especially given the fact that I included corpus data, where such variation is often uncovered (cf. Kimmelman et al. 2018). For spoken language, such variation had previously been formalized successfully within the framework of stochastic OT (Boersma 1997; Boersma & Hayes 2001). In Chapters 5 and 6, the ranking values of the proposed constraints were acquired based on the distribution of observed output forms with the Gradual Learning Algorithm (Boersma & Hayes 2001), and the acquisition process was simulated using OTMulti grammar in Praat (Boersma & Weenink 2020, 2023). This is an important contribution, as it clearly demonstrates that the framework of stochastic OT is well suited for the formalization of sign language variation, too.

Yet, a note on the size of the data set is in place here. For plural reduplication, the simulated distribution of output forms was not completely in line with the observed distribution for two phonological noun types. As explained in Chapter 5, a larger database with a more balanced distribution of phonological noun types may be necessary to replicate the variation in output forms as predicted by the algorithm. This latter point is of broader significance, since sign language corpora are in general relatively small (see, e.g., Kimmelman et al. 2018). This point is also addressed in Brentari et al.'s (2021) formalization of sign language data, in which they avoid powerful algorithms to capture variation in their OT-formalization, given the relatively small size of their data set. This is clearly an important point that should be kept in mind when running simulations involving sign language data.

Third, while the universality of the proposed constraints is pivotal for OT, most OT-formalizations to date have only taken into account data from spoken languages (see Downing & Inkelas 2015 for an overview), while studies offering formalizations of sign language data are few (a.o., Brentari 1998; Pfau & Steinbach 2005b; Kimmelman 2009; Eccarius & Brentari 2010; Brentari et al. 2021). The present study has provided strong arguments in favor of also considering the visual-spatial modality, by illustrating that the modality of signal transmission plays a crucial role in putting forward an OT-analysis. While the general constraint types are indeed modality-independent, some specific constraints (both faithfulness and markedness) necessarily refer to phonological features that are modality-specific, such as [1H], [lateral], and [trunk]. Of course, in formalizations of spoken languages, modality-specific constraints commonly play a role, too, e.g., in constraints such as NAS/VOI, which refers to the features [nasal] and [voice], demanding nasals to be voiced (Itô et al. 1995: 582). This raises a number of questions, such as (i) Are these constraints truly universal? (ii) Would it perhaps be better to assume that the specific constraint sets of spoken and signed languages are (partially) separate? (iii) Or should we simply assume that constraints referring to features specific to the oral-aural modality are ranked very low for sign languages, and vice versa?

The fact that the modality of signal transmission – and the existence of modality-specific phonological features in particular – necessarily has consequences for formalizations within the OT-framework is in line with studies that have cast doubt on the existence of true phonological universals (e.g., Evans & Levinson 2009; see also Sandler 2017). It also neatly illustrates the opportunity that sign languages offer for evaluating such claims about universality. The comparison of spoken and signed languages provides a unique window into the distinction between the abstract level of, in this case, phonology and morphology on the one hand, and the consequences (i.e., specific possibilities and limitations) resulting from the use of different physical articulators on the other hand. Sandler (2017: 58), when considering to what extent signed and spoken language phonology are actually comparable, already concluded that "in both spoken and sign languages, a phonological level exists, characterized by contrastive features, hierarchically organized feature categories, syllables, and structural elements that are linear, all organized around form rather than meaning. These properties suggest a common cognitive system in some sense". In the present OT-formalization, this shared system is reflected by the fact that the same general types of constraints can account for both modalities – and this applies not only to the phonological, but also to the morphological level (cf. also Meier 2002). Yet, Sandler (2017: 58) also points out that "clearly, the inventory of phonological features and feature categories is not universal. Because these are tied to articulatory systems in both modalities, the importance of phonetics in shaping phonology becomes clearer through a comparison of the two." Given this lack of universality, proposing OT-constraints without referring to modality-specific features will always be a very difficult, if not impossible, task.

7.4 Topics for future research

Several avenues for future research have already been touched upon throughout the dissertation. This final section points towards some topics that especially merit some attention in future studies on reduplication in NGT and in other sign languages.

Firstly, a question that I kept coming back to, but that largely remained unanswered, concerns the source of the variation in the data. Chapters 2, 3, and 4 have shown that signs which are not specified for any of the constraining features are sometimes zero-marked, i.e., reduplication appears to be optional for all three reduplicative functions. Several factors that might explain this type of variation have been explored, such as the presence of numerals and quantifiers for plurals and the use of a verb in a past-tense contexts for aspect. Yet, neither of these uncovered clear-cut patterns that can explain the alternation between different strategies for unconstrained verbs. Of course, it is possible that NGT reduplication in fact displays variation that is completely free, but one should bear in mind that the present study has left unexplored some other potential explanations for this variation.

It might well be the case, for example, that the variation is sociolinguistic in nature. Indeed, as indicated throughout the dissertation, previous studies have shown that sign languages may display sociolinguistic variation, not only in the lexicon, but also in their grammars (e.g., Palfreyman 2019). Future studies can systematically include participants with different demographic characteristics, in order to explore potential sociolinguistic variation. One factor that is worth exploring is the possible impact of regional variation, given that different sign regions exist in the Netherlands. It has long been acknowledged that there are lexical differences between different dialects of NGT (Schermer 2004), but recent studies have suggested that there might also be grammatical differences (Oomen 2016; van Boven, Oomen, et al. 2023).

Apart from sociolinguistic considerations, elements within the language may also explain the variation observed in the data. The present study has focused on phonological, morphosyntactic, and semantic factors potentially influencing NGT reduplication; the choice of these factors was mostly motivated by what had previously been found in studies on reduplication in NGT. Yet, it is very well possible that additional language-internal factors play a role. We can turn to patterns described for other sign languages to get an idea of what these may be. For instance, some studies have shown that the prosodic structure of an utterance may have an impact on whether a sign is reduplicated – Nespor & Sandler (1999), for instance, have shown that in Israeli Sign Language, reduplication may be influenced by a sign's position within the phonological phrase (see also Ormel & Crasborn 2012 for an overview), something which I have not considered for NGT. Studies addressing such explanations for variation could employ grammaticality judgements in order to systematically uncover patterns underlying the observed variation.

The second topic that future studies could explore involves other functions of NGT reduplication. The present study has focused on pluralization, aspect marking, and reciprocal marking, uncovering both similarities and differences between these reduplicative functions. Yet, reduplication has been shown to have a variety of additional functions cross-linguistically (see Chapter 1). In order to get an even more complete picture of this morphological process in NGT, future studies should explore other functions of NGT reduplication, describe the specific reduplication type(s) marking each of these functions and the restrictions on them, and compare the findings to those presented here. Such a study could take inspiration from reduplicative functions that have been identified for other sign languages, such as pluractionality (e.g., Kuhn & Aristodemo 2017 for French Sign

Language (LSF)), paucity (Veiga Busto 2021 for LSC), or word-class change (e.g., Supalla & Newport 1978; Abner 2017 for ASL – yet, see Klomp 2021 for an exploration of the derivation of noun-verb pairs in NGT, where it is indicated that reduplication may not play a role there, citing Schreurs 2006 and Spruijt 2017). Possibly, such investigations could also address whether the OT-formalization presented here can be extended to other reduplicative functions in NGT (including reciprocal reduplication).

This latter point leads us to the third and final topic for future research that I wish to highlight: the OT-formalization of sign language data in general, and of sign language reduplication specifically. I have already pointed out a few directions for such future OT-formalizations throughout Section 7.3. One important goal would be to test how the present formalization fares cross-linguistically. I have shown that some of the results reported for other sign languages are in line with predictions of the present formalization, but it remains to be seen whether reduplication patterns in other sign languages can indeed be formalized by re-ranking the general constraint types proposed here. Such studies will also contribute to another previously mentioned important research endeavor, which concerns the true universality of OT-constraints. Given that an ample amount of OT-formalizations of spoken language reduplication is available, adding more formalizations of sign language reduplication to the picture will help us in gaining a better understanding of modality-effects on such formalizations, and to work towards a new definition of the "universality" of constraints. One of the aims of the present study has been to highlight the need for such a redefinition.

Appendices

Appendix 2-A: Annotation values for the plural data

Tier name	**Annotation values**	
Noun	the Dutch gloss of the analyzed noun	
Noun type[1]	C C[circ] C[alt] C[circ][alt] B	B[contact] M L filler
Pluralization strategy	zero marking simple reduplication sideward reduplication other	
Number of repetitions	<1, 1, 2, 3, etc. if the movement of the base and reduplicant(s) was reduced/merged into one, long movement: unclear	
Numeral/quantifier	the Dutch gloss of the numeral/quantifier(s) present in the sentence	
Reduplication blocked by numeral/quantifier?	yes, no	
Base one-/two-handed	1-handed, 2-handed	
Plural one-/two-handed	1-handed, 2-handed	
Mouthing	Dutch word or part of word that is mouthed, orthographic form, e.g., ‘lampen’ (lamps) if not visible/clear: unclear	
Comments	any additional comments	

[1] Where C = comp(lex movement)-noun; B = body(-anchored)-noun; M = mid(sagittal)-noun; L = lat(eral)-noun.

Appendix 2-B: Nouns across noun types in the corpus and elicited data for plurals

Noun type	Nouns	
Body-nouns (types: 26)	PERSON(variant 1)	TROUSERS(variant 1)
	COUNTRY	MOVIE
	HUMAN	PILLOW(variant 1, variant 2)
	CONTACT	LAMP(variant 1)
	MAN	GIRL
	WOMAN	FRIEND
	PROBLEM	SHOP
	MOTHER	HOTEL(variant 1, variant 2)
	FARMER	MOUSE(variant 1, variant 2)
	GLASSES	DOLL(variant 1, variant 2, variant 3)
	DAY	
Lat-nouns (types: 10)	ADULT	PERSON(variant 2)
	CHILD	SCHOOL
	FLAG	PART
	WEEK	BOTTLE(variant 1)
	THING	LAMP(variant 2)
Mid-nouns (types: 9)	HOUSE	BOTTLE(variant 2)
	BOOK	CHAIR
	BUILDING	HOTEL(variant 3)
	WORD	OFFICE
	TROUSERS(variant 2)	
Comp-nouns (types: 6)	INPUT	BABY
	TRAIN	BICYCLE
	CAFÉ	CAR

Appendix 2-C: Overview of results from the statistical analyses for plural reduplication

Model 2C.1. Zero ~ Noun_type + Data_type + (Noun_type | Participant). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

Predictor	*Estimate*	*Odds ratio*	*95% CI*	*z*	*p*
Noun type (-BLM+C)	0.63	1.87	0.86 – 4.04	1.59	0.11
Noun type (-LM+BC)	2.33	10.24	3.49 – 30.06	4.23	<0.001*
Noun type (-CLM+B)	rank deficient				
Data type (-corpus+elicited)	0.21	1.23	0.63 – 2.4	0.61	0.54

Model 2C.2. Zero ~ Num + Data_type + (Num | Participant). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

Predictor	*Estimate*	*Odds ratio*	*95% CI*	*z*	*p*
Presence of numeral/quantifier (-no+yes)	0.06	1.07	0.6 – 1.89	0.22	0.83
Data type (-corpus+elicited)	0.51	1.67	0.84 – 3.31	1.47	0.14

Model 2C.3. Pearson correlation between Number of repetitions and Syllables in mouthing. Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

Pearson's R	*95% CI*	*Df*	*t*	*p*
0.2	0.1 – 0.29	361	3.83	<0.001*

Appendix 3-A: Overview of results from the statistical analyses for aspectual reduplication

Table 3A.1. Expected and observed values for aspect types in the corpus and elicited data.

Aspect type	Corpus		Elicited	
	expected	observed	expected	observed
Habitual	98.45	106	70.55	63
Continuative	89.13	106	63.87	47
Iterative	52.43	28	37.57	62
Total	*240*		*172*	

Model 3A.1. Pearson's Chi-squared test for aspect type (habitual, continuative, and iterative) and corpus/elicited data (Table 3A.1). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
36.303	2	412	<0.001*

Model 3A.2. Predicate.reduplication ~ Aspect.type * Data.set + (Aspect.type | Participant.number). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

Predictor	*Estimate*	*Odds ratio*	*95% CI*	*z*	*p*
Aspect type (-conthab+it)	1.7	5.47	2.76 – 10.87	4.86	<0.001*
Aspect type (-cont+hab)	-0.28	0.75	0.38 – 1.48	-0.82	0.41
Data set (-elicited+corpus)	0.78	2.17	1.07 – 4.4	2.15	0.03*
Aspect type (-conthab+it) : Data set (-elicited+corpus)	-1.15	0.32	0.09 – 1.15	-1.75	0.08
Aspect type (-cont+hab) : Data set (-elicited+corpus)	-0.17	0.84	0.22 – 3.25	-0.25	0.8

Table 3A.2. Expected and observed values for reduplication/zero marking of potentially constrained and unconstrained verbs in the elicited data.

Phonological features	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
Potentially constrained	31.89	33	42.11	41
Unconstrained	21.11	20	27.89	29
Total	*53*		*70*	

Model 3A.3. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and constrained/unconstrained verbs in the elicited data (Table 3A.2). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
0.05	1	123	0.82

Table 3A.3. Expected and observed values for reduplication/zero marking in past and non-past contexts in the elicited data.

Tense	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
Past	20.25	23	26.75	24
Non-past	32.75	30	43.25	46
Total	*53*		*70*	

Model 3A.4. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and past/non-past contexts in the elicited data (Table 3A.3). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
0.71	1	123	0.4

Appendix 4-A: Non-allelic verbs occurring in dual reciprocals in the corpus data set

Agreeing verbs

One-handed	**N**	**Two-handed**	**N**
LOOK.AT	12	ATTACK	2
INFLUENCE-1	1	ADAPT	1
AGREE	1	ADD.TO	1
INTERRUPT	1	TAKE.OVER	1
UNDERSTAND-2	1	INFLUENCE-2	1
ASK	1		
GIVE	1		
LISTEN	1		
Total	*19*		*6*

Plain verbs

One-handed	**N**	**Two-handed**	**N**
TALK	8	SIGN	2
SAY	1	ENCOUNTER	1
UNDERSTAND-1	3		
LEARN	1		
MAKE.AGREEMENT	1		
Total	*14*		*3*

Appendix 4-B: Overview of results from the statistical analyses for reciprocal reduplication

Table 4B.1. Expected and observed values for reduplication/zero marking of plain and agreeing verbs in the elicited data.

Verb agreement	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
Plain	11.13	3	18.87	27
Agreeing	11.87	20	20.13	12
Total	*23*		*39*	

Model 4B.1. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and agreeing/plain verbs in the elicited data (Table 4B.1). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
16.108	1	62	<0.001*

Table 4B.2. Expected and observed values for reduplication/zero marking of one- and two-handed verbs in the elicited data.

Handedness	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
One-handed	16.69	23	28.31	22
Two-handed	6.31	0	10.69	17
Total	*23*		*39*	

Model 4B.2. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and one-/two-handed verbs in the elicited data (Table 4B.2). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
11.71	1	62	<0.001*

Table 4B.3. Expected and observed values for reduplication/zero marking in simultaneous and sequential reciprocals in the elicited data.

Reciprocal type	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
Simultaneous	9.27	18	15.73	7
Sequential	13.73	5	23.27	32
Total	*23*		*39*	

Model 4B.3. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and sequential/simultaneous reciprocals in the elicited data (Table 4B.3). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
19.436	1	62	<0.001*

Table 4B.4. Expected and observed values for reduplication/zero marking of plain and agreeing verbs in the corpus data.

Verb agreement	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
Plain	11.05	8	5.95	9
Agreeing	14.95	18	8.05	5
Total	*26*		*14*	

Model 4B.4. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and agreeing/plain verbs in the corpus data (Table 4B.4). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
2.924	1	40	0.09

Table 4B.5. Expected and observed values for reduplication/zero marking of one- and two-handed verbs in the corpus data.

Verb agreement	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
One-handed	21.45	26	11.55	7
Two-handed	4.55	0	2.45	7
Total	*26*		*14*	

Table 4B.6. Expected and observed values for reduplication/zero marking of sequential and simultaneous reciprocals in the corpus data.

Verb agreement	Reduplication of verb		No reduplication of verb	
	expected	observed	expected	observed
Simultaneous	14.37	16	6.63	5
Sequential	11.63	10	5.37	7
Total	*26*		*12*	

Model 4B.5. Pearson's Chi-squared test with Yates' continuity correction for reduplication/zero marking and simultaneous/sequential reciprocals in the corpus data (Table 4B.6). Significant findings ($p \leq 0.05$) are indicated by an asterisk (*).

X^2	*Df*	*N*	*p*
0.632	1	38	0.43

Appendix 5-A: Detailed overview of pluralization strategies for different sub-types of body- and comp-nouns

Table 5A.1. Pluralization strategy by noun features for body- and comp-nouns (red. = reduplication; sim. = simultaneous).

	features	N	zero marking	simple red.	sideward red.	sim. articulation
body-nouns	[body, contact]	113	36 (31.8 %)	72 (63.7%)	5 (4.4%)	0
	[body]	72	38 (52.7%)	31 (43.1%)	1 (1.4%)	2 (2.8%)
comp-nouns	[rep]	11	6 (54.5%)	5 (45.5%)	0	0
	[rep, alt]	11	2 (18.2%)	8 (72.7%)	1 (9.1%)	0
	[rep, circ]	11	9 (81.8%)	1 (9.1%)	1 (9.1%)	0
	[rep, circ, alt]	7	6 (85.7%)	1 (14.3%)	0	0

Appendix 5-B1: OTMulti grammar (plural reduplication)

```
"OTGrammar 2"

<OptimalityTheory>
0 ! leak
7 constraints
       "M\s{AX}-\s{RED}" 100 100 1
       "RED=σ" 100 100 1
       "*P\s{LURAL}-L" 100 100 1
       "I\s{DENT}-BR-P\s{LACE}" 100 100 1
       "*B\s{ASE}[mid]R\s{ED}[mid]" 100 100 1
       "I\s{DENT}-IO-[1H]" 100 100 1
       "*[lat, 1H]" 100 100 1

0
5
"[bod, 1H] + RED"
4 candidates
       "[bod, 1H]"                  1 0 0 0 0 0 0
       "[bod, 1H] + [bod, 1H]"      0 0 1 0 0 0 0
       "[bod, 1H] + [lat, 1H]"      0 0 1 1 0 0 0
       "[bod, 2H]"                  0 1 0 0 0 1 0

"[bod, 2H] + RED"
3 candidates
       "[bod, 2H]"                  1 0 0 0 0 0 0
       "[bod, 2H] + [lat, 2H]"      0 0 1 1 0 0 0
       "[bod, 2H] + [bod, 2H]"      0 0 1 0 0 0 0

"[rep, 2H] + RED"
3 candidates
       "[rep, 2H]"                  1 0 0 0 0 0 0
       "[rep, 2H] + [lat, 2H]"      0 0 1 1 0 0 0
       "[rep, 2H] + [rep, 2H]"      0 0 1 0 0 0 0

"[lat, 1H] + RED"
5 candidates
       "[lat, 1H]"                  1 0 0 0 0 0 1
       "[lat, 1H] + [mid, 1H]"      0 0 1 1 0 0 1
       "[lat, 1H] + [lat, 1H]"      0 0 1 0 0 0 1
       "[lat, 2H] + [lat, 2H]"      0 0 1 0 0 1 0
       "[lat, 2H]"                  0 1 0 0 0 1 0

"[mid, 2H] + RED"
3 candidates
       "[mid, 2H]"                  1 0 0 0 0 0 0
       "[mid, 2H] + [lat, 2H]"      0 0 1 1 0 0 0
       "[mid, 2H] + [mid, 2H]"      0 0 1 0 1 0 0
```

Appendix 5-B2: Input-output distribution (plural reduplication)

```
"ooTextFile"
"PairDistribution"
17
"[bod, 1H] + RED" "[bod, 1H]"                20.1
"[bod, 1H] + RED" "[bod, 1H] + [bod, 1H]"    27.75
"[bod, 1H] + RED" "[bod, 1H] + [lat, 1H]"    1.6
"[bod, 1H] + RED" "[bod, 2H]"                1.1
"[bod, 2H] + RED" "[bod, 2H]"                20.1
"[bod, 2H] + RED" "[bod, 2H] + [bod, 2H]"    27.75
"[bod, 2H] + RED" "[bod, 2H] + [lat, 2H]"    1.6
"[rep, 2H] + RED" "[rep, 2H]"                57.5
"[rep, 2H] + RED" "[rep, 2H] + [rep, 2H]"    37.5
"[rep, 2H] + RED" "[rep, 2H] + [lat, 2H]"    5
"[lat, 1H] + RED" "[lat, 1H]"                15.6
"[lat, 1H] + RED" "[lat, 1H] + [lat, 1H]"    67.9
"[lat, 1H] + RED" "[lat, 2H]"                1.8
"[lat, 1H] + RED" "[lat, 2H] + [lat, 2H]"    12.9
"[mid, 2H] + RED" "[mid, 2H]"                43.2
"[mid, 2H] + RED" "[mid, 2H] + [mid, 2H]"    29.7
"[mid, 2H] + RED" "[mid, 2H] + [lat, 2H]"    21.6
```

Appendix 6-A1: OTMulti grammar (aspectual reduplication)

```
"ooTextFile"
"OTGrammar 2"
<OptimalityTheory>
0 ! leak
10 constraints
       "*RED[trunk]" 100 100 1
       "*RED[HS change]" 100 100 1
       "ALIGN-PFV" 100 100 1
       "ALIGN-IPFV" 100 100 1
       "M\s{AX}RED-PFV" 100 100 1
       "M\s{AX}RED-IPFV" 100 100 1
       "M\s{AX}BR[hold]" 100 100 1
       "D\s{EP}BR[hold]" 100 100 1
       "M\s{AX}IO[hold]" 100 100 1
       "D\s{EP}IO[hold]" 100 100 1

0
4
"[path, (hold)] + IPFV"
5 candidates
       "[path (hold)] Ø"                          0 0 0 0 0 1 0 0 0 0
       "[path][path]"                             0 0 0 1 0 0 0 0 0 0
       "[path, hold][path, hold]"                 0 0 0 1 0 0 0 0 0 1
       "[path, hold][path]"                       0 0 0 1 0 0 1 0 0 0
       "[path][path, hold]"                       0 0 0 1 0 0 0 1 0 1

"[path, trunk, hold] + IPFV"
5 candidates
       "[path, trunk, hold] Ø"                    0 0 0 0 0 1 0 0 0 0
       "[path, trunk][path, trunk]"               1 0 0 1 0 0 0 0 0 0
       "[path, trunk, hold][path, trunk, hold]"   1 0 0 1 0 0 0 0 0 1
       "[path, trunk, hold][path, trunk]"         1 0 0 1 0 0 1 0 0 0
       "[path, trunk][path, trunk, hold]"         1 0 0 1 0 0 0 1 0 1

"[path, HSC] + IPFV"
5 candidates
       "[path, HSC] Ø"                            0 0 0 0 0 1 0 0 0 0
       "[path, HSC][path, HSC]"                   0 1 0 1 0 0 0 0 0 0
       "[path, hold, HSC][path, hold, HSC]"       0 1 0 1 0 0 0 0 0 1
       "[path, hold, HSC][path, HSC]"             0 1 0 1 0 0 1 0 0 0
       "[path, HSC][path, hold, HSC]"             0 1 0 1 0 0 0 1 0 1

"[path, (hold)] + PFV"
5 candidates
       "[path (hold)] Ø"                          0 0 0 0 1 0 0 0 0 0
       "[path][path]"                             0 0 1 0 0 0 0 0 1 0
       "[path, hold][path, hold]"                 0 0 1 0 0 0 0 0 0 0
       "[path, hold][path]"                       0 0 1 0 0 0 1 0 1 0
       "[path][path, hold]"                       0 0 1 0 0 0 0 1 0 0
```

Appendix 6-A2: Input-output distribution (aspectual reduplication)

```
"ooTextFile"
"PairDistribution"
6
"[path, (hold)] + IPFV" "[path (hold)] Ø"                 51
"[path, (hold)] + IPFV" "[path][path]"                    49
"[path, trunk, hold] + IPFV" "[path, trunk, hold] Ø"      100
"[path, HSC] + IPFV" "[path, HSC] Ø"                      100
"[path, (hold)] + PFV" "[path (hold)] Ø"                  29
"[path, (hold)] + PFV" "[path, hold][path, hold]"         71
```

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Summary in English

Morphological reduplication in Sign Language of the Netherlands: A typological and theoretical perspective

This dissertation investigates morphological reduplication in Sign Language of the Netherlands (*Nederlandse Gebarentaal,* NGT). Reduplication is a process whereby (part of) a word or sign is repeated, in order to yield a systematic change in meaning. Specifically, the present study has three goals. First, it aims to provide a comprehensive description of reduplication in NGT, focusing on three of its functions, i.e., nominal pluralization, aspect marking, and reciprocal marking, and to uncover potential restrictions on NGT reduplication. The second goal is to offer a typological perspective on reduplication in NGT, by comparing the present findings to what has been described for reduplication in other signed and spoken languages. Finally, the third goal of the study is theoretical in nature: the findings are formalized in stochastic Optimality Theory (Boersma 1997; Boersma & Hayes 2001).

Chapter 1 lays the groundwork for the rest of the thesis, and starts by introducing some essential notions related to sign language phonology and morphology. Interestingly, while morphological modifications in sign languages mostly apply simultaneously (e.g., Aronoff, Meir & Sandler 2005; Pfau & Steinbach 2023), reduplication is common across sign languages, despite being a sequential process. In fact, as shown in the second section of the chapter, reduplication is not only common in both modalities, i.e., the oral-aural modality of spoken languages and the visual-spatial modality of sign languages, but also expresses similar meanings and often is iconic, i.e., the repetition in form frequently reflects a repetition or multitude in meaning (e.g., Kouwenberg & LaCharité 2015) – for example, it may express plural, continuative, or augmentative meaning (e.g., Rubino 2013). Still, reduplication comes with a modality-specific flavor: for instance, unlike spoken languages, sign languages have the unique possibility to articulate the reduplicant simultaneously with the non-dominant hand (e.g., Kimmelman 2018). Finally, Chapter 1 introduces Optimality Theory (OT; Prince & Smolensky 1993 [2004]), the theoretical model used to formalize the findings in this study. Such a formalization is of importance given that the universality of the proposed constraints is pivotal for OT; yet, while many OT-analyses of spoken language reduplication exist (see Downing & Inkelas 2015 for an overview), accounts of sign language reduplication are scarce (but see Pfau & Steinbach 2005b, a.o.). Further, the framework of stochastic OT (Boersma 1997; Boersma & Hayes 2001) and the Gradual Learning Algorithm (Boersma & Hayes 2001) offer promising possibilities for the formalization of sign language data, which often display variation. Yet, to date, no study has attempted to formalize sign language data within this framework.

Chapter 2 offers a description of the first reduplicative function under investigation: nominal pluralization in NGT. While a few previous studies have addressed pluralization in the language (Zwitserlood & Nijhof 1999; Harder et al. 2003), to date, no comprehensive description of NGT nominal plural reduplication is available. Previously, plural reduplication has been studied for various sign languages, and it has been observed that it often involves phonologically triggered allomorphy: specific nouns cannot be reduplicated due to their phonological make-up (for instance, Pizzuto & Corazza 1996; Sutton-Spence & Woll 1999; Pfau & Steinbach 2005a). The goal of the present study is, therefore, to describe the nominal pluralization strategies in NGT, and to identify potential phonological restrictions on these strategies. In order to do so, the study combines two methods: corpus analysis and data elicitation. As a starting point, I extracted 297 plural nouns from the Corpus NGT (Crasborn et al. 2008; Crasborn & Zwitserlood 2008). Further, using a novel gap-filling task, 189 plural nouns were elicited from five deaf NGT signers (one male, four female, age range 25–62, mean age 38.4). The results bring to light two general nominal reduplication types: (i) simple reduplication, under which the noun is repeated, as in (1a), and (ii) sideward reduplication, under which the noun is repeated while the hand moves sideward, as in (1b). Both types are sometimes executed simultaneously with the non-dominant hand.

(1) a.

BOOK BOOK++

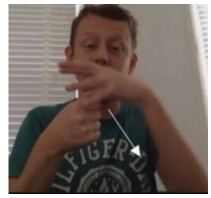
b.

CHILD CHILD>+>+

The results further demonstrate a relation between phonological properties of the base noun on the one hand, and the pluralization strategy on the other: (i) body-anchored nouns and nouns with a complex movement can undergo simple reduplication; (ii) nouns with a lateral location can undergo sideward reduplication (1b); (iii) nouns with a midsagittal location can undergo both simple (1a) and sideward reduplication (see also Pfau & Steinbach 2005a for this noun classification). It should be noted, however, that these are tendencies, as the patterns are not categorical. Moreover, all phonological noun types are sometimes zero-marked; plural reduplication thus appears to be optional. Interestingly, variation in plural reduplication is also attested in some spoken languages, such as Ilokano (Hayes & Abad 1989). The variation observed in NGT is striking, however, compared to what has been described for other sign languages, where the patterns are often more clear-cut. A potential explanation for such cross-linguistic differences can be found in the methodology of the studies.

Chapter 3 addresses the second reduplicative function investigated here: aspectual marking, specifically, predicate reduplication expressing habitual, continuative, and iterative meaning in NGT. Across sign languages, it has been observed that aspectual distinctions can be encoded by reduplicating the verb and modulating its movement (e.g., Klima & Bellugi 1979). Previous studies suggest that the same is true for continuative and habitual aspect in NGT, but they do not agree on whether there are phonological restrictions on aspectual reduplication: Hoiting & Slobin (2001) report that verbs with internal movement and/or body contact cannot undergo aspectual reduplication in NGT, while Oomen (2016) does not observe such restrictions. The present study further investigates aspectual reduplication in NGT and potential restrictions on the process, again by analyzing data from the Corpus NGT (building on a previous study by van Boven & Oomen 2021 on habitual aspect in NGT) as well as data elicited from six deaf NGT signers (two male, four female, age range 27–67, mean age 41), who participated in a picture-question task developed for this study. 106 habituals, 106 continuatives, and 28 iteratives were extracted from the corpus. In addition, 63 habituals, 47 continuatives, and 62 iteratives were elicited. The results of the study reveal two aspectual reduplication types: (i) simple reduplication of the verb, which marks both continuative and habitual aspect, as in (2a), and (ii) simple reduplication of the verb with pauses or holds in between movement cycles, which marks iterative aspect, as in (2b).

(2) a.



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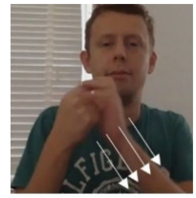
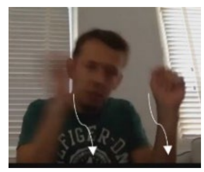


MELT+++

b.



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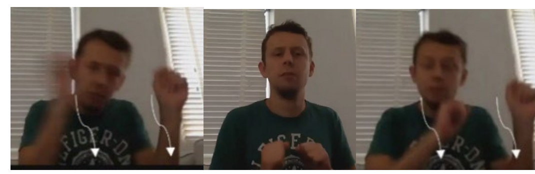

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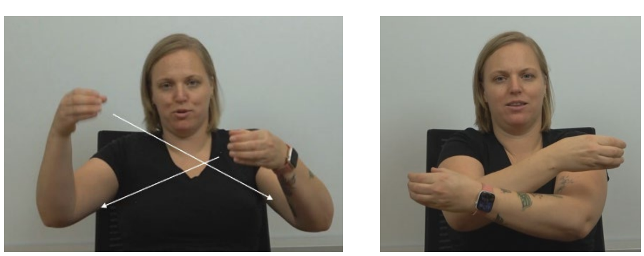
Phonological restrictions only seem to apply with regard to habitual/continuative reduplication: for these aspect types, verbs with specific phonological properties – a major location on the trunk or a handshape change – are always zero-marked in the data. For verbs lacking those properties, and for iterative aspect, no restrictions were identified, but, again, reduplication appears to be optional. This is in line with previous studies on other sign languages, which also describe optionality and variation in aspectual marking (e.g., Gray 2013; Palfreyman 2019). Further, the fact that the reduplicative form of iteratives (which have been subsumed under perfective aspect) appears to be distinct from that of habituals and continuatives (both of which have been subsumed under imperfective aspect), while a formal distinction between the latter two could not be established, suggests that NGT distinguishes perfective and imperfective, but does not make a further formal distinction. From a cross-modal perspective, this finding is not surprising, given that Bybee (1985) reports that most spoken languages in her sample distinguish only the imperfective and the perfective inflectionally (see also Comrie 1976; Dahl & Velupillai 2013). From an intra-modal perspective, however, the observation is more striking, given that specific verbal modulations for habituals or continuatives are often mentioned in previous studies on sign language aspectual reduplication (e.g., Sutton-Spence & Woll 1999; Cabeza Pereiro & Fernández Soneira 2004; Rathmann 2005).

Chapter 4 reports on a study investigating the third and final function of NGT reduplication that is investigated here: reciprocal marking. To date, investigations of a handful of sign languages have shown that so-called backward reduplication (Pfau & Steinbach 2003) often marks reciprocity, whereby the verb is reduplicated and its movement is reversed in the reduplicant, which may be executed sequentially or simultaneously (e.g., Pfau & Steinbach 2016). Again, allomorphy often plays a role – specifically, the morphosyntactic property agreement and the phonological property handedness have been found to influence the choice of reciprocal marking strategy (e.g., Pfau & Steinbach 2016). The same may also be the case in NGT: A small-scale study on the reciprocal form of agreeing verbs in NGT (Klomp 2021) suggests that the language employs backward reduplication, and that one- and two-handed verbs undergo different strategies. The present study more systematically investigates NGT reciprocal reduplication, taking into account not only the agreement and handedness properties of the base verb, but also whether the sentence involves simultaneous reciprocal meaning (where two participants perform an action at the same time) or sequential reciprocal meaning (where participants perform the actions in turn; cf. Ergin et al. 2020). The focus is on situations with two participants (i.e., dual reciprocals). Once again, searches in the Corpus NGT are combined with data elicitation. 42 dual reciprocals were extracted from the corpus. Six deaf NGT signers (5 female, 1 male, age range 28–68, mean age 53) participated in a task developed for this study, where they describe videos that show various sequential and simultaneous reciprocal actions, resulting in 62 elicited reciprocal sentences. The results show that NGT reciprocals can be marked by sequential or simultaneous backward reduplication, illustrated in (3a) and (3b), respectively, alternating with zero marking.

(3) a.

Right hand: CUP$_{3a}$ ${}_{3a}$GIVE.CUP$_{3b}$
Left hand: CUP$_{3b}$ ${}_{3b}$GIVE.CUP$_{3a}$.

b.



Right hand: CUP$_{3a}$ ${}_{3a}$GIVE.CUP$_{3b}$.
Left hand: CUP$_{3b}$ ${}_{3b}$GIVE.CUP$_{3a}$.

Three types of features appear to influence the choice of reciprocal marking strategy: (i) the *phonological* feature handedness, since two-handed verbs are always zero-marked in the data; (ii) the *morphosyntactic* feature agreement, since plain verbs tend to be zero-marked, but can also undergo simultaneous reduplication, while agreeing verbs can undergo all three possible strategies (cf. 3ab); and (iii) a *semantic* feature regarding the reciprocal meaning, since simultaneous reciprocal meaning tends to be marked by simultaneous reduplication (3b), while sequential reciprocal meaning tends to be marked by sequential reduplication (3a). This latter finding is typologically interesting, given that for spoken languages, Everaert (2000: 78) claims that the semantics of reciprocals do not have consequences for their "distributional properties". As for the attested allomorphy, it is striking that the morphosyntactic verb type usually plays a pivotal role in the choice between reduplication and zero marking in other investigated sign languages, while in NGT, the choice between these two strategies (also) seems to depend on phonological properties of the verb.

Chapters 5 and 6 move away from the descriptive and typological goals of the thesis, and turn to its theoretical objective. First, Chapter 5 presents an OT-formalization of NGT plural reduplication. The analysis successfully implements general constraint types that have been proposed for spoken language reduplication, and is thus in line with the aim to introduce constraints that are maximally modality-independent. Specifically, the formalization distinguishes input-output faithfulness (IO-FAITH) from base-reduplicant faithfulness (BR-FAITH), employs an ALIGNMENT constraint, and relies on the systematic implementation of phonological features. Most of the relevant phonological features implemented in the formalization, however, are necessarily modality-specific (e.g., [2H] or [body]). The ranking values of the proposed constraints were acquired by employing stochastic OT (Boersma 1997; Boersma & Hayes 2001) and the Gradual Learning Algorithm (Boersma & Hayes 2001), using OTMulti grammar in Praat (Boersma & Weenink 2020) to simulate the acquisition process. The learned constraint ranking represents the overall variation in forms correctly, but for a few phonological noun types, the distribution of pluralization strategies is not completely in line with what is observed in the data. It is possible that a larger database with a more balanced distribution of types would provide frequencies that are more in line with the distributions predicted for these noun types.

Chapter 6 presents a formalization of NGT aspectual reduplication. The same general, modality-independent constraint types as those proposed for plural reduplication are relevant, but at the same time, the constraints on aspectual reduplication add further modality-specific features to the picture (e.g., [trunk]). Following the same procedure as for plural reduplication, the acquisition process was simulated employing stochastic OT, and the learned constraint ranking correctly accounts for both the overall variation in forms, as well as the distribution of aspect marking strategies. A comparison of the OT-accounts of aspectual and plural reduplication brings to light interesting differences between these two functions. For instance, for aspect, the choice between reduplication types is governed by the aspectual morpheme in the input rather than by phonological features. Moreover, markedness and BR-FAITH constraints are ranked higher for aspect than for plurals, since restrictions on aspectual reduplication are stricter, and there is no complex reduplication under aspect marking (i.e., the base and reduplicant are always identical). At the end of the chapter, I briefly address the possibilities for a formalization of NGT reciprocal reduplication, and it becomes clear that the analyses of aspectual and plural reduplication can be built upon. Once again, the same general constraint types appear relevant. The implementation of the reciprocal morpheme can be achieved in the same way as the implementation of the plural and aspectual morphemes, assuming reduplication to be the default strategy. In line with what I proposed for aspect marking, markedness constraints dictating which signs cannot be reduplicated are likely high-ranked, and the choice of reduplication type is governed by the reciprocal morpheme in the input. At the same time, reciprocal reduplication patterns with pluralization in that it allows for discrepancies between base and reduplicant, i.e., BR-FAITH constraints are low-ranked.

Chapter 7, the final chapter of this dissertation, addresses the general typological and theoretical contributions of the work. First, the typological contributions become clear once we take both a cross-modal and an intra-modal perspective on the current findings. A cross-modal perspective is offered first, by considering the different reduplication types that NGT employs. In some cases, the choice between these types depends on the meaning that is expressed, while in others, properties of the base sign are decisive. For the oral-aural modality, Spaelti (1997) observed that some spoken languages which have multiple reduplication types available also display such a mixed system, and NGT thus fits into this picture. Further, in NGT, a mix of phonological, morphological, morphosyntactic, and semantic factors may influence the choice of reduplication type – and different combinations of these factors also play a role in the choice of reduplication type in some spoken languages (e.g., Harley & Leyva 2009 on Hiaki). Moreover, on a general level, the repetition in form often reflects a repetition in meaning in both modalities (see, e.g., Downing & Stiebels 2012; Börstell to appear). However, in NGT – and in other sign languages – the iconicity of the reduplicated form occasionally lies not only in the pure repetition of phonological material, but is also reflected by the specific reduplication type, such as the backward movement and the potential simultaneity in reciprocal reduplication – phonological characteristics that are simply impossible in spoken languages. Turning to an intra-modal perspective, a comparison of the different reduplication types in NGT to those of other sign languages reveals that there are cross-linguistic patterns with respect to which reduplication type expresses which function, in some cases due to iconicity. However, there are cross-linguistic differences, too. For instance, when marking continuative and habitual aspect, NGT does not modulate the rate and rhythm of reduplicated movements to distinguish the aspect types, unlike, for instance, ASL

(Klima & Bellugi 1979; Rathmann 2005). Thus, sign languages do not necessarily display exactly the same patterns when it comes to reduplication types and their functions, in spite of the fact that specific reduplication types may iconically express specific meanings (cf. also Nyst et al. 2021, a.o.). Finally, a comparison of the NGT constraints on reduplication to those reported for other sign languages reveals that there is intra-modal variation not only regarding the specific features that constrain reduplication, but also in terms of the reduplicative functions those constraints are relevant for, as well as how strictly they apply for each function. These findings add important novel insights regarding the range of variation among sign languages.

Chapter 7 then highlights two theoretical contributions of the dissertation. Firstly, the study provides insight into the OT-constraints that derive reduplication patterns in NGT, and possibly in sign languages more generally. Different pressures which influence NGT reduplication have been captured by means of different types of OT-constraints. Importantly, the general constraint types included in the present formalization have been adopted from formalizations of spoken language reduplication. The different patterns observed for NGT plural and aspectual reduplication could, to a large extent, be formalized successfully by ranking the general constraint types differently across the two functions. It is expected that this approach can be extended to reciprocal reduplication. The question remains whether these pressures are also relevant for reduplication in other sign languages, but at least some of the patterns that have been described for those languages can be predicted by re-ranking the constraint types proposed here. Secondly, the formalization of NGT reduplication has illustrated that the modality of signal transmission plays a crucial role in putting forward an OT-analysis, as specific constraints (both faithfulness and markedness) necessarily refer to phonological features that are modality-specific. This raises the question to what extent OT-constraints actually can be truly universal, and at the same time neatly illustrates the opportunity that sign languages offer for evaluating claims about universality.

The chapter, and thus the dissertation, concludes with some suggestions for future work on the topic. Most importantly, future studies should (i) seek an explanation for the variation and optionality in the data, both in sociolinguistic as well as language-internal factors; (ii) investigate other functions that NGT reduplication may have; and (iii) test how the proposed OT-formalization fares cross-linguistically, which will also contribute to the important research endeavor regarding the true universality of OT-constraints.

Samenvatting in het Nederlands
(summary in Dutch)

Morfologische reduplicatie in de Nederlandse Gebarentaal: Een typologisch en theoretisch perspectief

Het onderwerp van dit proefschrift is morfologische reduplicatie in de Nederlandse Gebarentaal (NGT). Reduplicatie is een woordvormingsproces waarbij (een deel van) een woord of gebaar wordt herhaald om de betekenis systematisch te veranderen. Het onderzoek heeft drie hoofddoelen. Het eerste doel is om reduplicatie in NGT uitgebreid te beschrijven en om mogelijke restricties op het proces te identificeren. Hierbij ligt de focus op drie functies van reduplicatie: meervoudsvorming van naamwoorden, aspectmarkering op werkwoorden en het vormen van wederkerige werkwoorden. Het tweede doel van het onderzoek is het bieden van een typologisch perspectief op reduplicatie in NGT, door de bevindingen te vergelijken met wat in vorig onderzoek beschreven is over reduplicatie in andere gebarentalen en in gesproken talen. Ten slotte is het derde doel van de studie theoretisch van aard: de resultaten worden geformaliseerd in stochastische Optimaliteitstheorie (oftewel *stochastic Optimality Theory*; Boersma 1997; Boersma & Hayes 2001).

In Hoofdstuk 1 wordt de basis voor de rest van het proefschrift gelegd. Ten eerste wordt een aantal essentiële aspecten van de fonologie en morfologie van gebarentalen geïntroduceerd. In gebarentalen worden morfologische processen meestal simultaan toegepast (bijv. Aronoff, Meir & Sandler 2005; Pfau & Steinbach 2023). Reduplicatie is juist een sequentieel proces, maar toch komt het vaak voor in gebarentalen. Ten tweede wordt duidelijk dat reduplicatie vaak voorkomt in beide modaliteiten, dat wil zeggen, niet alleen in de visuele-ruimtelijke modaliteit van gebarentalen, maar ook in de orale-aurale modaliteit van gesproken talen. Daarnaast drukt reduplicatie vergelijkbare betekenissen uit in beide modaliteiten en is het proces vaak iconisch, aangezien de herhaling in de vorm meestal een herhaling of veelvoud in de betekenis weerspiegelt (bijv. Kouwenberg & LaCharité 2015). Zo kan reduplicatie bijvoorbeeld het meervoud, continuatief aspect of de augmentatief uitdrukken (bijv. Rubino 2013). Reduplicatie heeft echter ook modaliteit-specifieke kenmerken: gebarentalen hebben, in tegenstelling tot gesproken talen, bijvoorbeeld de unieke mogelijkheid om reduplicatie simultaan te realiseren met de niet-dominante hand (bijv. Kimmelman 2018). Tot slot wordt in Hoofdstuk 1 Optimaliteitstheorie (*Optimality Theory,* hierna: OT; Prince & Smolensky 1993

[2004]) geïntroduceerd. Dit is het theoretische model dat wordt gebruikt om de resultaten van dit onderzoek te formaliseren. Een dergelijke formalisering is van belang omdat universaliteit een belangrijk kenmerk van OT-beperkingen is. Echter, terwijl er veel OT-analyses van reduplicatie in gesproken taal bestaan (zie Downing & Inkelas 2015 voor een overzicht), zijn OT-analyses van reduplicatie in gebarentaal schaars (maar zie o.a. Pfau & Steinbach 2005b). Daarnaast bieden stochastische OT (Boersma 1997; Boersma & Hayes 2001) en het *Gradual Learning Algorithm* ('Gradueel Leer Algoritme'; Boersma & Hayes 2001) veelbelovende mogelijkheden voor de formalisering van gebarentalen, waarin vaak veel variatie voorkomt. Toch heeft tot nu toe geen enkele studie geprobeerd om gebarentaaldata te formaliseren binnen deze kaders.

Hoofdstuk 2 beschrijft een onderzoek naar de eerste functie van NGT reduplicatie: nominale meervoudsvorming. Meervoudsvorming in deze taal is al onderzocht in een aantal eerdere studies (Zwitserlood & Nijhof 1999; Harder et al. 2003). Toch bestaat er tot op heden geen uitgebreide beschrijving van meervoudsvormende reduplicatie in NGT. Dit reduplicatieproces is al wel onderzocht voor verschillende andere gebarentalen. Die eerdere onderzoeken hebben aangetoond dat er vaak sprake is van fonologische restricties (zgn. *allomorphy*): bepaalde zelfstandige naamwoorden kunnen niet gereduplicieerd worden vanwege hun fonologische structuur (bijv. Pizzuto & Corazza 1996; Sutton-Spence & Woll 1999; Pfau & Steinbach 2005a). Het doel van het huidige onderzoek is dan ook om te beschrijven welke strategieën voor nominale meervoudsvorming er zijn in NGT en om mogelijke fonologische restricties op deze strategieën te identificeren. In dit onderzoek worden twee methodes gecombineerd: corpusanalyse en het uitlokken van reduplicatie. Als startpunt heb ik 297 meervoudige zelfstandige naamwoorden uit het Corpus NGT verzameld (Crasborn et al. 2008; Crasborn & Zwitserlood 2008). Daarnaast werden 189 meervoudige zelfstandige naamwoorden uitgelokt met behulp van een nieuw ontwikkelde invultaak waaraan vijf dove NGT-gebruikers meededen (één man, vier vrouwen, leeftijd 25–62, gemiddelde leeftijd 38,4). De resultaten laten zien dat er twee soorten nominale meervoudsreduplicatie zijn in NGT: (i) simpele reduplicatie, waarbij het zelfstandig naamwoord wordt herhaald, zoals in (1a), en (ii) zijwaartse reduplicatie, waarbij het zelfstandig naamwoord wordt herhaald terwijl de hand zijwaarts beweegt, zoals in (1b). Beide soorten reduplicatie worden soms simultaan uitgevoerd met de niet-dominante hand.

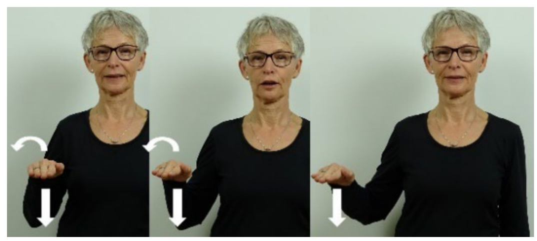
(1) a.


BOEK

BOEK++

b.

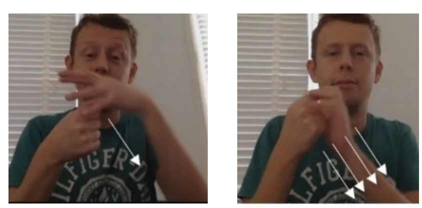

KIND


KIND>+>+

De resultaten van het onderzoek laten verder zien dat er een relatie is tussen de fonologische eigenschappen van het zelfstandig naamwoord aan de ene kant, en de meervoudsvormingsstrategie aan de andere kant: (i) zelfstandige naamwoorden die lichaamsgebonden zijn en zelfstandige naamwoorden met een complexe beweging kunnen simpele reduplicatie ondergaan; (ii) zelfstandige naamwoorden met een laterale locatie kunnen zijwaartse reduplicatie ondergaan (1b); (iii) zelfstandige naamwoorden met een midsagittale locatie kunnen zowel simpele (1a) als zijwaartse reduplicatie ondergaan (zie ook Pfau & Steinbach 2005a voor deze classificering van zelfstandige naamwoorden). Dit zijn echter geen categorische patronen, maar tendensen. Daarbij lijkt meervoudsreduplicatie optioneel te zijn voor zelfstandige naamwoorden van alle fonologische categorieën. Interessant genoeg is variatie in meervoudsreduplicatie ook voor sommige gesproken talen beschreven, bijvoorbeeld voor Ilokano (Hayes & Abad 1989). De variatie die in het huidige onderzoek wordt geconstateerd is echter opvallend in vergelijking met wat is beschreven voor andere gebarentalen, waar de patronen vaak categorischer zijn. Een mogelijke verklaring voor dergelijke cross-linguïstische verschillen kan worden gevonden in methodologische verschillen tussen de onderzoeken.

In Hoofdstuk 3 komt de tweede functie van reduplicatie die wordt onderzocht aan bod: aspectmarkering, en dan specifiek het redupliceren van een werkwoord om habituele, continuatieve en iteratieve betekenis uit te drukken in NGT. Uit eerder onderzoek naar andere gebarentalen is gebleken dat verschillende aspectuele betekenissen worden uitgedrukt door het werkwoord te redupliceren en de beweging ervan aan te passen (bijv. Klima & Bellugi 1979). Dit is in eerder onderzoek ook beschreven voor continuatief en habitueel aspect in NGT, maar de eerdere studies zijn het niet eens over de vraag of er fonologische restricties gelden: Hoiting & Slobin (2001) rapporteren dat werkwoorden met een interne beweging en/of lichaamscontact geen aspectuele reduplicatie kunnen ondergaan in NGT, terwijl dergelijke restricties niet naar voren komen in het onderzoek van Oomen (2016). Het huidige onderzoek bestudeert daarom aspectuele reduplicatie in NGT en mogelijke restricties daarop. Opnieuw worden data uit het Corpus NGT geanalyseerd (voortbouwend op een eerdere studie, namelijk van Boven & Oomen 2021 over habitueel aspect in NGT) en daarnaast worden data verzameld van zes dove NGT-gebruikers (twee mannen, vier vrouwen, leeftijd 27–67, gemiddelde leeftijd 41). Zij namen deel aan een taak waarin zij vragen over verschillende afbeeldingen beantwoordden. Die taak werd specifiek ontwikkeld voor dit onderzoek. Er werden 106 habituele zinnen, 106 continuatieve zinnen en 28 iteratieve zinnen uit het corpus verzameld. Daarnaast werden 63 habituele zinnen, 47 continuatieve zinnen en 62 iteratieve zinnen uitgelokt. De resultaten onthullen twee soorten aspectuele reduplicatie: (i) simpele reduplicatie van het werkwoord, een proces dat zowel continuatief als habitueel aspect markeert, zoals in (2a), en (ii) simpele reduplicatie van het werkwoord met pauzes tussen bewegingscycli waarin het gebaar even vastgehouden wordt, een proces dat iteratief aspect markeert, zoals in (2b).

(2) a.



SMELTEN SMELTEN+++

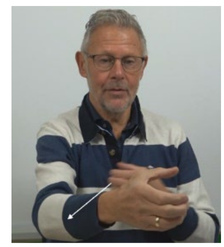
b.

SCHOONMAKEN SCHOONMAKEN+

Fonologische restricties lijken alleen van toepassing te zijn voor habitueel en continuatief aspect: voor deze aspecttypen worden werkwoorden met bepaalde fonologische eigenschappen – een locatie op de romp of een handvormverandering – nooit geredupliceerd in de data. Voor werkwoorden zonder deze eigenschappen, en voor iteratief aspect, werden geen restricties geïdentificeerd. Reduplicatie lijkt wel, opnieuw, altijd optioneel te zijn. Dit is in lijn met eerdere studies naar aspectmarkering in andere gebarentalen, die ook beschrijven dat er variatie is en dat aspectmarkering optioneel is (bijv. Gray 2013; Palfreyman 2019). Verder lijkt reduplicatie om de iteratief te markeren (eerder gecategoriseerd als perfectief aspect) dus te verschillen van reduplicatie om de habitueel en continuatief te markeren (beide eerder gecategoriseerd als imperfectief aspect), terwijl er geen vormelijk verschil tussen die laatste twee kon worden vastgesteld. Dit suggereert dat NGT alleen perfectief en imperfectief onderscheidt, maar geen verder onderscheid markeert op het werkwoord. Deze bevinding is niet verrassend vanuit een cross-modaal perspectief, aangezien Bybee (1985) al rapporteerde dat de meeste gesproken talen in haar steekproef alleen de imperfectief en perfectief onderscheiden d.m.v. inflectie (zie ook Comrie 1976; Dahl & Velupillai 2013). De bevinding is echter opvallender vanuit een intra-modaal perspectief, omdat eerdere onderzoeken naar andere gebarentalen vaak hebben beschreven dat habitueel en continuatief aspect onderscheiden worden door middel van aanpassingen aan het werkwoord (bijv. Sutton-Spence & Woll 1999; Cabeza Pereiro & Fernández Soneira 2004; Rathmann 2005).

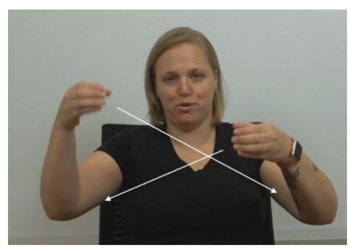
Hoofdstuk 4 beschrijft een onderzoek naar de derde en laatste functie van NGT reduplicatie die hier wordt onderzocht: het vormen van wederkerige werkwoorden. Vorig onderzoek naar een aantal andere gebarentalen heeft laten zien dat wederkerigheid vaak wordt gemarkeerd d.m.v. zogenaamde achterwaartse reduplicatie (Pfau & Steinbach 2003), waarbij het werkwoord wordt herhaald en de beweging van het werkwoord in de herhaling wordt omgedraaid; dit proces kan sequentieel of simultaan plaatsvinden (bijv. Pfau & Steinbach 2016). Opnieuw spelen restricties vaak een rol (oftewel er is *allomorphy*): zowel de morfosyntactische eigenschap congruentie als de fonologische eigenschap één-/twee-handigheid kunnen beïnvloeden welke strategie wordt gebruikt om wederkerigheid te markeren (bijv. Pfau & Steinbach 2016). Het lijkt erop dat dit ook geldt voor NGT: een kleinschalig onderzoek naar de wederkerige vorm van congruerende werkwoorden in NGT (Klomp 2021) laat zien dat deze werkwoorden achterwaartse reduplicatie ondergaan, en dat er verschillen zijn tussen één- en tweehandige werkwoorden. De huidige studie onderzoekt wederkerige reduplicatie in NGT meer systematisch. Hierbij worden niet alleen congruentie en één-/tweehandigheid in acht genomen, maar ook zowel simultane wederkerige betekenis (waarbij participanten een handeling tegelijkertijd uitvoeren) als sequentiële wederkerige betekenis (waarbij participanten de handelingen om de beurt uitvoeren; zie ook Ergin et al. 2020). De focus ligt op situaties met twee participanten (oftewel duale wederkerige situaties). Opnieuw wordt zoeken in het Corpus NGT gecombineerd met het uitlokken van reduplicatie. 42 duale wederkerige zinnen werden uit het corpus verzameld. Daarnaast deden zes dove NGT-gebruikers (5 vrouwen, 1 man, leeftijd 28–68, gemiddelde leeftijd 53) mee met een taak die voor deze studie is ontwikkeld, waarbij ze video’s van verschillende sequentiële en simultane wederkerige acties beschreven; dit resulteerde in 62 uitgelokte wederkerige zinnen. De resultaten laten zien dat wederkerige werkwoorden in NGT gevormd kunnen worden door sequentiële of simultane achterwaartse reduplicatie, geïllustreerd in respectievelijk (3a) en (3b). Deze strategieën worden afgewisseld met wederkerige zinnen waarin er geen markering is op het werkwoord.

(3) a.


Rechterhand: MOK$_{3a}$ $_{3a}$GEEF. MOK$_{3b}$
Linkerhand: MOK$_{3b}$ $_{3b}$GEEF. MOK$_{3a}$.

b.




Rechterhand: MOK$_{3a}$ $_{3a}$GEEF. MOK$_{3b}$.
Linkerhand: MOK$_{3b}$ $_{3b}$GEEF. MOK$_{3a}$.

Drie soorten eigenschappen lijken te beïnvloeden hoe wederkerigheid gemarkeerd wordt: (i) de *fonologische* eigenschap één-/tweehandigheid, aangezien tweehandige werkwoorden nooit geredupliceerd worden in de data; (ii) de *morfosyntactische* eigenschap congruentie, aangezien niet-congruerende werkwoorden vaak niet geredupliceerd worden, maar ook simultane reduplicatie kunnen ondergaan, terwijl voor congruerende werkwoorden alle drie de strategieën mogelijk zijn (zie 3ab); en (iii) een *semantische* eigenschap die te maken heeft met de specifieke wederkerige betekenis, aangezien simultane wederkerige betekenis meestal wordt gemarkeerd door simultane reduplicatie (3b), terwijl sequentiële wederkerige betekenis meestal wordt gemarkeerd door sequentiële reduplicatie (3a). Deze laatste bevinding is interessant vanuit typologisch oogpunt, aangezien Everaert (2000: 78) beweert dat dergelijke betekenisverschillen niet worden uitgedrukt door middel van verschillende wederkerige constructies in gesproken talen. Verder is het opvallend dat in andere onderzochte gebarentalen de morfosyntactische kenmerken van het werkwoord meestal de doorslag geven of het werkwoord wel of niet gerdupliceerd wordt, terwijl in NGT de keuze (ook) lijkt af te hangen van fonologische eigenschappen van het werkwoord.

Hoofdstukken 5 en 6 focussen niet langer op de beschrijvende en typologische doelen van het proefschrift, maar richten zich op het theoretische doel. Allereerst presenteert Hoofdstuk 5 een OT-formalisering van meervoudsreduplicatie in NGT. In de analyse worden, met succes, algemene beperkingstypen geïmplementeerd die eerder zijn voorgesteld voor reduplicatie in gesproken talen. Dit is in lijn met het streven om OT-beperkingen te introduceren die zo modaliteitsonafhankelijk mogelijk zijn. Specifiek maakt de formalisering een onderscheid tussen zogenaamde *input-output faithfulness* (oftewel overeenkomst tussen input en output, hierna: IO-FAITH) en *base-reduplicant faithfulness* (oftewel overeenkomst tussen de stam en de herhaling daarvan, hierna: BR-FAITH), wordt een ALIGNMENT-beperking ingezet en worden fonologische kenmerken systematisch geïmplementeerd. De meeste van deze fonologische kenmerken zijn echter noodzakelijkerwijs modaliteit-specifiek (bijv. [2-handig] of [lichaam]). De rangschikkingswaarden van de voorgestelde OT-beperkingen zijn verkregen door gebruik te maken van stochastische OT (Boersma 1997; Boersma & Hayes 2001) en het *Gradual Learning Algorithm* (Boersma & Hayes 2001), waarbij *OTMulti grammar* in Praat (Boersma & Weenink 2020) gebruikt is om het verwervingsproces te simuleren. De algehele variatie in vormen wordt correct gerepresenteerd door de geleerde rangschikking van beperkingen, maar voor een paar fonologische naamwoordcategorieën is de verdeling van meervoudsvormingsstrategieën niet volledig in lijn met de data. Mogelijkerwijs zou een grotere dataset (met een meer gebalanceerde verdeling tussen fonologische categorieën) frequenties opleveren die meer overeenkomen met de verdelingen die voorspeld worden voor deze fonologische categorieën.

Hoofdstuk 6 presenteert een formalisering van aspectuele reduplicatie in NGT. Hiervoor zijn dezelfde algemene, modaliteitsonafhankelijke beperkingstypen als eerder voorgesteld voor meervoudsreduplicatie relevant. Tegelijkertijd bevatten de OT-beperkingen voor aspectuele reduplicatie nog meer modaliteit-specifieke kenmerken (bijv. [romp]). Het verwervingsproces werd opnieuw gesimuleerd met behulp van stochastische OT, op dezelfde manier als voor meervoudsreduplicatie. Zowel de algehele variatie in vormen als de verdeling van strategieën om aspect te markeren worden correct gerepresenteerd door de geleerde rangschikking van beperkingen. Een vergelijking van de OT-analyse van aspectuele reduplicatie met die van meervoudsreduplicatie brengt interessante verschillen tussen de twee functies aan het licht. Zo wordt voor aspect bijvoorbeeld de keuze tussen reduplicatietypen bepaald door het aspectuele morfeem in de input in plaats van door fonologische kenmerken. Daarnaast zijn *markedness-* (oftewel gemarkeerdheid-) en BR-FAITH-beperkingen hoger gerangschikt voor aspect dan voor meervoud, omdat de fonologische restricties op aspectuele reduplicatie strikter zijn, en omdat er geen complexe reduplicatie is voor aspectmarkering (d.w.z., de stam en de herhaling daarvan zijn altijd identiek aan elkaar). Aan het einde van het hoofdstuk ga ik kort in op de mogelijkheden voor een formalisering van wederkerige werkwoorden in NGT. Hiervoor kan worden voortgebouwd op de analyses van aspectuele reduplicatie en meervoudsreduplicatie. Opnieuw blijken dezelfde algemene beperkingstypes relevant te zijn. Voor wederkerige werkwoorden kan het morfeem op dezelfde manier geïmplementeerd worden als is gedaan voor de meervouds- en aspectmorfemen, waarbij wordt aangenomen dat reduplicatie de basisstrategie is. *Markedness*-beperkingen, die dicteren welke gebaren niet geredupliceerd kunnen worden, zijn waarschijnlijk hoog gerangschikt, en de keuze van reduplicatietype wordt bepaald door het morfeem in de input – dit is in lijn met wat ik voorstelde voor aspectmarkering. Tegelijkertijd vertoont reduplicatie om wederkerigheid te markeren ook gelijkenissen met meervoudsvorming, aangezien er verschillen tussen de stam en de herhaling daarvan kunnen zijn, d.w.z., BR-FAITH-constraints zijn laag gerangschikt.

Hoofdstuk 7, het laatste hoofdstuk van deze dissertatie, bespreekt de algemene typologische en theoretische bijdragen van het onderzoek. Ten eerste worden de typologische bijdragen duidelijk wanneer we de huidige bevindingen zowel vanuit een cross-modaal als vanuit een intra-modaal perspectief bekijken – te beginnen met een cross-modaal perspectief op de verschillende soorten reduplicatie die hier beschreven zijn voor NGT. De keuze tussen deze reduplicatietypen hangt in sommige gevallen af van de betekenis die wordt uitgedrukt, terwijl in andere gevallen juist de eigenschappen van de stam doorslaggevend zijn. Voor de oraal-aurale modaliteit observeerde Spaelti (1997) dat sommige gesproken talen met meerdere reduplicatietypen ook zo'n gemengd systeem hebben; NGT past dus goed in dit beeld. Daarnaast kunnen verschillende combinaties van fonologische, morfologische, morfosyntactische en semantische factoren de keuze van het reduplicatietype beïnvloeden in NGT – verschillende combinaties van deze factoren spelen ook een rol bij de keuze tussen reduplicatietypen in sommige gesproken talen (bijv. Harley & Leyva 2009 over Hiaki). Verder weerspiegelt in beide modaliteiten de herhaling in de vorm vaak een herhaling in de betekenis (zie bijv. Downing & Stiebels 2012; Börstell to appear). Echter, in NGT – en in andere gebarentalen – ligt de iconiciteit niet altijd alleen in de herhaling van fonologisch materiaal, maar soms ook in het specifieke reduplicatietype. Dit geldt bijvoorbeeld voor de achterwaartse beweging en de potentiële simultaniteit van wederkerige werkwoorden. Dit zijn fonologische kenmerken die eenvoudigweg onmogelijk te realiseren zijn in gesproken talen. Als we nu een intra-modaal perspectief aannemen door de verschillende reduplicatietypen in NGT te vergelijken met die in andere gebarentalen, wordt duidelijk dat er cross-linguïstische patronen zijn in welk reduplicatietype welke betekenis uitdrukt, in sommige gevallen vanwege iconiciteit. Er zijn echter ook cross-linguïstische verschillen. Zo maakt NGT geen onderscheid tussen habitueel en continuatief aspect door het tempo en ritme van de geredupliceerde bewegingen aan te passen, in tegenstelling tot bijvoorbeeld Amerikaanse Gebarentaal (Klima & Bellugi 1979; Rathmann 2005). Gebarentalen laten dus niet noodzakelijkerwijs precies dezelfde patronen zien als het gaat om reduplicatietypen en hun functies, ondanks het feit dat specifieke reduplicatietypen specifieke betekenissen op een iconische manier kunnen uitdrukken (zie ook o.a. Nyst et al. 2021). Ten slotte laat een vergelijking tussen de restricties op reduplicatie in NGT en die in andere gebarentalen zien dat er intra-modale variatie is, niet alleen in de specifieke kenmerken die reduplicatie beperken, maar ook in de functies waarvoor die restricties relevant zijn, evenals hoe strikt ze zijn voor elke functie. Deze bevindingen leveren belangrijke nieuwe inzichten op in hoe ver de variatie tussen gebarentalen reikt.

Hoofdstuk 7 benadrukt vervolgens twee theoretische bijdragen van het proefschrift. Ten eerste biedt de studie inzicht in de OT-beperkingen die gelden voor reduplicatiepatronen in NGT, en mogelijk in gebarentalen in het algemeen. Verschillende spanningen die van invloed zijn op NGT-reduplicatie zijn vastgelegd in verschillende soorten OT-beperkingen. Belangrijk is dat de algemene beperkingstypen in de huidige formalisatie zijn overgenomen uit eerdere formalisaties van reduplicatie in gesproken talen. De verschillende patronen voor meervoudsreduplicatie en aspectuele reduplicatie in NGT konden grotendeels met succes worden geformaliseerd door de algemene beperkingstypen op verschillende manieren te rangschikken. Naar verwachting kan deze benadering ook worden toegepast op reduplicatie die wederkerige werkwoorden markeert. Het blijft de vraag of dezelfde spanningen relevant zijn voor reduplicatie in andere gebarentalen. In elk geval kunnen sommige van de patronen die voor die talen beschreven zijn, voorspeld worden door de voorgestelde beperkingstypen anders te rangschikken. Ten tweede heeft de formalisatie van reduplicatie in NGT geïllustreerd dat modaliteit een cruciale rol speelt in OT-analyses, aangezien specifieke beperkingen (zowel *faithfulness* als *markedness*) noodzakelijkerwijs verwijzen naar fonologische kenmerken die modaliteit-specifiek zijn. Dit roept de vraag op in hoeverre OT-beperkingen écht universeel kunnen zijn, en tegelijkertijd illustreert het de mogelijkheid die gebarentalen bieden voor het evalueren van beweringen over universaliteit.

Het hoofdstuk, en daarmee de dissertatie, sluit af met enkele suggesties voor toekomstig onderzoek naar het onderwerp. De meest belangrijke suggesties zijn dat toekomstige studies (i) zoeken naar sociolinguïstische en taalinterne verklaringen voor de variatie in de data en voor het feit dat reduplicatie optioneel lijkt te zijn; (ii) mogelijke andere functies van reduplicatie in NGT onderzoeken; en (iii) testen in hoeverre de voorgestelde OT-formalisatie kan worden uitgebreid naar andere (gebaren)talen. Dit laatste draagt ook bij aan een ander belangrijk doel, namelijk het verder onderzoeken van de ware universaliteit van OT-beperkingen.

Samenvatting in Nederlandse Gebarentaal
(summary in Sign Language of the Netherlands)

Bekijk de samenvatting in Nederlandse Gebarentaal via onderstaande link of scan de QR-code.
To view the summary in Sign Language of the Netherlands, go to the website below or scan the QR-code.

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About the author

Cindy van Boven (Woerden, the Netherlands, 1996) obtained her BA degree (*cum laude*) in Dutch Language and Culture from the University of Amsterdam (UvA) in 2017. During her bachelor's, she specialized in linguistics and followed several elective courses on sign language linguistics, which sparked her interest in the topic. She then continued her studies at the UvA with the research MA Linguistics, specializing in sign linguistics. She graduated *cum laude* in 2019.

During the final year of her master's, Cindy submitted a research proposal to NWO's *PhDs in the Humanities* funding scheme, together with dr. Roland Pfau and dr. Silke Hamann. The proposal was granted, and she started her PhD in September 2019. During her PhD, Cindy presented her work at a variety of international conferences, and published peer-reviewed articles in several journals. She also taught courses and classes on (sign) linguistics at the UvA, as well as at the *Sign Languages & Linguistics* winter school at the Université de Genève in 2021.

Public outreach has played an important role during Cindy's PhD project. Her research findings have been made available in Sign Language of the Netherlands (NGT), and they have been presented to teachers of NGT. Cindy also co-organized the first SignLab Open House, which took place in April 2023 and where results from sign language research were presented in NGT. She contributed two chapters to a popular-scientific book about linguistics (*Taalmysteries*, 2022), and has been an editor of the newsletter of a Dutch association for applied linguistics (*het WAP*) since 2022.

After completing her PhD project, Cindy started working as a postdoctoral researcher at UvA's SignLab in February 2024.