The Dissertation Committee for Elena Igorevna Liskova Certifies that this is the approved version of the following dissertation:

Universal Quantification in the Nominal Domain in American Sign Language

Committee:

Richard P. Meier, Supervisor

David G. Quinto-Pozos, Co-Supervisor

Josep Quer Villanueva

Patience L. Epps

David I. Beaver

John T. Beavers

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Elena Igorevna Liskova

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Dedication

To my family.

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Universal Quantification in the Nominal Domain in American Sign Language

Elena Igorevna Liskova, Ph.D.

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Supervisor: Richard P. Meier

Co-Supervisor: David G. Quinto-Pozos

While quantification in American Sign Language (ASL) has been an object of linguistic investigation for more than two decades, there are still relatively few studies on that topic. Most crucially, detailed descriptions of many aspects of quantification in ASL are still lacking.

This dissertation is a description of universal quantification in the nominal domain in ASL. Using data I collected from eight deaf native ASL signers, I report various lexical, morphological, and syntactic strategies that signers use to encode universal quantification. These strategies include explicit marking of quantification by means of lexical universal quantifiers and aspectual marking on directional verbs. In addition, I describe universal interpretations in sentences with definite plural and mass noun phrases and in sentences with predicates conveying total affectedness of the patient/theme argument.

Focusing further on ASL lexical quantifiers, I provide a detailed description that addresses variation in forms, morphological properties, and syntax. This description is further supplemented by the discussion of possible historical sources of ASL universal quantifiers and the place of non-native quantificational expressions in the lexicon. From a

typological perspective, I discuss modality-independent and modality-specific properties that explain the distribution of universal quantifiers in ASL. In particular, I consider distributivity, interaction with the semantics of nouns, and the role of space.

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Chapter 1: Introduction

1.1. Opening Remarks

The study of quantification has long been based on English and a few other Indo-European languages. In response to this biased sampling of the world's languages, several volumes have appeared in the past couple of decades that compile research on quantification in typologically diverse languages (Bach, Jelinek, Kratzer, & Partee, 1995; K.-H. Gil, Harlow, & Tsoulas, 2013; Keenan & Paperno, 2012; Matthewson, 2008). These volumes are driven by the goal of providing careful descriptions as well as semantic and syntactic analyses of quantificational phenomena in a wide range of languages.

Most work on quantification has been done on spoken languages. Until recently, there were just a few studies of some aspects of quantification in American Sign Language (ASL) and other signed languages, but more work has emerged in the last few years (some of which is discussed in Chapter 2). At the time when I embarked on this project, no overall description of how quantification is expressed in ASL, or any other sign language, was available. In this regard, recent overviews of quantification in ASL (Abner & Wilbur, 2017) and in Russian Sign Language (Kimmelman, 2017) offer particularly valuable contributions to the field. Importantly, more detailed descriptions of individual signed languages will provide new data that can be used to address interesting theoretical questions about the semantics, morphology, and syntax of quantificational expressions in signed languages. Such descriptions are needed to determine whether signed languages pattern similarly to spoken languages with respect to quantification. In other words, they

can help us address the question of what effects the visual-gestural modality has on how quantification is expressed. Thus, the study of quantification in signed languages allows us to investigate the range of structures that express quantificational meanings in world's languages and to examine the behavior of quantifiers cross-modally. It also allows us to explore the role that the use of three-dimensional space can play in the expression of quantification. As I demonstrate below, using evidence from previous research and from the analysis of my own data, physical space is employed in ASL, for example, in the expression of distributivity, quantifier domain restriction, and the geometric properties of the referent.

In this dissertation, I investigate how universal quantification in the nominal domain is encoded in ASL. In particular, I examine semantic equivalents of English *all, every,* and *each*.[1] I use 'nominal domain' here to refer to various ways of expressing universal quantification over a noun phrase (NP)[2] denotation. This includes not only cases when a quantifier forms a constituent with an NP, but also other means of expressing quantification over an NP, such as by means of verbal morphology, and also cases when NPs are interpreted universally in sentences with no overt quantifier. Using data I collected from eight native signers of ASL, I provide a detailed description of ASL universal quantifiers, including variation in their forms, their morphological properties, and syntax. I discuss modality-independent and modality-specific properties that explain the distribution

[1] The so-called *free-choice* English quantifier *any* sometimes has a universal interpretation. ASL has a sign glossed as ANY that may or may not be semantically equivalent to English *any*. This sign was not included in the present study.

[2] Here and throughout this dissertation I use the term 'noun phrase' (often abbreviated as NP) as a traditional designation, ignoring the question of whether the noun or a determiner (as suggested by Abney, 1987) is the head of the phrase.

of these quantifiers and trace their possible historical sources. I also address the place of non-native quantificational expressions in the ASL lexicon.

The remainder of this chapter is structured as follows. In the next section (1.2), I provide some background information. I start by discussing some important conclusions drawn from previous cross-linguistic work on quantification. I then provide a brief description of structures that have been observed in the expression of nominal quantification in ASL. In Section 1.3, I motivate and describe my research questions. Section 1.4 gives an overview of the present study. Importantly, since this study was designed to collect data on of a wider range of quantificational meanings than what I focus on in this dissertation, I explain the scope of this dissertation in Section 1.5. Finally, Section 1.6 describes the organization of this dissertation.

1.2. BACKGROUND

1.2.1. Quantification across languages

1.2.1.1. D-quantification and A-quantification

Starting with Partee, Bach, and Kratzer (1987), two types of quantification have been distinguished: *D-quantification* and *A-quantification*. Here, I follow Keenan and Paperno (2012, p. 1) who state that D-quantifiers "build expressions which are (or bind) arguments of predicates" and A-quantifiers "directly build predicates – verbal affixes, pre-verbs, auxiliary verbs, or predicate modifiers (adverbs, PPs)." Examples of D-quantifiers in English are *all*, *some*, *no,* and *most*; A-quantifiers include *always*, *sometimes*, *never*, *often*, etc. Importantly, the definition of D-quantifiers above deviates

from Partee et al.'s original usage in that it includes items that are not determiners. Thus, in the example from St'át'imcets in (1), *tákoem* 'all' is a D-quantifier, as defined above, even though it is not a determiner.[3] As indicated by square brackets, *tákoem* forms a constituent with a full determiner phrase that already contains a determiner.

(1) léxlex [tákoem i=smelhmúlhats=a]
intelligent [all DET.PL=woman(PL)=EXIS] St'át'imcets
'All (of the) women are intelligent' (Matthewson, 2013, p. 20)

In many languages, quantification over noun phrases is primarily or exclusively expressed by means of D-quantifiers. A classic example of such a language is English, which uses quantificational determiners to form quantified noun phrases, such as *all women* or *each man*. Interestingly however, it has been shown that some languages express quantificational over NP arguments by means of A-quantifiers. Thus in (2a), a verbal affix *nokka-* expresses quantification over the verb's object argument.[4] Example (2b) shows an adverb *aoseoho* quantifying over the subject argument.[5]

[3] In this dissertation, when citing a spoken language example taken from a previously published source, I follow the original glosses and explain abbreviations used by the author in a footnote. The following abbreviations are used in (1): DET = determiner, EXIS = existential, PL = plural.

[4] Abbreviations used in (2a): 3 = proximate third person, ObvP = obviative third person plural, Subj = subject.

[5] Viera (1995) explicitly argues that *aoseoho* 'all' and *ŋoa* 'men' in (2b) do not form a discontinuous constituent. Abbreviations used in (2b): 3ag. = third person agent, evid. = evidential particle, obliq. = oblique topicalized form.

(2) a. Pesq skitap nokka=psehl-a kiwhosu.
one man (3)-all=skin-3Subj.ObvP muskrat.ObvP Passamaquoddy
'One man skinned all the muskrats' (Bruening, 2008, p. 99)

b. aoseoho sekwehe i-tow-i ŋoa
all evid. 3ag.-lay down-obliq. men Asurini do Trocara
'All men lay down' (Vieira, 1995, p. 706)

While a number of languages have been shown to use A-quantification for quantification over NP arguments,[6] it is not clear how common it is for a language to use it as a sole strategy for expressing quantification. One language that have been claimed to lack D-quantification altogether is Asurini do Trocara (Vieira, 1995). Additionally, Jelinek (1995) reported the absence of D-quantification for the Straits Salish languages, but subsequent research has offered counterevidence to her claim (see Davis, 2013, and references therein).[7] One typological characteristic that Partee (1995, p. 560) suggested as a correlate of the use of A-quantification to express quantification over NP arguments—and perhaps more specifically the subclass of A-quantification that involves the use of verbal/predicate morphology—is "morphological and syntactic verb-prominence, of heavy loading of information in the verb," as in Australian languages such as Warlpiri and Gun-djeyhmi.

[6] In addition to the languages in (2), some other languages that have been shown to use A-quantification to express quantification over NP arguments include Warlpiri (Bittner & Hale, 1995), Mayali (Evans, 1995), Czech (Filip, 1996), ASL (Petronio, 1995), and Catalan Sign Language (Quer, 2012).

[7] Davis (2013), however, argues in support of Jelinek's (1995) analysis of Straits Salish as lacking generalized quantifiers (contra Barwise and Cooper's (1981) NP-Quantifier Universal).

Considering examples of A-quantification over NP arguments by means of verbal/predicate morphology in Warlpiri, Gun-djeyhmi and ASL, Partee (1995) suggests analyzing such cases as involving "an operator with some quantificational force (and perhaps further content as well) [that] is applied directly to the verb or other predicate at a lexical level, with (potentially) morphological, syntactic, and semantic effects on the argument structure of the predicate" (p. 559). Importantly, these operators demonstrate "specificity of both their quantificational interpretation and their manner of associating with the argument structure of the verbs they combine with" (p. 577). For example, the argument for which such an operator provides quantificational value may depend on the class of a verb it applies to. Consider sentences in (3).[8] The prefix *djangged-* in Gun-djeyhmi applies to the subject of an intransitive verb (3a) and to the object of a transitive verb (3b). ASL examples (which I discuss Section 1.2.1.3) will show that such an operator may only apply to verbs/predicates of a particular class, namely, directional verbs and classifier constructions.

(3) a. Guluban ga-djangged-di.
Flying.fox 3sg-mob-stand
'There's a big mob of flying foxes.' (subject)

[8] Abbreviations used in (3): 3sg = third person singular, PSTPF = past perfect.

b. Guluban garri-djangged-na-ng.
Flying.fox we-mob-see-PSTPF Gun-djeyhmi
'We saw a mob of flying foxes.' (object) (Partee, 1995, p. 558)
(can't mean 'A mob of us saw…' or 'We in a mob saw…')

Notably, Partee points out that such cases of A-quantification differ from examples of "true A-quantification, with unselective quantifiers and a syntactic (or topic/focus…) basis for determining, insofar as it is determinate, what is being quantified over" (p. 559). True A-quantification can be exemplified by English quantificational adverbs like *always* and *often*.

1.2.1.2. Syntactic and semantic properties of universal D-quantifiers

Focusing on syntactic differences between D-quantifiers in a sample of 37 spoken languages from 25 families, Matthewson (2013, p. 37) observes that "quantifiers in almost all languages do not form a fully uniform category, but display lexical differences in combinatorial possibilities." For instance, in such languages as Maori, Muna, and Tuvaluan, an equivalent of *all* attaches to a full DP (similar to English *all the books*) while an equivalent of *each* combines directly with an NP. Matthewson therefore suggests that "rather than seeking a typology of languages with respect to quantification, what we need is a typology of individual quantifiers [across languages]" (p. 38).

Cross-linguistic investigation of quantification further shows that many languages have more that one universal quantifier (Keenan & Paperno, 2017; Matthewson, 2008, 2013). English *all, each,* and *every* are of course well-known examples of this

phenomenon. To take another example, in Malagasy there are eight universal quantifiers that "differ in distribution and somewhat it meaning, some being more collective, others being more distributive. A given sentence may contain several, all quantifying the same constituent" (Keenan, 2008, p. 339). Thus Partee (1995, p. 579) states that "there is considerable variation in the semantic as well as the syntactic properties of various universal quantifiers in various languages, and it is not unlikely that closer attention to the semantic differences among them will be useful in the search for principles relating syntactic form to semantic interpretation cross-linguistically in the domain of quantification."

One parameter along which universal quantifiers in many languages have been noted to differ is distributivity (D. Gil, 1995; Keenan & Paperno, 2017, among others). Generalizing across a number of spoken languages, D. Gil observes that some universal quantifiers force distributive interpretations (that is, they do not allow collective interpretations), while others permit both distributive and collective interpretations. He refers to the former as *distributive* quantifiers and to the latter as *non-distributive* quantifiers.[9] Notably, his term *non-distributive* "should be taken to mean 'not necessarily distributive, not 'necessarily not distributive'" (Faller & Hastings, 2008, p. 296, fn. 41). 'For example, English universal quantifiers include the non-distributive quantifier *all* and the distributive quantifiers *each* and *every*. Thus, (4a) can be interpreted as the men carrying the suitcases collectively or individually, while (4b) only allows the latter

[9] Gil further divides distributive quantifiers into *distributive-key* and *distributive-share* (the terms are adapted from Choe, 1987).

interpretation. Consistent with that, *all* can occur with a collective predicate like *gather*, while *each* or *every* cannot, as shown by the contrast between (4c) and (4d).

(4) a. All men carried three suitcases.
b. Every/each man carried three suitcases.[10]
c. All men gathered at dawn.
d. *Every/*Each man gathered at dawn.

(adapted from D. Gil, 1995)

Most of the cross-linguistic studies of D-quantifiers reported here are based on spoken languages exclusively. A notable exception constitutes Keenan and Paperno (2017). Their overview of quantification in 36 languages from diverse language families includes two sign languages: ASL and Russian Sign Language (RSL). Keenan and Paperno offer a number of generalizations and observations. Importantly, both ASL and RSL pattern similarly to the spoken languages in the sample with respect to the proposed generalizations (although for a couple of generalizations the relevant data is missing for one sign language or the other). Most relevant to the present discussion, these languages conform to Generalizations 4a and 5 below. Similarly to many spoken languages, ASL and RSL have several D-quantifiers meaning 'all' and universal quantifiers in these languages can be classified with based on whether they allow distributive interpretations.

[10] In this work, Gil focuses on *every* but notes that most of his observations are also valid for *each*.

(5) Gen 4a: All [36 Ls in our sample] have one (often several) lexical D-quantifiers meaning ALL.

Gen 5: All 36 Ls in our sample distinguish phonologically between a *collective* universal and a *distributive* one.[11]

(Keenan & Paperno, 2017, p. 996)

Haspelmath (1995) traces the diachronic development of semantic equivalents of English *all* and *every* in a number of spoken languages. For each of these quantifiers, across languages, he found commonalities in their diachronic sources and identified types of such sources (e.g., 'all' from 'whole,' 'every' from a free-choice determiner, etc.). At the same time, he found that within a language these quantifiers have different, unrelated sources. "Although both 'all' and 'every' correspond to the universal quantifier in logic, natural languages typically make a clear distinction between these two types of determiners" (p. 379). Haspelmath's work demonstrates that the investigation of the historical development of individual quantifiers can help explain their syntactic and semantic properties.

In summary, the cross-linguistic work on quantification that is mentioned above emphasizes the importance of fine-grained semantic, syntactic, and historical accounts of individual quantifiers. Existing typological research on universal D-quantifiers demonstrates that: (1) Many languages have multiple universal quantifiers differing in their combinatorial properties; (2) Distributivity is a parameter that divides universal quantifiers

[11] Keenan and Paperno use (un)grammaticality with collective predicates (like *gather*) as a diagnostic for their classification; thus their generalization does not specify whether what they refer to as *collective universals* allow distributive interpretations or not.

in many languages; (3) Investigation of diachronic sources of quantifiers is a useful tool in explaining semantic and syntactic properties of quantifiers.

1.2.2. Lexical and morphological means of expressing quantification in ASL

ASL teaching grammars list various lexical D-quantifiers that can be used to express nominal quantification. These signs include numerals like ONE[12] and TWO and non-numeric quantifiers like MANY, SEVERAL, and ALL. At the same time, it has been observed that some types of quantification over NPs in ASL can be expressed with the help of various morphosyntactic strategies, namely, morphology on directional verbs[13] and classifier constructions (A-quantifiers, following the terminology introduced in Section 1.2.1.1).[14] One important feature that characterizes these strategies is the linguistic use of physical space.

Directional verbs. Directional verbs (e.g., GIVE, SHOW, TAKE, INFORM) are verbs that "change their direction of movement to point toward the locations of various arguments in the sentence" (Fischer & Gough, 1978, p. 28). By means of these movements,

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[12] Glossing conventions used for sign language examples are explained in Appendix A.

[13] A note on terminology is in order. The proper analysis of this class of verbs, and consequently the correct terminology, is a subject of an ongoing debate. Some studies analyze directionality as exhibited by these verbs as an overt realization of agreement between subject and/or object arguments of the verb in person and number (Lillo-Martin, 1986a; Lillo-Martin & Meier, 2011; Mathur & Rathmann, 2012; Meier, 1982; Quer, 2011). These researchers refer to this class of signs as *agreement* or *agreeing verbs*. Other researchers have suggested that directionality marks semantic roles associated with the arguments (Johnston & Schembri, 2007; Liddell, 2003, among others). The corresponding terms used by these researchers are *indicating verbs*. Since the issue of the proper grammatical analysis of directionality is not going to be addressed here, I will use the more descriptive and theory-neutral term *directional verb* (Casey, 2003; Fischer & Gough, 1978; Hou, 2013).

[14] These constructions have been referred to by a variety of terms in descriptions of ASL and other sign languages (Cormier, Quinto-Pozos, Sevcikova, & Schembri, 2012; Schembri, 2003). One commonly used label is *verbs of motion and location* (Supalla, 1982, 1986). Here I follow Sandler & Lillo-Martin (2006) in using the term *classifier construction* which is neutral with respect to the internal structure of these forms and their grammatical role(s).

directional verbs not only mark subject (agent/source) and/or object (recipient/goal), but also show whether their selected arguments are singular, dual, or plural. In addition, directional verbs can express distributivity. For example, in producing an exhaustive form of the verb GIVE 'I gave each of them' the distributive marker takes the form of "several small slightly displaced repetitions" (Sandler & Lillo-Martin, 2006, p. 39).

Classifier constructions. Classifier constructions are morphologically complex signs in which a handshape (a classifier) is used to represent certain semantic features of a noun argument.[15] They "[are] used for the purpose of denoting spatial relations and motion events and for characterizing shapes and dimensions of objects" (Sandler & Lillo-Martin, 2006, p. 76). To give an example, a signer might refer to several cars in a row by first producing a classifier handshape for a vehicle with both hands and then, while holding the non-dominant hand in place, moving the other hand away in a sweeping motion along a linear path.

Handshape, location, and movement are all meaningful in classifier constructions. "The locations articulated by the hand or hands in this system signify precise locations within a space established to represent the event" (Sandler & Lillo-Martin, 2006, p. 79). Different types of movement convey such notions as existence of a particular entity, its location or the kind of motion it undergoes. Importantly, the path and manner of movements also express meaning. These last two components are particularly relevant for the expression of nominal quantification. Thus, in the earlier example of a classifier

[15] Some researchers compare classifiers in ASL to verbal classifiers in spoken languages (e.g., Sandler & Lillo-Martin, 2006; Zwitserlood, 2003), whereas other researchers have pointed out that there are important differences (see, e.g., Engberg-Pedersen, 1993; Schembri, 2003).

construction with a vehicle classifier, the sweeping motion along a linear path indicates a row of several cars. I will provide further information as to how directional verbs and classifiers constructions express nominal quantificational in my discussion of previous literature in Chapter 2.

1.3. RESEARCH QUESTIONS

1.3.1. Description of quantificational expressions

Given the lack of thorough accounts of many aspects of quantification in ASL, the main goal of the present study is to provide a better description of ASL quantification in the nominal domain. The general question I am asking is this: what is the range of lexical, morphological, and syntactic means that ASL uses to encode nominal quantification? Previous accounts, which I describe in Chapter 2, show that strategies for nominal quantification in ASL include lexical quantifiers, morphology on directional verbs and classifier constructions. These accounts, however, do not allow us to construct a complete inventory of strategies for expressing particular quantificational meanings. Furthermore, in many cases there is not enough descriptive detail available on the forms of individual quantifiers. Thus, more specific research questions that my study aims to address concern the form (and variation in form) of ASL quantificational expressions, their interpretation, and their syntactic distribution. For quantificational expressions that do not differ in their quantificational force, I consider differences in their semantics and restrictions on their use.

1.3.2. Interaction with the semantics of quantified nouns

Another question that I explore in this study is whether and how the choice of a particular quantificational strategy correlates with the semantics of a quantified noun. In particular, I consider the count/mass, concrete/abstract, and human/non-human and animate/inanimate distinctions. From descriptions of quantification in spoken languages we know that in some language quantifiers can be classified based on whether they combine with *count* or *mass* nouns or *both* (Keenan, 2012). For instance, consider English *many/*much students*, **many/much flour*, and *some students/flour*. The question that arises in this respect is whether ASL systematically marks the count/mass distinction as well. One could hypothesize that ASL would also make a distinction between quantifying over individuated objects (denoted by count nouns) and substances (denoted by mass nouns), and that how this distinction is expressed might be iconically motivated. The specific kind of iconicity involved here could be some sort of individuated representation of count references vs. delimiting non-individuated homogeneous representation of masses.

My motivation for considering the *concrete/abstract* distinction is based on an intuition that some quantificational strategies that are available for concrete nouns in ASL cannot be applied to abstract nouns. Wiemer-Hastings and Xu (2005, p. 720) define concrete concepts as those that "represent physical entities, defined by spatial boundaries and perceivable attributes" and abstract concepts, by exclusion, as "not physical" (but they also recognize that there are "graded differences in concreteness"). For the purposes of this work, I use this definition to classify nouns denoting corresponding concepts into concrete and abstract. Mandarin Chinese has been shown to use different sets of classifiers for

concrete and abstract nouns (Liu, 2012); for example, *kuai* 'chunk' for concrete nouns that refer to chunky things like rocks, *dian* 'point' for abstract nouns denoting a suggestion, a request, or a criticism.

One example of a quantificational strategy that appears not to be available for quantification of abstract nouns in ASL is the use of classifier constructions.[16] As discussed in more detail below in Section 2.1.2.2, one class of classifier constructions that can express nominal quantification involves *entity* or *semantic* classifiers (Engberg-Pedersen, 1993; Schembri, 2003; Supalla, 1982, 1986, among others), that is, handshapes that correspond to different semantic classes (e.g., human, vehicle, tree). To my knowledge, the inventory of these classifiers in ASL does not include handshapes for abstract non-tangible entities. This may be explained by the fact that classifier constructions with entity classifiers are used to describe spatial relationships between physical objects, therefore they are likely not used in descriptions of nonmaterial objects, and consequently there are no entity classifiers for abstract concepts. An interesting question to investigate in this respect is whether any quantificational expressions that utilize physical space are used with abstract nouns. We do not yet know much, if anything, about quantification of abstract nouns because all existing accounts of quantification I am aware of only consider examples with concrete nouns.

One further semantic parameter that I included in the study design was animacy, more specifically the *human/non-human* and *animate/inanimate* distinctions. I am not

[16] Note that entity classifiers in ASL are not numeral classifiers like those in Mandarin Chinese – ASL's entity classifiers are neither obligatory with a numeral, nor do they require a numeral. Furthermore, as mentioned earlier (fn. 15), it is a subject of debate in the literature how similar classifiers in signed and spoken languages are.

aware of any spoken language in which these distinctions affect quantification, although the effect of animacy on the occurrence of number marking on nouns is documented in a number of languages (Haspelmath, 2013). I also did not have a particular hypothesis about whether and how these distinctions would affect quantification in ASL, but they were easy to incorporate into the design of my data collection and their inclusion was in line with my goal to investigate the interaction of noun semantics and quantification.

1.3.3. Typological comparison

From a typological perspective, the present study seeks to explore the following research questions. First, I am asking if the parameters that separate quantifiers in ASL are the same as those proposed for spoken languages. One distinction that has been adopted in the previous research on quantification in signed languages (Kimmelman, 2017; Quer, 2012) is that between *D-quantification* and *A-quantification* (Partee, 1995; Partee et al., 1987). I describe this distinction in the following chapter and use it to classify previous accounts of nominal quantification in ASL. As mentioned earlier, I also consider a cross-linguistically attested classification of quantifiers into those that occur with *count* nouns and those that occur with *mass* nouns. I furthermore explore the possible role of two other parameters, namely *abstract/concrete* and *animate/inanimate* distinctions. The final parameters that I examine is *distributivity* which has been shown by Gil (1995) to differentiate universal quantifiers in spoken languages.

The second research question that I address is whether the historical sources of ASL quantifiers are similar to those identified for quantifiers in spoken languages. In doing so, I

explore phonological and semantic processes involved in language change in ASL and the role of iconicity.

The question underlying my investigation of similarities and differences in the realm of quantification between spoken languages and signed languages, as exemplified by ASL, is what effects the visual-gestural modality has or does not have on linguistic structure in sign. This question is an important one because it bears on the issue of what properties of quantification are modality-independent, and thus are universal properties of language, and which ones might be modality-specific. One particular aspect that differentiates ASL and many other signed languages from spoken languages is the linguistic use of physical space. Previous work shows that space is used, for example, to express quantification by means of morphology on directional verbs. I expect to find the effects of the use of space in a number of quantificational strategies.

1.4. Overview of the Study

To date, there does not exist a sufficiently large corpus of ASL video data that would allow for an investigation of quantification. Therefore, to address the research questions described in the previous section, I designed an elicitation procedure to collect exploratory data. I outline the design of my study here and describe it in more detail in Chapter 3.

In this study, I examine how ASL encodes nominal quantification by looking at how it expresses semantic equivalents of three basic semantic classes of quantifiers (Keenan, 2012), to wit generalized universal quantifiers *all, every, each*, generalized

existential quantifiers *some*,[17] *several, (a) few/little, many/much, no*, and the proportional quantifier *most*. I chose to focus on this list of quantifiers because other researchers who investigated quantification in lesser-studied languages addressed a similar set of quantifiers (see, for example, the chapters by Bruening, Etxeberria, Faller & Hastings, and Zerbian & Krifka in Matthewson (2008)). Importantly, this previous research provides data that allows for direct comparison of quantifiers in other languages with similar quantifiers in ASL. Furthermore, the quantificational expressions listed above cover a range of quantificational meanings, thus allowing me to check if generalizations can be made about how quantification works in ASL in general.

In accordance with my goal to explore the interaction of noun semantics with quantification, elicited nouns include semantically *count* and *mass* nouns, and nouns in each of those groups can be further subdivided into *concrete* and *abstract*. Based on these two distinctions, the elicited nouns can be classified into four classes. Examples of each class include: concrete count—STUDENT, abstract count—STORY, concrete mass—WATER, abstract mass—ENERGY. Furthermore, the group of concrete count nouns contains nouns differing according to the *human/non-human* and *animate/inanimate* distinctions, for example, animate human—STUDENT, animate non-human—DOG, inanimate—COOKIE.

An additional set of sentences was elicited to focus specifically on quantification by means of morphology on a directional verb (due to the time constraints having to do with

[17] In this study, I only address quantificational 'some,' excluding the indefinite reading (as in, *Some guy is stalking me*).

the length of the elicitation session, only the verb GIVE was included) and a classifier construction (classifier construction with the vehicle classifier). These sentences were elicited to investigate (a) the range of quantificational meanings that can be expressed with these strategies and (b) the use of multiple strategies within the same sentence all quantifying over the same noun (e.g., a lexical quantifier plus morphology on a directional verb).

To investigate historical sources of ASL quantifiers, I examine materials in the Historical Sign Language Database (http://hsldb.georgetown.edu), which constitute the richest existing collection of ASL historical data, and information available from previously published research.

1.5. Scope of This Dissertation

The study design outlined above is motivated by my research questions, most importantly, by my goal to provide a more thorough description of nominal quantification in ASL. I collected and coded data on a range of quantificational meanings discussed in the previous sections. However, the scope of the project exceeds the time available for this dissertation. Therefore, in this dissertation (except for Chapter 3 where I provide details of my data collection methodology), I only focus on the expression of universal quantification in ASL.

The research questions that I explore in this dissertation remain largely the same as those described in Section 1.3. Additionally, I investigate an additional question that falls under the scope of my goal stated in Section 1.3.3 to provide a description of quantification

in ASL but that is not mentioned explicitly there. Two quantificational expressions in my data, the lexicalized fingerspelled loan sign #ALL and the sign I gloss as INDIVIDUAL[distr] (described in Sections 4.3.1.1 and 4.3.2.3 respectively) contain handshapes from the ASL fingerspelled alphabet, thus demonstrating influence from English. In the model of ASL lexicon proposed by Brentari and Padden (2001), such items are classified as non-native. For these quantifiers, I consider their place in the ASL lexicon and ask whether they pattern similarly to other non-native lexical items.

1.6. ORGANIZATION OF THIS DISSERTATION

Chapter 2 is an overview of previous research on nominal quantification in ASL and other topics relevant for the discussion of the data. In Chapter 3, I describe the methods that I followed to collect data for this study. In Chapter 4, I describe the data. In Chapter 5, I further discuss lexical universal quantifiers and offer another dimension to my description by considering historical sources of ASL quantifiers and their place in the ASL lexicon. Finally, Chapter 6 summarizes the findings and offers suggestions for future research.

Chapter 2: Previous Research

In this chapter, I overview previous accounts of quantification in the nominal domain in ASL and other sign languages. I distinguish between D-quantification and A-quantification, as defined in Section 1.2.1.1, as both of these types of quantification have been shown to express quantification over NPs in sign languages. In section 2.1, I focus on ASL but mention other sign languages briefly when they demonstrate similarities to ASL. Section 2.2 is devoted specifically to the discussion of quantification in other sign languages.

2.1. QUANTIFICATION IN ASL

2.1.1. D-Quantification in ASL

2.1.1.1. Teaching grammars on the use of D-quantifiers

ASL has various signs, such as MANY, MOST, ALL, and #ALL, that are commonly introduced in ASL teaching grammars as equivalents of the corresponding English D-quantifiers *many, most,* and *all*. Some examples of sentences with these sign from an ASL textbook by Humphries and Padden (1992) are shown in (1).[18]

(6) a. HERE U-S **MANY** PEOPLE HAVE MONEY
'Many people here in the US have money.'
(Humphries & Padden, 1992, p. 311)

[18] Translations of these examples are mine.

b. **MOST** TIME IX-1 OUT LUNCH

'I go out for lunch most of the time.'

(ibid., p. 128)

c. **#ALL** DEAF

'(They are) all deaf.'

(ibid., p.97)

t

d. WORSE PROBLEM, PEOPLE POOR. **ALL** COUNTRY HAVE

'The worst problem is poor people. All countries have it.'

(ibid., p. 311)

Baker-Shenk and Cokely (1991b) discuss ASL quantifiers[19] in their resource text for teachers on ASL grammar and culture. With respect to the position of quantifiers in a sentence, they point out that a quantifier tends to occur before the noun, as in (6) above. However, "when a number has special significance, then it is often signed *after* a noun and is stressed" (p. 374). Thus in (7a), an asterisk after TEN indicates that the sign is stressed or emphasized which, according to Baker-Shenk and Cokely, "usually involves making the sign faster and sharper" (p. 139). In some cases when a quantifier has special significance, it can occur before and after the noun (7b). This is an examples of the so-called "double constructions" (Petronio, 1993) in which a sign is repeated in the clause-final position,

[19] Baker-Shenk and Cokely refer to ASL quantifiers as *number signs*, and they further subdivide them into *specific number signs* (i.e., numerals ONE, TWO, etc.) and *non-specific (indefinite) number signs* (i.e., non-numeric quantifiers, such as MANY, FEW, and SEVERAL). Note that this choice of terminology differs from what one may encounter in descriptive grammars of English and other spoken languages. Baker (1995), for examples, uses the term *quantity words* for numerals and non-numeric quantifiers, while using the term *number words* for nouns like *dozen*, *hundred*, and *thousand*. He also discusses an interesting case of "a two-word sequence [of the quantity word *all* and a numeral] that itself has the force of a quantity word" (p. 175), as in ***All four** (of the) lions eat meat*. It is yet to be determined if ASL has a parallel construction combining ALL/#ALL and a numeral.

which is the position associated with prosodic focus (Wilbur, 1994). Double constructions are common in ASL. In addition to numeral and non-numeral quantifiers, other elements that have been noted to appear in these constructions include, e.g., modals, negatives, WH-quantifiers, and verbs (Petronio, 1993).

(7) a. P-A-T, BUY **PENCIL TEN***, REASON, TOMORROW EXAM
‘Pat bought *ten* pencils for the exam tomorrow.’

b. gest:‘hey’, P-A-T BORN **TWO BOY TWO***
‘Hey! Pat gave birth to two boys – *two* of ‘em!’
(adapted from Baker-Shenk & Cokely, 1991b, pp. 374–375)

Baker-Shenk and Cokely further point out that, in sentences with both a quantifier and a classifier construction referring to the same noun, the typical order is *noun–quantifier–classifier construction*, as demonstrated in (8). This order occurs in sentences with a noun and the quantifier appearing either with topic marking (a brow raise and a slight backwards tilt of the head), as in (8), or without it.

(8) CUP FOUR CL:A’in a row’
ndh: CL:B’surface’
‘Four cups are standing in a row on top of something.’
(adapted from Baker-Shenk & Cokely, 1991b, p. 375)

According to Baker-Shenk and Cokely, the facts about the distribution of quantifiers described above apply to both numerals, as in (7) and (8) and non-numeric quantifiers such as MANY, FEW, SEVERAL, and SOME. Interestingly, with respect to non-numeric quantifiers, which they call *indefinite number signs*, the authors note that they "do not seem to be used as often in ASL as indefinite number words are used in a spoken language like English" (Baker-Shenk & Cokely, 1991b, p. 376). On their view, non-numeral quantifiers are used when the focus is on the degree of plurality, but in other cases ASL tends to employ other ways to indicate indefinite plurals (e.g., equivalents of English *some, several, a few, many*); for example, by means of classifier constructions or verbal morphology on directional verbs, which I address below in my discussion of A-quantification in ASL.

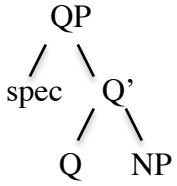
2.1.1.2. Structure of a quantified noun phrase

A linguistic analysis of the syntactic structure of a quantified noun phrase (QNP) in ASL, conducted within the framework of X-bar Theory, is offered in Boster (1996). Her analysis is based on sentences with numerals, but she points out that her results extend to the non-numeric quantifiers ALL, ALOT, SOME, FEW, and MANY.[20] Following Fischer (1975), Liddell (1980), Padden (1988), and others, Boster takes Subject –Verb–Object to be an underlying word order in ASL. She further assumes, following Fischer (1990), that ASL is a topic-prominent language, and topicalization is a common syntactic operation in

[20] The glosses are listed as given in the original. Boster does not describe the forms of these signs, so it is impossible to say, for example, if she uses the gloss *ALL* for the same sign as I do in the description of my data in Chapter 4.

ASL that moves presupposed information (the topic) to the beginning of the sentence before new information (the comment). Boster then argues that QNPs in ASL are head-initial maximal projections of a quantifier (Figure 2.1).

Figure 2.1. Proposed structure of QNPs (Boster, 1996, p. 161)[21]



Example (9a) below (as well as sentences in (6) above) demonstrates the basic in-situ order of the quantifier and the NP. Boster notes that the reverse NP–quantifier order is also possible, as shown in (9b). She accounts for this order by applying Fischer's (1990) *mini-topicalization* analysis. According to Fischer, ASL allows topicalization within a phrase by which a complement moves to the specifier position.[22]

(9) a. IX-1 WANT **THREE BOOK**
'I want three books.'

[21] In this work, Boster (1996, p. 169) sets aside the issue of "[w]hether or not a QP in ASL can, or must, fall hierarchically 'under,' or be subcategorized by a DP," as suggested by Abney (1987) in his DP Hypothesis.

[22] Fisher (1990) characterizes mini-topicalized complements as 'definite.' However, it is not entirely clear what her definition of definiteness is in this case. Her examples of mini-topicalized noun complements involve noun–modifier sequences like [MAN]^{t} PINK. While bare NPs in ASL may have a definite interpretation, her examples are translated into English with indefinite noun phrases, e.g., *a pink man*. In her turn, Boster (1996) claims that topicalization in ASL and other languages is licensed by definiteness or specificity, but she does not explain if this claim extends to cases of mini-topicalization.

b. IX-1 WANT **BOOK THREE**

'I want three books.'

(adapted from Boster, 1996, p. 160)

Similarly to sentence topics (discussed next), mini-topics in ASL may be accompanied by topic non-manual marking (a brow raise and a tilt of the head). Boster (1996) notes, however, that this marking is optional for mini-topics, as evidenced by its absence on BOOK in (9b).

Note that example (9b) shows the same NP–quantifier order as example (7a) from Baker-Shenk and Cokely (1991b) that I discussed in the previous section. However, unlike Baker-Shenk and Cokely's description, Boster's (1996) discussion does not mention that the number in (9b) has any kind of special significance or that it is stressed. This leaves open a possibility that (7a) and (9b) exemplify two different constructions, both demonstrating the NP–quantifier order.

The main focus of Boster's analysis is a particular syntactic construction in which the quantifier and the quantified NP are separated and the NP appears in the topic position at the beginning of a sentence (10a). This phenomenon is commonly referred to as "floating quantifiers," and it has been observed in many languages, including English, Japanese, German, Spanish, etc.

(10) a. t
BOOK IX-1 WANT **ALL**

b. t
*__**ALL**__ IX-1 WANT **BOOK**

'I want all of the books.'

(adapted from Boster, 1996, p. 193)

While sentences like (10a) were accepted by most of native signers of ASL that Boster consulted, sentences in which only the quantifier is separated were not (10b).[23] She considers various conditions under which the NP–quantifier split like that in (10a) is (dis)allowed and argues that it is best analyzed as an instance of A'-movement, in particular "topicalization of the NP complement to Q to a position beyond the QP" (p. 178).

One characteristic of NP–quantifier splits that Boster argues her analysis accounts for is the "subject–object asymmetry" whereby, unlike an object NP, a subject NP cannot be separated from its quantifier. She proposes that (11a) is ungrammatical because A'-movement from subject position incurs a violation of subjacency (as defined in Lasnik & Saito, 1992). (Since I am mostly interested in describing the relevant ASL data, I will leave out further details of Boster's argument.) In contrast, (11b) is good because it is an example of left dislocation, rather than topicalization: STUDENT IX[pl]-a is "assumed to have been base generated in situ" (Boster, 1996, p. 180).[24] Since no movement is involved, no subjacency violation could have occurred.

[23] Boster notes that a few of her consultants who did not allow the NP to be separated from the quantifier require that the entire QNP be topicalized.

[24] The function of pointing signs in ASL has been the subject of much discussion in the literature. Some researchers have suggested that pointing signs accompanying nouns function as definite determiners (Kegl,

(11) a. ***STUDENT** TODAY **THREE** ARRIVE CLASS LATE
t
'Three students were late to class today.'

b. **STUDENT IX[pl]-a** TODAY **THREE IX[pl]-a** ARRIVE CLASS LATE
t
'(As for) Those students, today three of them arrived to class.'

(adapted from Boster, 1996, pp. 180–181)

A further contrast can be made between (11a) and (12). Boster explains that (12) is grammatical because it involves mini-topicalization (NP complement STUDENT moves to the QP-specifier position above the head THREE), and thus it does not violate subjacency.

(12) **STUDENT THREE** ARRIVE CLASS LATE
'Three students were late to class.'

(Boster, 1996, p. 183)

As I will show in Chapter 4, for the most part the syntactic distribution of D-quantifiers in my data follows the patterns described above.

2003; Wilbur, 1979). MacLaughlin (1997) analyzes prenominal points as definite determiners and postnominal points as locative adverbials. Pointing signs used for personal reference without an accompanying noun have traditionally been treated as personal pronouns (Meier & Lillo-Martin, 2013; Sandler & Lillo-Martin, 2006). More recently, Koulidobrova and Lillo-Martin (2016) argued for a unified analysis of various uses of pointing signs as demonstratives.

2.1.1.3. Sentences with the NP-quantifier split and mapping onto tripartite structures

Partee (1995) considers various strategies that languages use to express quantification. Following the work of Lewis (1975), Heim (1982), and Kamp (1981), she proposes that at some level these strategies have a tripartite structure: Operator–Restrictor–Nuclear Scope. Notably, the NP-quantifier split construction in ASL sentences like (10a) demonstrates that the restrictor (the quantified NP) can be overtly separated by means of topic non-manuals from the operator (the quantifier) and the nuclear scope (the rest of the sentence).

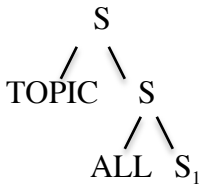
Partee (1995) discusses a similar example, in (13), where the topic supplies the restrictor, but where, unlike (10a), the operator appears in front of the subject and is separated from the nuclear scope by means of an intonation break, indicated by a comma. (Partee cites Petronio's (1989) unpublished manuscript as a source of this example.)

(13) t
STUDENT GROUP, #ALL, IX-1 LIKE
'I like all (of the) students.

(adapted from Partee, 1995, p. 551)

This example is particularly interesting because all three components of the tripartite structure are overtly separated. It should be noted that Partee considers this sentence an instance of A-quantification, rather than D-quantification, and treats #ALL as "as predicate expression or open sentence" (p. 376). A rough syntactic structure for (13) is given in Figure 2.2.

Figure 2.2. Schematic syntactic structure for example (13) (Partee, 1995, p. 576)



It remains unclear at the moment how common sentences like (13) are in ASL. I am not aware of any in depth analyses that would be proposed for them. My data, which I discuss in Chapter 4, do not contain any such examples but it may be the case that this construction is associated with a particular discourse context that my elicitation procedure did not include.

That being said, examples like (10a) with the restrictor of the quantifier appearing in topic position are well attested not only in ASL, but also in other sign languages. Quer (2012) reports similar data for Catalan Sign Language (LSC) and Kimmelman (2017) for Russian Sign Language (RSL). Quer further argues on the basis of data from LSC and ASL that tripartite structure is used in these languages to encode both D-quantification and A-quantification. He, thus, concludes that "tripartite structures [are] an important heuristic and analytical tool that helps capture the correlations and correspondences in the different strategies that languages employ to encode quantificational meanings" (Quer, 2012, p. 90).

2.1.1.4. Modality-specific phenomena

Some interesting modality-specific phenomena in the realm of quantification have to do with the use of space to express quantifier domain.[25] Davidson and Gagne (2014) demonstrate that in ASL (and also in LSC, as shown by Barberà, 2012) the domain of a quantifier "can be marked in the [default] low horizontal plane by placing the quantifier in the location of a plural discourse referent that serves as its domain" (p. 113). Thus, in (14a) a plural pointing sign IX[pl] assigns a set of students to locus *a*, the quantifier is then produced in the same location (indicated by coindexation) which shows that the set of students is its domain. This strategy is optional though, as shown in (14b); the domain of a quantifier can be supplied by discourse context.

(14) a. POSS-1 STUDENT IX[pl]-a SMART. NONE-a/ONE-a/#ALL-a SKIP CLASS
'My students, they are smart. None/one/all of them skip(s) class.'

b. POSS-1 STUDENT SMART. NONE/ONE/#ALL SKIP CLASS
'My students are smart. None/one/all skip(s) class.'

(adapted from Davidson & Gagne, 2014, p. 114)

Furthermore, Davidson and Gagne demonstrate the role of space, specifically sign height, in expressing quantifier domain restrictions in ASL.[26] They argue that the "use of vertical (LOW/HIGH) space is a way to implicitly convey set size, and can be used to provide information about the restriction of quantifier domains" (Davidson & Gagne, 2014,

[25] In addition to works reported here, see Schlenker (2011a, 2011b) for a discussion of overt coindexation in the context of binding properties of quantifiers in ASL and French Sign Language.
[26] See also Barberà (2012) whose analysis of sign height in LSC focuses on its role in expressing specific and non-specific indefinites.

p. 113). So, a quantifier produced in the default low horizontal plane refers to a set of individuals that is salient in the given context; increasing the sign height widens the domain of a quantifier. Consider the example in (15). Davidson and Gagne offer the following context: "the signer is traveling with his family, and it becomes a late night on the road so he hastily finds a place for them to spend the night. When they awake in the morning, they realize they are staying at a nudist colony, although the signer and his family are not practicing nudists" (pp. 115-116).

(15) *Context: At or discussing a nudist colony*

a. #$ALL_{LOW/MID}$ NOT WEAR CLOTHES
'All the people at this nudist colony don't wear clothes.'

b. #ALL_{HIGH} WEAR CLOTHES
'Everyone wears clothes.'

(adapted from Davidson & Gagne, 2014, p. 116)[27]

As indicated by the subscript, #$ALL_{LOW/MID}$ is produced in the low or mid plane of the signing space (in front of the signer's chest), and #ALL_{HIGH} is produced in the high plane (above the signer's shoulders). In (15a), the context supplies the domain of #$ALL_{LOW/MID}$, namely, all people at a nudist colony. In (15b), the domain of #ALL_{HIGH} is wider than in (15a) and includes people outside of the given context. If (15b) is produced in the same

[27] The example that (15) is based on is presented in the source with a pointing sign glossed as IX-arc (IX[pl] in my notation)–functioning as a third person plural pronoun–instead of #ALL. I have modified the original example based on the comment made by the authors: They point out that IX-arc in their example can be replaced with #ALL and specify the interpretation would be "more strongly universal" (Davidson & Gagne, 2014, p. 117).

discourse following (15a), "a property ascribed to this high set (such as wearing clothes) should apply to nearly everyone except the sets that have already been mentioned (the nudist colony), which is why nudity works well in this example" (Davidson & Gagne, 2014, p. 116). Importantly, it is not only the contrast between low and high levels that is utilized in ASL, intermediate levels can also be used for intermediate domain sizes. The number of such levels, Davidson and Gagne argue, is restricted by the limitations of the perceptual system.

The quantifiers that have been shown by Davidson and Gagne to demonstrate such use of height include #ALL, ONE/SOMEONE, and NONE. An interesting question for future research is whether relative set sizes and domain restrictions of other quantifiers can also be signaled by means of height at which they are signed. My study will have nothing to say about this type of vertical use of space. I will, however, consider other ways in which space plays a role in the expression of quantification, including examples of how it is used to signal quantifier domain, similar to what I have shown in (14a) above.

2.1.2. A-Quantification in ASL

As mentioned in Chapter 1, in this work I consider a subtype of A-quantification that involves cases when nominal quantification is expressed by means of morphology on a predicate.[28] Petronio (1995) investigates how the quantificational value of bare noun phrases (NPs) that are unspecified for number is determined in sentences with different

[28] Partee (1995) refers to this type of A-quantification as *lexical quantification*. Other researchers use the term *lexical quantifier* to refer to expressions whose "meaning is understood as a unit rather than computed as a function of the denotations of subconstituents" (Keenan & Paperno, 2012, p. 941), e.g., English quantifiers *each, all, often*. It is the latter definition of lexical quantifiers that I follow in this dissertation.

types of ASL verbs. She considers plain verbs, directional verbs (specifically those that move between locations associated with arguments referring to human referents), and classifier constructions.[29] Plain verbs are verbs that do not change their form depending on their arguments (e.g., KNOW, LOVE, BUY, etc.).[30] Petronio shows that in sentences with plain verbs bare NPs are interpreted as singular or plural depending on "contextual, discourse, and pragmatic factors" (p. 608). More importantly for the present discussion, she shows that directional verbs and classifier constructions interact with bare NPs and can determine their quantificational value. While sometimes labeled as verbs, classifier constructions differ morphologically and phonologically from ASL verb that do not use classifiers (Sandler & Lillo-Martin, 2006). However, they function as predicates and thus their quantificational properties exhibit A-quantification. Drawing largely on Petronio's work, in the following sections I describe how morphology on directional verbs and classifier constructions expresses nominal quantification.

2.1.2.1. Directional verbs

As described in Section 1.2.2, directional verbs involve movements of the hand(s) between locations associated with various arguments, and by means of these movements they subject (agent/source) and/or object (recipient/goal) are marked.[31] For present

[29] Petronio uses Padden's (1988) classification of verbs into plain, agreement/agreeing, and spatial. Spatial verbs in this classification include so-called *verbs of motion and location* (Supalla, 1982). As footnoted in Section 1.2.1, in this work I use theory-neutral terms *directional verbs* (instead of *agreement/agreeing verbs*), and *classifier constructions* (instead of *verbs of motion and location*).

[30] Some of these verbs, however, can be produced "in a locus associated with a location of an event (e.g. WANT, BUY, and LEAVE-ALONE)" (Lillo-Martin & Meier, 2011, p. 106).

[31] Additionally, some ASL verbs can mark their selected arguments by changing orientation (facing of the hand) (Fischer & Gough, 1978; Lillo-Martin & Meier, 2011; Padden, 1988). These include some directional

referents, these locations depend on their actual physical locations, and for non-present referents these are abstract locations previously assigned to the referents for referential purposes. Following seminal work on verbal morphology by Klima and Bellugi (1979), Petronio (1995) demonstrates that marking on directional verbs can determine the quantificational value of relevant bare NP arguments. In each of the sentences below, the verb INFORM moves towards the location associated with the object NP NURSE and is marked for singular (16a), dual (16b), and multiple (16c).

(16) a. NURSE IX-1 FINISH INFORM[sg]
t
'I informed the nurse.'

b. NURSE IX-1 FINISH INFORM[dual]
t
'I informed two nurses.'

c. NURSE IX-1 FINISH INFORM[mult]
t
'I informed the nurses.'

(adapted from Petronio, 1995, p. 609) [32]

verbs as well as verbs that do not exhibit directionality as defined above. For example, Fischer and Gough report that LOOK shows both directionality and change in facing, while OWE only shows changes in facing.

[32] Here, I provided the translations into English given in the original. Note that in (16a) and (16c) the object noun phrase is translated as a definite (*the nurse* and *the nurses* respectively), while in (16b) it is translated as an indefinite (*two nurses*). Bare nouns in ASL can be interpreted as either definite or indefinite, so without further context, each of the translations given reflects only one possible interpretation of the given ASL sentence.

Klima and Bellugi note that "[a]lthough inflections for number may be used in describing situations involving two or more separate actions, the inflectional forms for number themselves do not specify […] whether the information was conveyed in separate actions or in a single act" (p. 281). This supports the analysis of these forms as instances of quantification over entities denoted by NP arguments.

The multiple modification in (16c) is a "horizontal arcing movement at the end of the sign" (Sandler & Lillo-Martin, 2006, p. 39). Klima and Bellugi (1979), as well as Petronio (1995), analyze it as a marker of number that is used to show that the action denoted be the verb applies to some, many, or all members of the set of individuals denoted by the relevant NP argument. In contrast, Baker-Shenk and Cokely (1991b) gloss the multiple modification as 'all,' thus suggesting that the relevant NP argument of a verb with a multiple modification is viewed as a collective group and the action denoted by the verb applies to all members of this group. I will say more about the interpretation of verbal modifications discussed in this section after I describe how nominal quantification can be expressed by morphology on classifier constructions.

Petronio (1995) further demonstrates that a set of individuals denoted by the relevant NP argument of a verb with the multiple modification should consist of three or more individuals. Additionally, when the NP occurs with a quantifier, the quantification value of the NP must be compatible with the verbal modification. Thus, in contrast to good examples (17a-b), the sentence in (17c) is ungrammatical because the quantificational value of TWO STUDENT is at odds with that provided by the multiple modification.

(17) a. t
THREE STUDENT IX-1 ASK[mult]
'I asked three students.'

b. t
MANY STUDENT IX-1 ASK[mult]
'I asked many students.'

c. t
*TWO STUDENT IX-1 ASK[mult]
'I asked two students'

(adapted from Petronio, 1995, p. 610)

Interestingly though, it has also been observed that the presence of the modification on the verb is optional; instead, a signer may use an unmodified verb form in combination with some alternative syntactic, morphological, and/or lexical strategy (e.g., a lexical or a classifier construction) (Hou, 2013).

Another marking on directional verbs that is particularly relevant to the present discussion is the distributive modification.[33] As mentioned in Chapter 1, this modification is realized as "several small, slightly displaced repetitions" (Sandler & Lillo-Martin, 2006, p. 39). When used on a directional verb, this modification indicates an exhaustive form, as

[33] In addition to distributive/exhaustive modification, Klima and Bellugi (1979, p. 284) list several other modifications that "specify distributed actions of the verbs," most notably *allocative determinate* ("actions distributed to specified individuals at distinct points in time") and *allocative indeterminate* ("actions distributed to unspecified individuals over time"). These two modifications are not exhaustive, and, since in this dissertation I focus on universal quantification, I will exclude them from the present discussion. Some other modification that Klima and Bellugi describe—such as *apportionative external* ("actions distributed around members of a closed group") or *seriated internal* ("actions distributed with respect to internal features (or typical parts) of an object")—may supply universal interpretation, but it is not clear how common they are across ASL verbs and across ASL signers, therefore I do not reported them here too.

demonstrated by GIVE in (18a) and SHOW in (18b). The interpretation is that the action denoted by the verb involves repeated acts performed with respect to each member of the set of individuals denoted by the relevant argument.

(18) a. ____t
STUDENT-a, BOOK ANN GIVE[distr]-a
'Ann gave a book to each student.'

b. ____t
STUDENT-a, PICTURE ANN SHOW[distr]-a
'Ann showed the picture to each student.'

(adapted from Petronio, 1995, pp. 611–612)

The form that the distributive verbal modification takes is important. Quer (2012) notes that in LSC short reduplication along an arc is used to express distributivity not only on verbs but also on lexical and functional nominal items (e.g., possessives). Kimmleman (2015) reports similar data for RSL. Similarly in ASL, displaced reduplication has been observed to be used on various classes of signs. Some accounts describe it as a marker of distributivity, while others point out its role in expressing plurality. Thus, displaced reduplication of a noun "two or three times in an arc or linear movement path" has been described by Valli, Lucas, and Mulrooney (2005, p. 114) as a marker of plurality.[34] Kuhn (2017) argues that the same marking is used to express distributivity on ASL numerals and the adjective DIFFERENT. As I describe in the following section, displaced reduplication

[34] In her recent work on number specification, Koulidobrova (2016) claims that bare NPs in ASL are neither singular nor plural, but rather they are unspecified for number. This leads her to question the analysis of nominal reduplication as a marker of plurality.

has been shown to be used on classifier constructions in ASL (Baker-Shenk & Cokely, 1991b; Conlin-Luippold & Hoffmeister, 2013; Supalla, 1982). My data, which I describe in Chapter 4, furthermore demonstrates that the same modification is used on one form of the lexical distributive quantifier EACH and the noun INDIVIDUAL functioning as a distributive adverbial.

2.1.2.2. Classifier constructions

Classifier constructions are morphologically complex signs in which all three major parameters of the sign–handshape, location, and movement –are independently meaningful. Most notably, the handshape of a classifier construction represents certain semantic features of a noun argument, and it is commonly referred to as *a classifier*. Different types of classifiers have been distinguished (Sandler & Lillo-Martin, 2006, pp. 77–83, and references therein). Petronio's (1995) discussion of quantification of bare NPs only concerns *entity* (or *semantic*) classifiers, which are classifiers that refer to a particular semantic class (e.g., 'vehicle', 'airplane', 'tree,' etc.). She points out that one particular semantic class of entity classifiers in ASL, namely "upright two-legged animate objects such as humans, bears, and monsters," has separate classifier forms that correspond to referents with quantificational values: 'one', 'two', 'three', 'four', and 'many/plural.'[35] For instance, in (19a), the classifier 1 stands for a single human entity, while in (19b) the classifier 44 stands for plural entities.

[35] Baker-Shenk and Cokely (1991b) also list a classifier with the quantificational value 'five.'

(19) a. STORE-a MAN CL:1'go to'-a
t
'The man went to the store.'

b. STORE-a MAN CL:44'go to'-a
t
'The men (many in number) went to the store.'

(adapted from Petronio, 1995, p. 614)

Classifiers in this semantic class are formed by mean of extending fingers on one or both hands. Thus, the classifier 1 is a fist with the index finger extended and pointing up, and the classifier 44 is made by extending all fingers (except the thumb) on both hands and placing the hands so that the little finger of the dominant hand contacts the index finger of the non-dominant hand.[36]

Baker-Shenk and Cokely (1991b) describe another set of classifiers that are marked for plural. They are used to represent groups of animate or inanimate entities. These classifiers are produced with the hand(s) in either the 4 or 5 handshape (further specified for the position of the fingers: bent, straight or wiggling), but, unlike the classifiers described above, the palm orientation is towards the location of the referent (e.g., downwards for a herd of cows, upwards for stars in the sky). They can be signed with

[36] Petronio notes that the classifier 44 is sometimes described as representing a line of people. Baker-Shenk and Cokely (1991b) describe various modification of this classifier: bending fingers to represent seated entities, modifying movement and palm orientation of the two hands to indicate arrangement of the described entities and direction they are facing. They furthermore point out that the classifier 55 (produced by extending all digits on both hands) is used by some signers in the same contexts as the classifier 44.

either one or two hands; the two hands are typically used to describe a very large group.[37] The size of the group can be conveyed by moving the hands along the signing space tracing the location and boundaries of the referent (Conlin-Luippold & Hoffmeister, 2013; Supalla, 1982). Size information on these and other classifier constructions can also be expressed by means of accompanying non-manual marking (e.g., puffed cheeks for particularly large groups, pursed lips for smaller groups).

The classifiers described above are the only ones that are or have a form that is marked for plural. Other classifiers only have a singular form, but constructions with these classifiers indicate plurality through their movement component (Baker-Shenk & Cokely, 1991b; Conlin-Luippold & Hoffmeister, 2013; Supalla, 1982). Baker-Shenk and Cokely (1991b) explain that one way to represent several objects is by repeating a classifier in different locations "reflecting to some degree the actual position and orientation of different things described" (p. 363). To show that the objects are in a random or non-linear arrangement, both hands with the same classifier handshape move in an alternating manner. To show an orderly or linear arrangement, the signer "will repeat the classifier in a straight line with the dominant hand. Often the non-dominant hand […] 'holds' the starting place of the line while the dominant hand makes each separate 'articulation' (production) of the classifier–each time moving to a slightly different location" (p. 297). These constructions can be used to indicate a specific, small number of objects, usually two to four.[38] In such

[37] A classifier construction with both hands in the Bent5 handshape facing downward held in front of the signer's chest and then moving forward has become a conventionalized sign commonly glossed as SCADS-OF or HORDES-OF.

[38] Additionally, two referents can be represented by simultaneously producing classifiers on both hands (Baker-Shenk & Cokely, 1991b; Supalla, 1986).

cases, the repetitions are produced "slowly and deliberately (as if actually representing the location of each thing)" and the number of times that the classifier is articulated corresponds to the number of described referents (p. 363). Alternatively, these constructions can be used to express the meaning of *some*, *several*, or *many*. To do so, the classifier is repeated "faster with less attention to actual placement;" the number of articulations is usually three or four (p. 363). A very large number of objects is typically indicated by increasing the speed of repetitions of the classifier.

Instead of repeated articulations of a classifier, a plural referent in a linear arrangement can be indicated by making a sweeping movement of the classifier (on the dominant hand) along a linear path. According to Baker-Shenk and Cokely (1991b, p. 299), this construction is used to indicate "*many* things in a row."

To summarize, the above description shows that some classifier constructions in ASL can express quantification by means of their handshape or movement. The range of quantificational meanings that these constructions express includes some low cardinal values and equivalents of cardinal quantifiers *many*, *several*, *some.*

It is worth pointing out the similarity in form between the sweeping movement of classifier constructions and the multiple modification on directional verbs (described in the previous section), and between the spatially distributed reduplication in a row of classifier constructions and the distributive modification on directional verbs (and many other lexical items, as mentioned above).[39] Notably though, previous accounts suggest that these

[39] Baker-Shenk and Cokely (1991b) make a similar observation, also noting that a sweeping arc-like movement and displaced reduplication are used with pointing signs functioning as plural pronouns. A further example of similarity between movement in classifier constructions, verbal modifications, and pointing signs

modifications on directional verbs allow for or, perhaps, in the case of distributive modification require a universal interpretation of its relevant noun arguments, whereas the described morphology on classifier constructions provides an existential interpretation to the accompanying noun. It is possible that the multiple and the distributive modifications on directional verbs are not themselves responsible for universal interpretation, rather there are some semantic, syntactic or pragmatic conditions under which such interpretation arises. To the best of my knowledge, this question has not yet been investigated.

2.2. QUANTIFICATION IN OTHER SIGN LANGUAGES

Most research on quantification in sign languages to date is on ASL. Interestingly, Kimmelman (2017) notes that perhaps the earliest descriptive work on quantification in sign languages was done not on ASL but on RSL (Zajtseva, 1987). She described several lexical quantifiers in RSL and pointed out the role of space (in particular, spatial reduplication) in expressing distributive quantification. Research on quantification in sign languages other than ASL remains sparse however. Descriptive studies and/or analyses of particular aspects of quantification in other sign language that I am aware of have been offered for LCS (Quer, 2012; Quer & Steinbach, 2015), RSL (Kimmelman, 2015, 2017), LSF (Kuhn, 2017; Kuhn & Arsitodemi, 2015; Schlenker, 2011a, 2011b), and German Sign Language (DGS) (Perniss, 2001).[40]

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is that between the displaced reduplication with alternating hand movements in classifier constructions, similar movement in pointing signs, and the allocative determinate and indeterminate modifications on directional verbs described by Klima and Bellugi (1979) (see fn. 33).

[40]Additionally, there are accounts of number marking in some signed languages where quantifiers are mentioned in passing. See, for example, Miljan (2003) on Estonian Sign Language and Stavans (1996) on Israeli Sign Language.

Quer (2012) considers quantificational constructions in ASL and LSC and demonstrates that these languages "resort to essentially the same kinds of mechanisms attested for the expression of quantification in spoken languages, namely A- and D-quantification, and A-quantificational structures seem to be widespread" (p. 90). Notably, he showed that A-quantification in LSC includes the use of verbal morphology in ways "mostly coinciding" with what has been described for directional verbs in ASL (described in Section 2.1.2.1). In the examples below, morphology on the directional verb ASK expresses quantification over the object argument of the verb.

(20) a. PERSON++ STUDENT IX^TWO IX-1 1-ASK-3[dual]
'I asked the two students.'

b. PERSON++ STUDENT IX^THREE IX-1 1-ASK-3[mult]
'I asked the three students.'

c. PERSON++ STUDENT IX^THREE IX-1 1-ASK-3[distr]
'I asked each of the three students'

(adapted from Quer, 2012, p. 89)

In the discussion of DGS, Perniss (2001) reports examples where multiple and distributive marking provide a quantificational interpretation for a verb's relevant NP argument. Kimmelman (2015, 2017) describes a similar role for distributive morphology on directional verbs in RSL. In fact, one would expect to find that similar examples of A-quantification in all languages that have directional verbs. Importantly, previous research

has found directional verbs in most sign languages (Lillo-Martin & Meier, 2011, and references therein), although there are documented cases of emergent or village sign languages that appear to lack directional verbs, such as Al-Sayyid Bedouin Sign Language (Aronoff, Padden, Meir, & Sandler, 2004), Providence Sign Language (Washabaugh, 1986), and Kata Kolok (Marsaja, 2008). What is particularly remarkable about morphology on directional verbs is its similarity in form across languages. Aronoff, Meir, and Sandler (2005) have argued that this similarity, as well as the near universality of directional verbs across sign languages, is a modality effect, explained by the availability of spatial resources that can be used for iconic representation.

Morphological means of expressing quantificational meanings such as 'some,' 'several', 'many'—which are usually subsumed under the label *plural marking*—are common across sign languages. The use of classifier handshapes to express quantification that I have described above for classifier constructions in ASL (Section 2.1.2.2) finds parallels in other sign languages. Kimmelman (2017) cites Filimonova (2012) who describes a classifier used in expressing movement of multiple objects to or from a location (cf. with CL:44'go to' in ASL in (19)). Distributive marking on nouns and numerals has been reported in LSQ (Quer, 2012), RSL (Kimmelman, 2015, 2017) and DGS (Perniss, 2001). As I have noted with respect to directional verbs, this marking takes a similar form across sign languages; in all of the languages reported above distrubutivity is marked by spatial reduplication of the sign.

In addition to the morphological strategies described above, sign languages make use of lexical means of expressing quantification. In his description of quantification in

RSL, Kimmelman (2017) reports a universal non-distributive D-quantifier ALL and a distributive EVERY. Interestingly, the latter is practically identical in form and in its variation to the ASL quantifier EACH that I describe in Chapter 4. This similarly is likely explained by the historical connection of both languages to Old LSF.

Additionally, Kimmelman records a set of six universal quantifiers that can all be translated as 'whole' or 'completely' but show different privileges of occurrence depending on the type of object they quantify and its spatial arrangement. Kimmelman mentions that the exact details of the privileges of occurrence of these signs and their relation to iconicity are topics that require future research. Interestingly, here again we find similarities between ASL and RSL, which I note but will not discuss in any detail. Among the RSL quantifiers in this group we find those that are similar to what has been described as *result-state markers* in ASL (Wright, 2014). The quantifiers that Kimmelman glosses as WHOLE3 and WHOLE6 are similar to the ASL NOT-A-TRACE whose role in expressing universal quantification in ASL I describe in Chapter 4. Another RSL quantifier WHOLE2 is similar to the ASL sign that Wright glosses as DRAIN and describes as showing "the level of fluid rapidly descend[ing] to the bottom of a container" (p. 82).

The comparison of lexical quantifiers between ASL and RSL does not allow us to tease apart the effects of their mutual historical connection to Old LSF from the effects of visual iconicity on the form of signs. Importantly, formal similarity in lexical quantifiers can be also observed among lexical quantifiers in unrelated sign languages, as shown in the online dictionary hwww.spreadthesign.com (e.g., the sign for *each* in Lithanuan Sign Language and Chinese Sign Language). Thus, cross-inguistic investigation of lexical

quantifiers appears to be a particular fruitful area for the investigation of the role of iconicity.

So far, I have shown some ways in which sign languages show a striking similarity in the morphological means that they employ to encode quantification, as well as some similarities at the lexical level. To conclude, I will mention two areas where differences in the expression of quantification between sign languages have been found. One such example is provided by Quer and Steinbach (2015) who report differences between in quantifier scope ambiguities between ASL and LSC. Another example comes from the comparison of the use of numerals and classifier constructions in expressing number and quantification in DGS and Turkish Sign Language (TID). Perniss and Özyürek (2004) found differences between the two languages in word order, spatial modification of signs, frequency of occurrence, and the realization of specific forms.

Chapter 3: Methods

In this chapter, I explain how I collected the data and coded it for further analysis. In Section 3.1, I describe the basic design of the study. Section 3.2 provides information about the participants. Section 3.3 describes the data collection procedure that I followed and the materials I used to elicit the data. Section 3.4 explains how the data was coded for analysis. In Section 3.5, I make some additional remarks on my elicitation materials and data analysis. Finally, in section 3.6, I explain the steps I took to collect supplemental data.

3.1. Design of the Study

As I pointed out in Chapter 1, there is no sufficiently large corpus of ASL available to date that could be used to investigate quantification. Therefore, to collect exploratory data on strategies for nominal quantification in ASL, I designed a data collection procedure in the form of one-on-one interview sessions in ASL that I conducted with Deaf bilingual ASL-English users. During interviews, participants were asked to translate English sentences into ASL, discuss possible alternative translations, and comment on how confident they were that their translations were good ASL sentences.

Elicitation by means of translation is often avoided in linguistic research due to the concern that the source language, such as English, may influence the data (see, e.g., Fischer, 2009; Padden, 2015, for recommendations on methods in sign language research). At the same time, Matthewson (2004) defends the use of translation tasks in semantic fieldwork and offers guidelines for how to collect translations and interpret the results. Some situations in which the use of translation is necessary, according to Matthewson, are:

"[w]hen one simply does not know how to say something in the object language" or "[w]hen one knows that an English sentence can be translated in two or more ways and wants to know what the most natural, or preferred, way is" (p. 381). Both of these situations characterize the present data collection. In designing stimuli, I followed Matthewson's guidelines for eliciting translations, such as her recommendation to elicit translations of complete and grammatical sentences only. While supporting the use of a translation task, Matthewson points out that "translations gathered during elicitation sessions should be regarded as a clue rather than a result" (p. 380). She thus recommends supplementing this technique by asking for judgments. As a follow up to the translation task described here, I elicited judgments on some of the collected data from one native signer (see Section 3.6). A more extensive collection of judgments covering a larger fragment of the data and including a larger number of participants is left for subsequent research.

There are also practical reasons for why I chose to use a translation task. It allowed me to elicit a range of quantificational meanings with both concrete and abstract nouns. The alternative, i.e. the use of picture or video stimuli, did not seem feasible. It appeared to be difficult, and at times perhaps impossible (e.g., in the case of abstract nouns) to design visual stimuli for each sentence I wanted to elicit.

Some steps were taken to minimize the concern associated with the use of English. First, I recruited participants who were fluent in both ASL and English and were well aware of the differences between the two languages. Second, whenever possible, English

elicitation sentences were accompanied by pictures that provided contextual information for the sentence (see Section 3.3.1 for details).

The collected data, which I describe in Chapter 4, contain a number of examples of ASL structures differing from those of English stimulus sentences. Some examples of such differences involve syntactic patterns described in Section 2.1.1.2. Thus, my data include sentences with a lexical quantifier occurring in a position that does not match the stimulus, as shown in (21a-b). Other examples of differences between stimuli and their translations into ASL are cases in which English stimuli with a lexical quantifier were translated into ASL sentences without a corresponding lexical quantifier sign; instead quantification was expressed through other means. Such responses are described in Section 4.2. To give one example, in (21c) the participant produced an iconically motivated classifier construction depicting that a glass was knocked over to express the idea that the entire quantity of the water was spilled.

(21) a. Stimulus sentence: *The girl ate each of the cookies.*

t
COOKIE EACH[distr] GIRL DEVOUR (P4)[41]

b. Stimulus sentence: *The girl ate all of the cookies.*

t
COOKIE GIRL EAT ALL (P6)

c. Stimulus sentence: *The man spilled all of the water on his laptop.*

t
LAPTOP-c MAN WATER CL:C'glass knocked over' c-SPILL<1h>-rt (P8)

[41] The letter and number codes listed in parentheses to the right of each example refer to the participant(s) who produced the corresponding sentences or constructions.

The examples above show that the participants were able to focus on conveying the meaning of the stimuli into ASL and to abstract away from they way this meaning is expressed in English, which suggests the reliability of my data.

3.2. PARTICIPANTS

Participants were eight adults (six females and two males) between the ages of 22 and 43.[42] All participants self-identified as deaf. Five of them have been using ASL since birth because they had either deaf parents or an older deaf sibling (see Table 3.1). Three started using ASL when they participated in various early learning programs at the age of two, three, and four, respectively. All participants used ASL with other members of the Deaf community on a regular basis. In addition to ASL, all participants were fluent users of English. Seven participants held a university degree (BA/BS or higher), and one participant was a college senior (Table 3.1). Based on the described characteristics, I consider the participants fluent ASL-English bilinguals.

[42] A total of 12 people participated in data collection. Four of them were late signers who started acquiring ASL around college age. Their data was not used in the present analysis.

Table 3.1. Participants' ASL and educational background

Participant code	Age of exposure to ASL	Parental hearing status	Older deaf sibling(s)?	Highest academic degree achieved
P3	2 y.o.	hearing	no	MA
P4	birth	hearing*	yes	BA
P5	birth	deaf	no	college senior
P6	birth	deaf	no	PhD
P7	birth	deaf	no	MA
P8	3 y.o.	hearing	no	MA
P9	4 y.o.	hearing	no	BS
P10	birth	deaf	no	BA

* Participant's mother is a hearing woman who acquired ASL natively from her deaf parents.

At the time of data collection, all participants resided in Austin, Texas, or its vicinity. However, they do not represent a homogeneous sample with respect to their geographical background. All of them had previously lived and studied in various places in the US outside of Texas. Educational institutions attended by the participants where ASL is used for instruction include residential schools for the Deaf in Pennsylvania, Florida, Texas, Maryland, and both MSSD and Gallaudet University in Washington D.C.[43]

3.3. PROCEDURE AND MATERIALS

Each participant had an approximately 1.5-hour long one-on-one interview session in ASL with the researcher, a hearing non-native signer of ASL. To avoid fatigue, the

[43] This list of residential schools attended by the participants may not be complete. In answering a question about their educational background, some participants provided names of schools they went to, while others listed the types of schools (e.g., residential, charter, public/mainstreaming) without specifying their name.

participants were offered breaks as needed. Before starting the interviews participants were asked to complete a brief paper questionnaire designed to collect information about their age and ASL and educational backgrounds (see Appendix B).

The interview session began with the interviewer explaining the task to the participant. Participants were told that they would be asked to translate various English sentences into ASL and give as many variants for translating each sentence as they could think of. They were also asked to comment on how confident they were that their translations were good ASL sentences. Participants were invited to indicate their confidence ratings using the following gestures:

 a thumbs up gesture when they were fully confident in their translation,

 a "thumb-halfway-up" gesture - a closed fist with the thumb extended to the side - when they were less than fully confident in their translation (for example, when they thought that other ASL signers may produce something like this but they themselves preferred a different translation).[44]

Stimuli, described in detail below, were presented to participants on a laptop computer using Keynote presentation software. In addition to soliciting participants' responses to the stimuli, the interviewer encouraged a discussion of alternative translations by asking participants if a given English sentence could also be translated using a particular ASL sign or expressions.

[44] A thumbs down gesture was not offered because it was not expected that participants would offer translations that they themselves considered completely unacceptable.

The data collection took place either in the Signed Language Laboratory Experimental Observation Room on the UT Austin campus or, when it was more convenient for participants, at their home. The interviews were recorded using two video cameras. One camera captured the participant, and the other captured both the participant and the interviewer. Figure 3.1 demonstrates the views taken by both cameras, as well as the spatial arrangement of the participant, the interviewer, and the laptop.

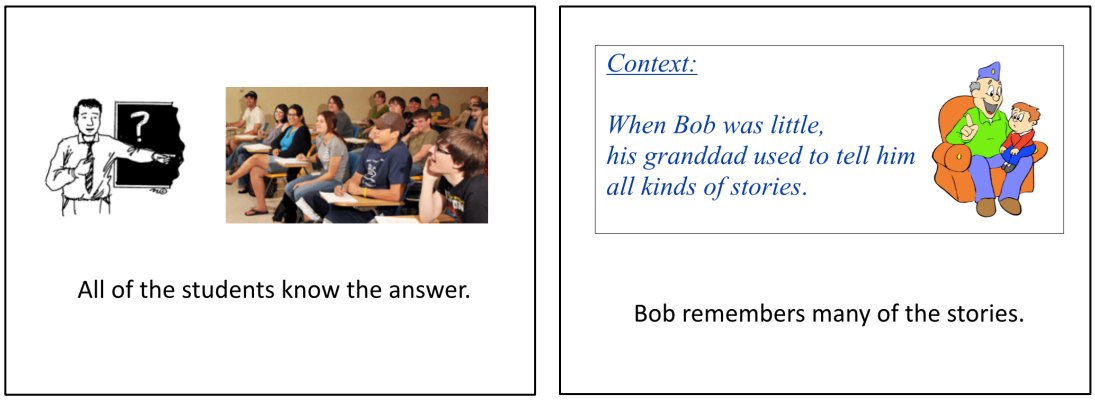
Figure 3.1. Stills from cameras 1 and 2 showing the room arrangement during interviews

The two cameras captured the participant from two different angles. Camera 1 provided a full frontal view of the participant's face (which is important for the analysis of non-manual behaviors) and allowed for a better view of the hand movements along a transverse axis (right <-> left), while Camera 2 provided a better view of the hand movements along a sagittal axis (front <-> back). Additionally, having two cameras ensured that, if one of them accidentally turned off during the interview, most of the data from the participant would be lost.

3.3.1. Stimuli

The elicitation stimuli were English sentences, each presented along with contextual information describing a situation in which the sentence could be used. The contextual information was either a picture (Figure 3.2a), or a picture accompanied by a short description (Figure 3.2b), or just a short description of a situation (Figure 3.2c). Textual descriptions were used in those cases when a picture alone was either insufficient to describe the context, or when it was difficult or impossible to use a picture (e.g. for sentences with abstract nouns like *story* or *energy*).[45] A complete list of elicitation sentences and associated contextual information is given in Appendix C.

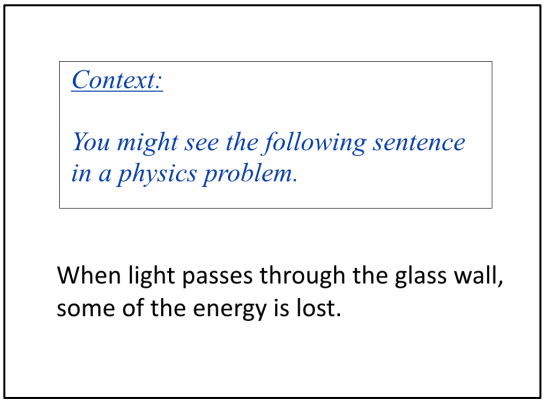
Figure 3.2. Examples of slides used for elicitation of translations



a. b.

[45] Notably, Matthewson (2004) argues that the use of a meta-language (such as English) for presenting discourse contexts is unlikely to influence the results. Using examples from Salish, she offers evidence that consultants produce English-like structures only when these structures are grammatical in the object language, and that consultants readily offer "structures and interpretations that are very foreign to English ears and, conversely, reject constructions that are grammatical in English" (p. 397). In practical terms, Matthewson advises to provide a context before the elicitation sentence. In accordance with her recommendation, the participants in this study were first presented with a slide showing a context only, followed by a slide with both the context and the sentence.

Figure 3.2: continued.



c.

Stimuli of the form *The teacher gave a book to QUANTIFIER of the students in class* deserve a separate mention because they allow for two readings. The ambiguity is with respect to how many books were given: one book per student or one book total. The accompanying image (Figure 3.3) was intended to make more salient the interpretation according to which each of the students received his own copy of the book. On this image, a teacher is holding a stack of several books, suggesting that she is distributing those books among the students. Furthermore, the students are sitting facing different directions, so they do not appear to form a unified group, which reinforces the interpretation that each of them is going to use his own copy of the book. Yet the image does not completely rule out the other interpretation of the sentence, i.e. that the students receive one book to share. Judging by their responses, most of the participants interpreted such sentences as involving multiple books. Only one participant noticed the ambiguity and asked the interviewer for clarification. Once told that there was one book per each student, she continued translating the stimuli accordingly.

Figure 3.3. Elicitation slide for *The teacher gave a book to QUANTIFIER of the students in class*

Three groups of stimulus sentences were used for elicitation. As I explained in Section 1.3.2, one question that the present data collection was designed to address is whether the choice of a particular quantificational strategy correlates with the semantics of a quantified noun. In particular, I considered the count/mass, concrete/abstract, and animacy distinctions. Thus, sentences in Group 1 elicited quantification of concrete nouns, and Group 2 dealt with abstract nouns. Both groups included count and mass nouns. Additionally, the subgroup of concrete count nouns in Group 1 included nouns that differed in animacy. Group 3 sentences were designed to investigate morphosyntactic means for the expression of quantification in ASL, to wit directional verbs and classifier constructions, and the possibility of their co-occurrence with lexical quantifiers. All three groups are described in more detail in the following sections. A complete list of stimulus sentences is given in Appendix C.

3.3.1.1. Groups 1 and 2: Focusing on semantic distinctions

Every stimulus sentence in Group 1 and 2 had one *target noun* – a noun whose quantification was the focus of elicited translation. Target nouns were presented in English as definite noun phrases consisting of a definite article and a noun (either plural for count nouns, e.g. *the students*,[46] or singular for mass nouns, e.g. *the water*). Each target noun phrase was presented in two environments:

1. embedded in a partitive nominal construction of the form '*QUANTIFIER + of + the + NOUN*' (as in *All of the students know the answer*, or *The girl ate some of the cookies*);
2. by itself, i.e. without a quantifier, in the form '*the + NOUN*' (as in *The students know the answer*, or *The girl ate the cookies*).

When embedded in a partitive construction, each target noun phrase occurred with each of the quantifiers in Table 3.2, as appropriate.

Table 3.2. Quantifiers used for elicitation

With count nouns	*all, each, every, some, several, a few, few, many, none, most*
With mass nouns	*all, some, a little, little, much, none, most*

Note: Underlined words are quantifiers used with both count and mass nouns.

In Table 3.3, I list all target nouns elicited in the stimulus sentences in Groups 1 and 2. The difference in the number of target count and abstract nouns was part of the design. I

[46] As I explain in Section 3.5 below, the quantifier *every* in the stimuli is followed by *one* due to the selectional properties of the quantifier.

included both animate and inanimate nouns (*students* vs. *cookies*), as well as nouns that referred to human and non-human beings (*students* vs. *dogs*). Both of these distinctions are only relevant for the category of concrete count nouns. As a result, this category had to contain at least three nouns. The number of concrete mass nouns was then matched with that of concrete count nouns. I included only two abstract count and two abstract mass nouns to keep the length of interview session within 1.5 hours.

Table 3.3. Target nouns in stimulus sentences in Groups 1 & 2

	Count	**Mass**
Group 1: Concrete	*students* *dogs* *cookies*	*water* *flour* *money*
Group 2: Abstract	*stories* *ideas*	*history* *energy*

3.3.1.2. Group 3: Eliciting sentences with a directional verb or a classifier construction

Group 3 included sentences that were designed to collect examples of:

a. quantification in sentences with a directional verb,

b. quantification in sentences with a classifier construction,

Only count concrete nouns were used as target nouns in this group (Table 3.4). For (a), it was the noun *student* functioning as an indirect object of the verb *give* (which corresponds to the directional verb GIVE in ASL). The same two syntactic environments ('*QUANTIFIER+ of + the + NOUN*' and 'the + *NOUN*') and the same set of quantifiers (*all, each, every, some, several, a few, few, many, none, most)* as in Groups 1 and 2 were used.

For (b), since my goal was to elicit the use of classifier constructions, I chose the noun *car* whose equivalent in ASL has a corresponding entity classifier "vehicle". Classifier constructions in ASL have been reported to be used as a spatial mechanism for expressing existence (Chen Pichler & Hochgesang, 2009), so I used stimuli with a *QUANTIFIER + car* embedded into the existential *there* construction, e.g., *There are <u>many cars</u> on the street*. Additionally, for the purpose of providing comparison with the rest of the data, I included stimuli with the noun *car* in the same environments as the nouns in Groups 1 and 2 and the noun *students* above ('*QUANTIFIER + of + the + NOUN*' and '*the + NOUN*'), e.g., *<u>Many of the cars</u> on the street are old, <u>The cars</u> on the street are old*.

Only quantifiers allowed in the existential *there* construction were used: *many*, *some*, *no/none*.

Table 3.4. Target nouns in stimulus sentences in Group 3

Focus of elicitation	**Target nouns**
Quantification in sentences with a directional verb	*students*
Quantification in sentences with a classifier construction	*cars*

3.3.2. Order of stimulus presentation

To partly reduce the possible effects of the order in which the stimuli were presented on the participants' responses (such as those associated with familiarity with the task or experimental fatigue), I used two different orders during elicitation. As shown in Table 3.5, the differences between the two orders included: (a) the order in which groups of

sentences were presented, and (b) within Groups 1 and 2, the order in which the sentences with mass and count nouns were presented. Half of the participants responded to stimuli presented in Order 1 and the other half to stimuli presented in Order 2.

Table 3.5. Orders of stimulus presentation

Order 1	Group 1 (Concrete Count, then Concrete Mass) → Group 2 (Abstract Count, then Abstract Mass) → Group 3
Order 2	Group 3 → Group 2 (Abstract Mass, then Abstract Count) → Group 1 (Concrete Mass, then Concrete Count)

Additionally, practice slides with three new sentences were added at the very beginning of the Keynote presentations used during elicitations. This was done to ensure that participants were "warmed up" and clear about the task before they started responding to sentences containing target nouns. This adjustment to the presentations was made when the data collection was already in progress, so two participants (P3 and P4) did not go though the practice stage of the interview, while the other six (P5 through P10) completed the practice stage.

3.4. CODING OF THE DATA

3.4.1. Coded subset

Time constraints combined with the detailed nature of the coding (described below in Section 3.4.2) did now allow me to code all of the collected data. Therefore, I identified

a subset of target nouns, and only coded sentences elicited with these nouns.[47] The nouns are listed in Tables 3.6 and 3.7, which are modified versions of Tables 3.3 and 3.4 respectively. Note that these nouns include at least one noun in each semantic class differing with respect to the count/mass and concrete/abstract distinctions, with the class of concrete count nouns further differing with respect to the animate/inanimate distinction.

Table 3.6. Target nouns in stimulus sentences in Groups 1 & 2 whose translations were included in coding

	Count	**Mass**
Group 1: Concrete	*students* *cookies*	*water* *money*
Group 2: Abstract	*stories*	*energy*

Table 3.7. Target noun in stimulus sentences in Group 3 whose translations were included in coding

Focus of elicitation	**Target nouns**
Quantification in sentences with a directional verb	*students*

As the comparison between Tables 3.7 and 3.4 shows, sentences that were elicited to explore the use of classifier constructions were left out of the coded subset. The reason for this decision was that the types of classifier constructions that has been observed to play a role in expressing nominal quantification in previous literature (as discussed in Section

[47] In line with my goal to explore how a variety of quantificational meanings are expressed in ASL, I coded the data for all of the quantificational meanings included in the study design (Table 3.2). However, as I explained in Section 1.5, in this dissertation I only focus on universal quantification.

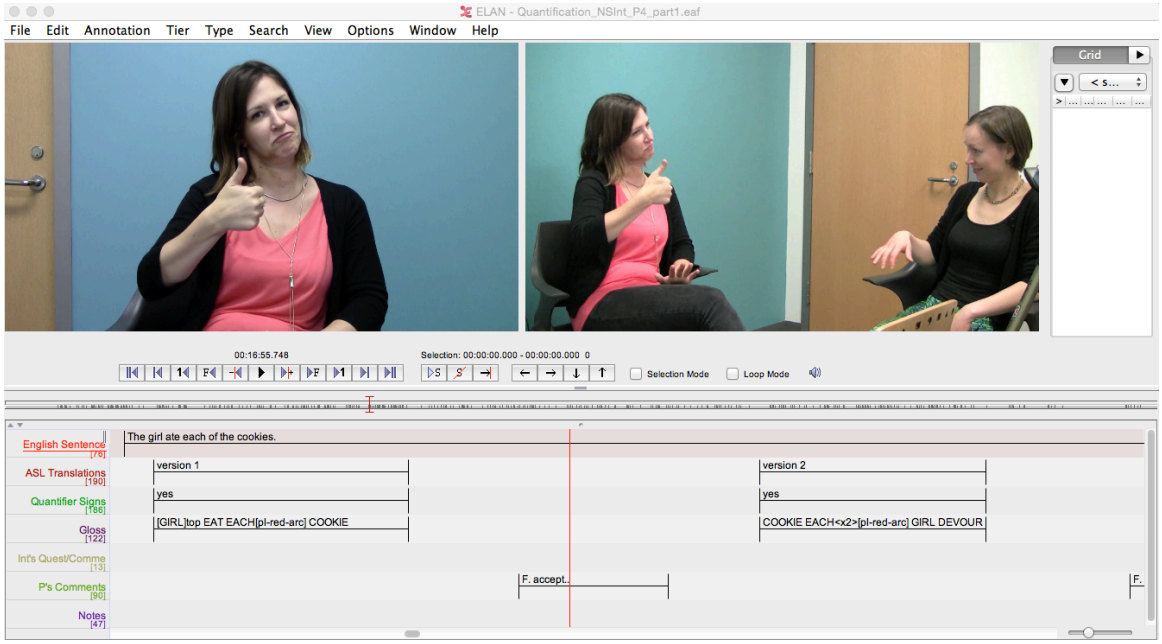
2.1.2.2)—namely, those classifier constructions involving entity classifiers marked for number and or for specific movement patterns—were not expected to be used in expressing universal quantification. That being said, the results will show that the coded data did contain one classifier construction that contributed to the universal interpretation of the NP. I will discuss the relevant data in Section 4.2.3.2.

3.4.2. Coding in ELAN

All video data were coded using the ELAN multimedia annotation tool.[48] ELAN allows the researcher to add annotation to a video. Different aspects of the video data can be annotated on separate tiers (see an example in Figure 3.4). ELAN also allows multiple videos of the same event to be imported and synchronized with each other. This functionality was particularly useful for me because it allowed me to simultaneously view videos from both cameras I used for recording.

[48] ELAN stands for Eudico Linguistic Annotator: https://tla.mpi.nl/tools/tla-tools/elan/. It is developed at Max Planck Institute for Psycholinguistics, The Language Archive, Nijmegen, The Netherlands (Crasborn & Sloetjes, 2008).

Figure 3.4. ELAN window with annotations on several tiers



The same procedure was followed in coding responses from each participant. The first step was to annotate sections of the video that corresponded to the discussion of each stimulus sentence. This step allowed me to know which sentence was being translated or discussed by the participant at each point of the video, without referring back to the order in which stimulus sentences were presented. It was also important for the subsequent analysis because it made it possible to look at the annotations without the videos and match translations and comments given by the participant with the corresponding stimulus sentences.

The second step involved annotating fragments that corresponded to each of the translations into ASL provided by the participant. A label *version 1*, *version 2*, etc. was given to each translation of the same stimulus sentence. Sometimes after the participant

provided their initial response(s), she would offer additional translations that were incomplete sentences (e.g., a quantified noun phrase only, or a subject-less sentence, when the subject could be recovered from the previous discussion). In such cases, a label *option 1*, *option 2*, etc. was assigned to those responses. In addition, a label *non-option* was used to annotate signs or sequences of signs that the participant rejected as possible translations.

Each of the versions, options, and non-options was then coded for whether or not a lexical quantifier was used in the translation or not. This was done to separate translations that had a lexical quantifier from those that did not include one.

The next step involved glossing all versions, options, and non-options. For those versions that were elicited by stimulus sentences that contained more than one clause (e.g., *When light passes through the glass wall, some of the energy is lost*), I only glossed the part of the participant's translation that corresponded to a clause containing a target noun. In all other cases, I glossed versions, options, and non-options given by the participants in their entirety.

Lastly, I recorded participants' comments. I recorded their confidence ratings (described in Section 3.3). I also noted any other relevant comments they made, as well as their answers to my questions soliciting clarification or additional information about structures they used or possible alternative translations. To contextualize the participant's responses, when needed, I noted my questions as well.

3.5. ADDITIONAL REMARKS ON METHODOLOGY

In this section, I list a few additional points that further explain my elicitation materials and analysis of the collected data.

As described above, the stimuli included sentences with two distributive universal quantifiers, namely *every* and *each* (I described distributive vs. non-distributive classification of quantifiers in Section 2.2.). These quantifiers are similar in meaning and can appear in the same context (as in, *Every/each student passed the test*). At the same time, many authors (Beghelli & Stowell, 1997; Tunstall, 1998; Vendler, 1967, to name a few) noted that they also show several distinctions in distribution and meaning. However, the design of the present study did not target these differences. Both quantifiers were presented in the same syntactic frame, and stimuli with these quantifiers were accompanied by the same contextual information.

There are two other comments that I would like to make regarding the stimuli. First, I chose to use partitive nominal constructions of the form 'quantifier + *of* + *the* + noun' (*all of the water, each of the cookies*) rather than non-partitive constructions of the form 'quantifier + noun' (*all water*, *each cookie*). Partitive noun phrases and their non-partitive counterparts "are quite similar in interpretation, the main difference being that in the case of partitives, the quantification appears to be over some specific, non-empty, contextually fixed set" (de Swart, 1998, p. 183). In my study, each stimulus sentence was presented in a particular context, thus making the use of partitive noun phrases more appropriate.

The second comment concerns quantified noun phrases with *every*. This quantifier selects for a singular noun phrase (compare, *every student* vs. **every students*), and it

cannot combine directly with *of* + *the* + NP, because NPs in partitives are obligatorily plural. The problem is easily solved by using *every one* instead of *every*, as in *every one of the students*. The insertion of *one* is motivated solely by the selection constraints of *every*. For ease of presentation, in the description of my data, I refer to ASL quantifiers elicited by the stimuli with *every one* as ASL equivalents of *every*.

My final remark concerns my approach to the analysis of the data. If, upon seeing a new stimulus sentence, the participant indicated that this sentence had the same meaning as the one that was just discussed, I would acknowledge her response and invite her to move on to the next stimulus. For example, after discussing the sentence *Bob remembers <u>each</u> of the stories* the participants would see *Bob remembers <u>every</u> one of the stories*. Some participants pointed out that for them the latter would be translated into ASL the same way as the former (the participants used the sign SAME). In such cases, I did not ask the participants to provide translations for the latter sentence. As a result, for some stimulus sentences my data contains no separate responses from each single participant. For the purpose of data description and analysis, I fill in such gaps in the data with responses provided for the corresponding stimulus. To demonstrate with the example above, for my discussion of the participants' translations for the sentence with *every* I use their translations for the sentence with *each*.

3.6. SUPPLEMENTAL DATA COLLECTION

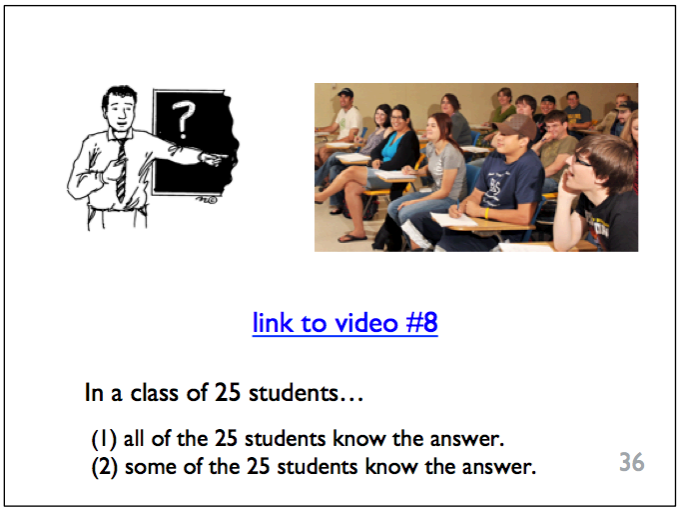
To better fill out the data description and verify some tentative conclusions made from the analysis of translation data, I conducted an interview with another native signer of

ASL. The signer was a deaf individual who started acquiring ASL from birth from her deaf parents and siblings. The highest academic degree she achieved was an MA. I will refer to this signer as *consultant*. During the interview, the consultant was asked to do the following tasks: (a) provide acceptability judgments on ASL sentences, (b) select preferred readings for ASL sentences, (c) translate sentences from English into ASL. All sentences were accompanied by contextual information, such as a picture or textual description of a discourse context, as described in Section 3.3.1. No video recording took place during the interview; I took notes of the consultant's responses by typing them on the computer.

For the acceptability judgment task, the consultant was shown a set of ASL sentences. Some of these sentences were video clips of responses taken from the translation data. Other sentences were constructed specifically for this elicitation; they were presented as English glosses. In addition to offering glosses, for clarification purposes, I signed these sentences for the consultant. The consultant was asked to judge sentences in given contexts as 'fully acceptable', 'less than fully acceptable', or 'unacceptable' using the gestures described in Section 3.3—a thumbs up gesture and a "thumb-halfway-up" gesture—plus a thumb down gesture.

For the preferred reading selection task, the consultant was shown another set of ASL sentences, presented as video clips of responses from the translation data. For each sentence, two readings that disambiguate the context were offered in English (see an example in Figure 3.5). The consultant's task was to select the reading that she thought was the most natural interpretation of an ASL sentence in the given context. The consultant was also asked to comment on whether the other reading was possible as well.

Figure 3.5. An example of a slide eliciting a preference judgment



Lastly, several translations from English into ASL were elicited to supplement the responses elicited in the main translation task. I followed the procedure described in Section 3.3 and used materials similar to those described there.

Chapter 4: Results

4.1. Overview

The data show that participants employed various strategies to encode semantic equivalents of the English universal quantifiers *all*, *each*, and *every*. For the purposes of analysis and description, I classified participants' responses into two types based on the presence of a lexical universal quantifier.[49] There are several lexical quantifiers in ASL that express nominal universal quantification. They will be described in detail in Section 4.3. Responses without a lexical universal quantifier are sentences where quantificational force is associated with aspectual morphology on a directional verb as well as sentences where there is no sign or explicit morpheme that acts as a universal quantifier, yet the preferred interpretation for the NP is universal. They will be the topic of Section 4.2.

Table 4.1 summarizes participants' use of the two types of responses. The results are broken down by the noun whose quantification was elicited in each case. Although I use nouns as a shorthand for sentences containing these nouns, I do not wish to imply that the (non-)use of an overt quantifier necessarily depends on the noun. To demonstrate the relative frequency of the two types in the data, I list the numbers of participants who produced responses of each type.[50]

---

[49] Lexical universal quantifiers used by the participants can be more precisely classified as D-quantifiers, as defined in Section 2.1 and including floating quantifiers. However, for simplicity, I will refer to them as just *quantifiers*.

[50] I do not to report the numbers or percentages of tokens of each type because they are less informative for the purposes of comparison between these types. Encouraged to consider all possible translations, participants would usually offer several translations per stimulus that often differed in features other than the presence or absence of an overt universal quantifier. For example, a participant would offer two translations that each had

Table 4.1. Use by participants (n=8) of responses with and without a lexical universal quantifier

Noun	With a lexical universal quantifier		Without a lexical universal quantifier	
	Participants	**# of partici-pants**	**Participants**	**# of partici-pants**
STUDENT (as subject)	P3–P10	8	P3	1
STUDENT (as indir. obj.)	P3–P10	8	P4, P6, P9, P10	4
COOKIE	P3–P10	8	P3, P4, P8, P9, P10	5
STORY	P3–P10	8	P8, P10	2
WATER	P7, P9, P10	3	P3–P10	8
MONEY	P3–P10	8	P4, P5, P8, P9	4
ENERGY	P4, P5, P7, P9, P10	5	P3–P9	7
Average		**6.9**		**4.4**

As can be seen from the table, across nouns all of the participants produced both types of responses. In many cases, a participant would offer responses of both types for the same stimulus. Overall, responses with a lexical quantifier are more frequent in the data. On average, 6.9 participants out of eight produced responses with an overt universal quantifier for a given noun, while 4.4 participants produced responses without one. Looking at responses for individual nouns, for five out of seven nouns in the dataset all participants produced responses with a lexical quantifier, while responses without a lexical quantifier were offered by one to five participants. Interestingly, the situation is reversed for the remaining two nouns (WATER and ENERGY). Responses without a lexical quantifier were more common, given by eight and seven participants respectively, and responses without a lexical quantifier were given by three and five participants. I will

a lexical quantifier but differed in syntactic structure, or a participant's translations might differ in which lexical quantifier was used.

discuss possible explanations for the paucity of responses with an overt universal quantifier with WATER and ENERGY in Section 4.2.3.2.

Since the preponderance of my data constitute responses with a lexical universal quantifier, I focus primarily on that part of my data.[51] I provide their detailed description in Section 4.3 and further discuss them in Chapter 5. As for responses without a lexical universal quantifier, in this dissertation I only offer their general description. In the following section (4.2), I discuss several examples of sentences in this group and offer suggestions about where universal interpretations for NPs may come from. The examples I consider in this section were discussed with a native signer consultant (as described in Section 3.6). Unless otherwise noted, she confirmed that the preferred interpretation for those examples is universal.

4.2. UNIVERSAL INTERPRETATION OF NPS IN SENTENCES WITHOUT A LEXICAL UNIVERSAL QUANTIFIER

An important property that needs to be noted in describing responses without a lexical universal quantifier is that the relevant NPs (i.e. those whose quantification was elicited) denote some specific, contextually salient plural or mass referent. As explained in the methods chapter (Chapter 3), each elicitation sentence had a partitive construction of the form '*QUANTIFIER + of + the + NOUN*' and was presented along with contextual information introducing the quantified referent. I thus treat elicited NPs as definite—familiar and/or unique (Abbott, 2006)—comparable to English definite descriptions

[51] It is impossible to determine whether the prevalence of responses with an overt universal quantifier in the data reflects how universal quantification is typically encoded in naturally occurring ASL. The methodology I used (described in Chapter 3) may have biased the participants to use strategies that make quantification explicit.

consisting of the definite article *the* plus a nominal expression. Unlike English, however, ASL does not obligatorily mark definiteness. As noted earlier (Section 2.1.1.2, fn. 24), some researchers have suggested that a pointing sign (IX) accompanying an NP functions as a definite determiner (Kegl, 2003; MacLaughlin, 1997; Wilbur, 1979).[52] More recently, Koulidobrova and Lillo-Martin (2016) have argued against that view proposing instead that IXs (adnominal, as well as those used as pronouns) are demonstratives. Whether analyzed as definite determiners or demonstratives, these accounts agree that adnominal IXs mark the NPs that they occur with as definite. For example in (1), the sign glossed as IX[pl] (produced with a sweeping motion of the index finger over an area in space) follows the sign STUDENT[53] and provides a definite, as well as collective plural, interpretation for the noun STUDENT. Importantly, however, the use of an IX with an NP is optional in ASL and a bare NP can be interpreted as definite. This is the case for ANSWER in (22) and GIRL and COOKIE in (23). Examples discussed in this section contain definite NPs occurring with and without IXs.

(22) Stimulus sentence: *All of the students know the answer*.

t
STUDENT IX[pl] UNDERSTAND ANSWER (P3)[54]

[52] To be precise, MacLaughlin (1997) argued that only prenominal IXs are definite determiners, while postnominal IXs should be analyzed as locative adverbials.

[53] ASL nouns typically are unspecified for number. Plurality can be expressed through noun reduplication, but this strategy appears to be only available for a small set of nouns (Baker-Shenk & Cokely, 1991b; Valli, Lucas, & Mulrooney, 2005). No examples of noun reduplication were found in my data.

[54] The signer who produced this sentence felt strongly that the sign commonly glossed as UNDERSTAND is the best translation for 'to know' in this particular case.

(23) Stimulus sentence: *The girl ate all of the cookies*.

t
GIRL DEVOUR COOKIE (P4)

In Section 4.2.1, I consider responses where no particular sign can be identified as contributing to the expression of universal quantification. In Section 4.2.2, I describe responses where universal quantification is associated with aspectual marking on directional verbs. Finally, in Section 4.2.3, I discuss the role of various strategies expressing total affectedness of the patient/theme argument in providing a universal interpretation.

4.2.1. Interpretation of sentences with definite mass and plural NPs

Let us further consider the sentence in (22). Offered by P3 as a translation for a stimulus sentence with the universal quantifier *all*, as well as a translation for the corresponding stimulus sentence with *every*, this sentence can be translated as *The students know the answer*. As confirmed by my native signer consultant, the preferred interpretation for this sentence is that, for each of the students in the set referred to by STUDENT IX[pl], it is true that he/she knows the answer. It has been widely observed that plural definites in English similarly often get a universal interpretation. A brief summary of how such cases have been treated in the literature follows; this cursory review is not designed to argue for a particular analysis of the ASL example in (22) but rather to suggest what phenomena may explain the presence of such responses in the data.

Roughly two types of accounts have been put forward to account for such cases (see Schwarz, 2013, for a an overview). Following the work on plurality by Sharvy (1980) and Link (1983), accounts of one type propose that plural definites have maximal semantics (e.g., the NP/DP *the students* denotes a maximal sum of students in the contextually relevant set). A universal interpretation arises through collective predication or by adding a distributive operator that attaches to the predicate and introduces a universal quantifier into the compositional analysis of the sentence in question (Link, 1987).[55] Accounts of the other type are motivated by the observation that plural definites sometimes get non-maximal interpretations. For example, the sentence *The windows are open* can be interpreted as 'Some windows are open' in the context of an impending thunderstorm (example from Malamud, 2012; based on Yoon, 1996).[56] These accounts propose that plural definites have weaker existential semantics and that universal interpretations arise by some kind of pragmatic strengthening.

It is an interesting question for future research whether the analyses proposed for plural definites in English can be applied to ASL. Notably, this research will also need to involve a more in-depth investigation of definiteness in ASL. As noted above, ASL differs from English in that definiteness of NPs is not obligatorily marked, and there is an ongoing discussion in the literature about the exact semantic contribution of pointing signs. For the

[55] Link's D-operator applies to one-place predicates and thus accounts for distributive readings of subject arguments only. However, such readings are also available for arguments in non-subject positions. To account for such cases, Lasersohn (1998) offers a type-theoretic generalization of the D-operator.

[56] Yoon (1996) argues that the predicate *open* creates a preference towards the non-maximal interpretation of the NP in this sentence. Malamud (2012) points out, however, that this preference does not completely rule out the maximal interpretation ('All of the window are open'); it is available, for instance, in the context of house painters coming to paint the window frames.

purposes of the data description in this section, I would simply like to point out that the example in (22) shows that, similarly to English, ASL sentences containing definite plural NPs can receive a universal interpretation even in the absence of an overt universal quantifier. Note that I use the term *universal interpretation* loosely to mean interpretation similar to that of expressions with the English quantifiers *all*, *each*, and *every*. By doing so, however, I do not wish to imply that examples described here necessarily express universal quantification proper.[57]

In addition to sentences with plural definites, the data also contain examples with mass definites that are interpreted universally.

(24) Stimulus sentence: *My friend returned all of the money*.

_____t
MONEY POSS-1 FRIEND 3-GIVE-1 3-#BACK-1 (P4, P8)

The preferred interpretation for (24) is that the friend returned all of the money that he had borrowed. As in (22), here the universal interpretation is due to how a predicate is interpreted when its argument is a definite NP, and one may need to consider both semantic and pragmatic factors. Whether the analysis of sentences with mass definites should differ from those with plural definites may depend on one's approach to the semantics of mass nouns, in particular their mereological properties (see Lasersohn, 2011, for a comparison of mass nouns and plurals and for extensive references on the topic).

[57] See, for example, Löbner (2013, Section 4.5.3) for a discussion of the referential (rather than quantificational) nature of definite plural and mass NPs.

4.2.2. Aspectual marking on directional verbs

The data contain sentences in which a universal interpretation of an NP is associated with aspectual marking on a verb belonging to the class of *directional verbs* (defined in Section 1.2.2). As discussed in Section 2.1.2.1, the role of aspectual marking on directional verbs in expressing quantificational value of their selected NP arguments has already been pointed out in the literature.[58] Two verbal modifications that have been noted in that regard—multiple and distributive/exhaustive—both occur in my data. Examples (25) and (26) below show the two most frequent verbs with these modifications that were used by the participants.

(25) Stimulus sentence: *The teacher gave a book to all of the students in class*.

_____t
STUDENT IX<5>[pl] TEACHER GIVE-OUT<2h>[mult] BOOK[59] (P4)

(26) Stimulus sentence: *The teacher gave a book to each of the students in class*.

_____t _____t _____mm
TEACHER STUDENT GIVE<X>[distr] BOOK (P6)

The sign glossed as GIVE-OUT<2h>[mult] in (25) is illustrated in Figure 4.1. This form is listed in ASL dictionaries under various glosses including DISTRIBUTE, GIVE-OUT,

[58] While focusing on the role of aspectual marking on directional verbs in expressing nominal quantification, I leave aside a discussion of its role in expressing quantification over events. But see Kuhn and Aristodemo (2015) who discuss distributive exhaustive marking in ASL and French Sign Language as an expression of pluractionality.

[59] In the gloss *IX<5>[pl]*, '5' in angle brackets indicates that the pointing sign is produced with the 5 handshape (open palm) rather than with the typical 1 handshape (index finger). I am not sure if the difference in handshape corresponds to difference in interpretation. There are only two tokens of this sign in the data, both produced by the same participant.

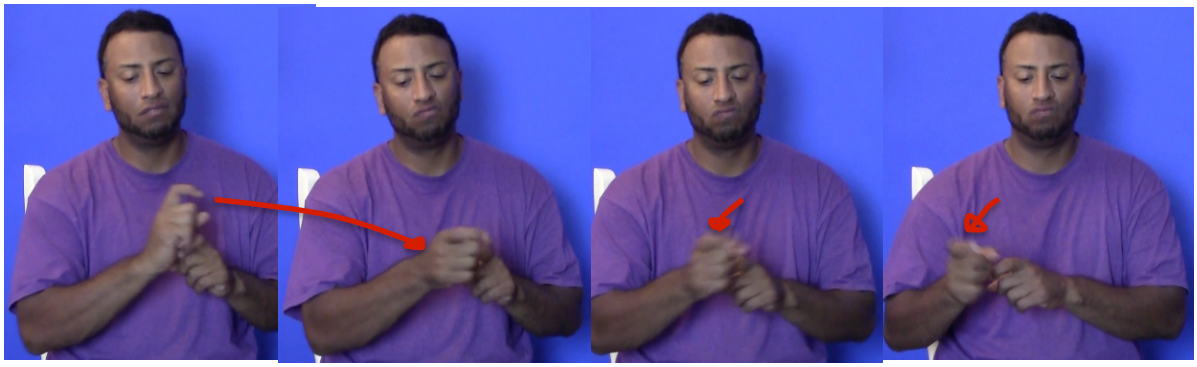
HAND-OUT (Tennant & Brown, 1998, www.handspeak.com/word, www.lifeprint.com). As indicated by my gloss, I consider GIVE-OUT<2h>[mult] a two-handed multiple form, where the multiple modification is the horizontal arcing movement of the hands from the location in front of the signer's chest to the sides. The interpretation supplied by this modification for the sentence in (25) is that the act of giving was directed at all of the individuals in the set of students.[60] The form of GIVE-OUT without the multiple modification is a one-handed sign produced by changing the hand aperture from closed (FlatO handshape) to open (5 handshape) while the hand moves from the location associated with subject/agent towards the location associated with indirect object/recipient. In her discussion of semantic differences between forms of the verb GIVE in ASL, Wilcox (1997) suggests that this change in aperture is a *completive* morpheme. She points out that GIVE-OUT (which she glosses as $GIVE_1$-*completive*) has "[t]he sense of thoroughly and completely releasing or passing an object to someone" (p. 187). Important to note is that, unlike the English phrasal construction *give out*, GIVE-OUT without the multiple modification is unspecified for the number of recipients. However, when the multiple modification is added, the only possible interpretation is that multiple recipients are involved (L. Hou, personal communication).

[60] My ASL consultant rejected an interpretation where the books were received by several but not all of the students for both (25) and (26). Further investigation is necessary to determine if the interpretation of sentences with verbs modified for multiple and distributive aspect is always strictly universal or whether exceptions are allowed in certain contexts.

Figure 4.1. GIVE-OUT<2h>[mult]

The sign glossed as GIVE<X>[distr] in (26) is illustrated in Figure 4.2. The aspectually unmarked form of this sign can be exemplified by the two leftmost stills in Figure 4.2. According to Wilcox (1997, p. 188), GIVE<X> (which she glosses as $GIVE_2$) describes the act of giving but also involves additional semantic features of 'permanent possession', 'money', and 'value'. It is probably the sense of value related to the important role that books play in education that is being invoked by the use of GIVE<X> in (26). The distributive modification of GIVE<X> takes the form of several (usually, three) displaced repetitions of the sign. The effect of this modification on the interpretation of (26) is that the act of giving is viewed as separate repeated actions directed at each of the individual students in the set.

Figure 4.2 GIVE<X>[distr]



Both the multiple and the distributive modifications provide universal distributive interpretation to their indirect object/recipient argument. The difference in the interpretation of the two modifications appears to be due to whether the recipients are viewed as a collective group comprised of individuals (such as a class of students) or a set of discrete individuals. The quantificational effect of these modifications is similar to that of lexical universal quantifiers, such as ALL/#ALL and EACH that I will describe later in Section 4.3. Notably, the relevant NP arguments of GIVE-OUT<2h>[mult] and GIVE<X>[distr] in (25) and (26) refer to a contextually salient set of students. In this regard it is worth noting the similarity of (25) and (26) to examples (22) and (24) that I discussed in the previous section, as well as to English sentences with plural definites. One type of analysis that has been proposed for sentences with plural definites in English posits an implicit distributivity operator that attaches to the predicate. If one applies such an analysis to ASL, the multiple and distributive modifications on directional verbs could then be treated as an overt realization of such an operator.

It remains to be noted that the data includes sentences where directional verbs modified for multiple or distributive aspect are used along with a lexical quantifier. For example, in (27a) a lexical quantifier EACH is use along with GIVE[distr]. This verb shows the same modification as GIVE<X>[distr], discussed above, but is produced with the FlatO handshape. Other responses show that the aspectual modifications are optional in the presence of a lexical quantifier (Hou, 2013, reports similar data). Thus, in (27b) quantification is expressed by means of the lexical quantifier ALL and the verb GIVE does not show any aspectual modification. Out of 46 sentences containing both a lexical quantifier and a form of GIVE in my data, twelve responses had a verb unmodified for multiple or distributive aspect.

(27) Stimulus sentence: *The teacher gave a book to all of the students in class*.

a. t
EACH STUDENT TEACHER BOOK GIVE[distr] BOOK (P4, P8)

b. t
CLASS IX-c STUDENT IX[pl]-c TEACHER BOOK GIVE-c ALL-c IX[pl]-c (P10)

Notably, there were no responses without a lexical quantifier in which a directional verb occurs in an aspectually unmodified form. This suggests that sentences with directional verbs require explicit marking of quantificational value of their selected argument.

4.2.3. Conveying total affectedness of the patient/theme argument

In some of their responses with the relevant NP bearing the thematic role of patient/theme,[61] participants made use of various strategies to indicate that the entire referent is being affected or otherwise acted upon. It is this meaning of totality that results in an interpretation comparable to that of the quantifier *all*. These strategies, to be described in the following subsections, include (1) the use of an inherently telic verb, (2) the use of a *result-state marker (*Wright, 2014) that indicates that the action denoted by the verb reached a natural endpoint, and (3) the use of a classifier construction iconically representing an event.

4.2.3.1. Inherently telic verbs and result-state markers

Consider a translation for the stimulus sentence *The girl ate all of the cookies* in (23), repeated below as (28a). Most notably, it involves the use of the verb glossed as DEVOUR (illustrated in Figure 4.3). The ASL dictionary on www.handspeak.com/word/ lists the sign, including its articulatory variants (one-handed or two-handed symmetrical sign, final handshape open or closed), under the glosses DEVOUR and CONSUME.[62] The following definitions are offered: "[t]o eat hungrily and/or very quickly; to eat all of food quickly" and "[t]o eat up or use up (a resource)." In line with these definitions, the ASL signer I consulted reported that the most natural interpretation for (28a) is that the girl ate

[61] These NPs can be analyzed as 'Incremental Themes' (Dowty, 1991; Krifka, 1989, 1992, 1998; Tenny, 1994, among others), which are arguments that undergo a gradual change in the event described by the verb and the progress of an event can be measured by the change in its incremental theme.

[62] Another dictionary, www.lifeprint.com, glosses the sign as WOLF-DOWN. Both www.lifeprint.com and www.handspeak.com/word/ show this sign with the initial BentB handshape, rather than the 5 handshape shown in Figure 4.3. ASL signers I consulted confirmed that the difference in handshape represents variation in articulation of the same sign.

all of the cookies. She further noted that an interpretation where some cookies were left uneaten may be possible if DEVOUR is used to expresses rapid consumption. On the basis of informal interactions with other signers, I know that, for some signers, DEVOUR necessarily denotes eating until completion (see also Wright, 2014, p. 134). For these signers, it would lead to a contradiction to follow up (28a) with a hedge indicating that not all of the cookies were consumed. Taken together, the dictionary definitions cited above and the discussed signer judgments suggest that DEVOUR, in at least one of its senses, entails complete consumption of a unit or a particular quantity of food. Thus, (28a) has a prominent interpretation that the entire quantity of cookies was consumed, which is comparable to the interpretation of the stimulus sentence with a universal quantifier *all*.

(28) Stimulus sentence: *The girl ate all of the cookies*.

a. $\overline{\text{GIRL}}^{\text{t}}$ **DEVOUR** COOKIE (P3, P4)

b. $\overline{\text{GIRL EAT}}^{\text{t}}$ **NOT-A-TRACE** COOKIE (P8)

c. $\overline{\text{GIRL EAT[dur]}}^{\text{t}}$ **RUN-OUT** COOKIE (P3)

Figure 4.3. DEVOUR

Another way to convey that eating resulted in complete consumption is shown in (28b-c). Unlike DEVOUR, the verb EAT—either unmodified (28b) or modified for durative aspect (28c)—does not entail eating until completion.[63] Instead, in these examples the main verb is accompanied by a separate sign indicating that no cookies are left. These signs are NOT-A-TRACE (28b) and RUN-OUT (28c), illustrated in Figures 4.4[64] and 4.5 respectively. The use of these signs as lexical result-state markers has been previously described by Wright (2014). He writes that NOT-A-TRACE "denotes a total absence of substance, such as hair after [a] complete shaving or cleaning a surface to absolute spotlessness" (p. 84).[65] RUN-OUT is used to express "exhausting a quantity of food or other material" (p. 83).[66]

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[63] See also Wright (2014) who argues that ASL dynamic verbs representing complex events, like EAT, that are used with quantized arguments lack the endpoint-inclusion inference, unlike their English counterparts where this inference is a conversational implicature.

[64] NOT-A-TRACE also has a two-handed symmetrical variant (see, e.g., Wright, 2014, p. 85).

[65] Tennant and Brown (1998, p. 367) list a similar sign which they gloss as BARE, BLAND, BLANK, EMPTY, NAKED, NUDE, VACANT, VOID. It differs from NOT-A-TRACE (Figure 4.2) in that there is no change of handshape: the Open8 handshape is used throughout the sign. The change in handshape aperture in

Figure 4.4. NOT-A-TRACE

Figure 4.5. RUN-OUT

As noted by Wright, the two signs differ syntactically. NOT-A-TRACE is a postverbal particle, while RUN-OUT can be used as the main verb, which I demonstrate in (29) below. In the earlier example (28c), it is unclear if RUN-OUT is used as a postverbal

---

NOT-A-TRACE thus corresponds to the semantic component of reaching an endpoint, namely the state of emptiness/cleanliness, associated with this sign (see also Wilbur (2003) and Malaia and Wilbur (2012), among others, for their discussion of change in handshape aperture as one of the "kinematic signatures" that mark telicity on ASL verbs). Notably, the change in handshape aperture in NOT-A-TRACE is also accompanied by a change in mouth aperture (open mouth → closed mouth).

[66] This is sign as glossed as ALL-GONE on www.handspeak.com/word/ and as DEPLETE or RUN-OUT-OF on http://www.lifeprint.com/.

particle or as the main verb of a separate clause; the sentence does not have any clear prosodic break between EAT[dur] and RUN-OUT. Used as the main verb, RUN-OUT in (29) is similar to DEVOUR in (28a) in that it entails total affectedness of its patient/theme argument and, as a result, supplies a universal interpretation to it. The sentence in (29) expresses the event where all of the contextually relevant energy is lost.

(29) Stimulus sentence: (*When light passes through the glass,) all of the energy is lost*.
(…) ENERGY **RUN-OUT** (P3)

Another sign that, according to Wright, can be used as a result-state marker and or as a main verb is PAY-OFF. It expresses the complete return of a debt. The use of PAY-OFF as result-state marker is demonstrated by (30) from my data.

(30) Stimulus sentence: *My friend returned all of the money*.
t
MY FRIEND 3-GIVE-1 **PAY-OFF** MONEY (P8)

In (31) I demonstrate the use of two additional inherently telic verbs that were used by the participants: DISSAPPEAR and DISSIPATE.[67] Figures 4.6 and 4.7 illustrate the verbs.

[67] These sign as glossed as LACK(MISSING) and DISSOLVE respectively on www.handspeak.com/word/.

(31) Stimulus sentence: (*When light passes through the glass,) all of the energy is lost*.

a. (…) ENERGY **DISAPPEAR** (P4, P7, P8, P9)

b. (…) ENERGY **DISSIPATE** (P6)

Figure 4.6. DISAPPEAR

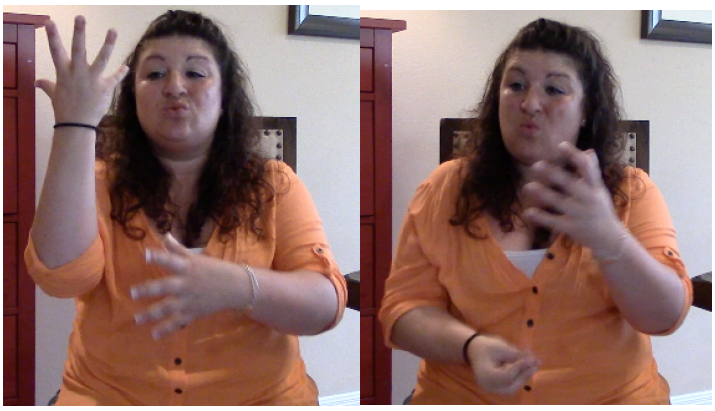


Figure 4.7. DISSIPATE

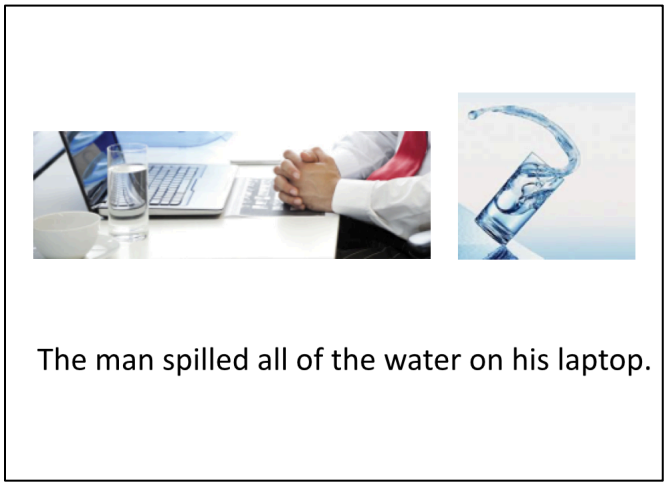
Both DISAPPEAR and DISSIPATE express an event culminating in complete disappearance or dissipation of some object. Similar to example in (29), my consultant

judged the responses in (31) as having an interpretation whereby the entire amount of the energy has dissipated.

4.2.3.2. A classifier construction

Another example of expressing total affectedness of the referent of the patient/theme NP comes from participants' translations for the sentence *The man spilled all of the water on his laptop*. Figure 4.8 shows the slide used for the elicitation of this sentence. As can be seen from the accompanying images, the referent of *the water* is established as a certain amount of water contained in a glass.

Figure 4.8. Elicitation slide for *The man spilled all of the water on his laptop*.



The most common way to express the event described by the English stimulus sentence in my data involved the use of a classifier construction depicting that the glass was knocked over on its side, shown in Figure 4.9 (see Section 2.1.2.2 for a description of classifier constructions in ASL). All eight participants produced responses with this classifier

construction. In contrast to that, only four of the participants offered alternative responses that did not contain this construction. As seen in Figure 4.9, the signer used his right hand in the C-shape to represent the movement in space of a cylindrical object (the glass) from an the upright position to a horizontal position. The handshape used can be analyzes either as an *entity classifier* representing the glass or as a *handling classifier* representing the man's hand holding the glass (different types of classifiers are discussed, e.g., in Sandler & Lillo-Martin, 2006, pp. 77–83). The mouth movement, which I gloss as 'pth' in (32a), signals a careless act. The signer's left hand simultaneously produces another classifier construction representing the surface of a laptop. The relative position of the hands with respect to each other on the right still in Figure 4.9 shows that the surface of the laptop is where the spilling event occurred.

Figure 4.9. CL:C'glass knocked over' (right hand) and CL:B'laptop surface' (left hand)

Consider the following examples.[68] In (32a), the classifier construction CL:C'glass knocked over' alone expresses the event described in the stimulus by depicting what happened to the glass containing the water. In (32b-c), the same classifier construction is used along with a form of the verb SPILL. ASL dictionaries I consulted (Tennant & Brown, 1998; www.lifeprint.com; www.handspeak.com/word/) gloss this sign as SPILL or SPREAD. The form of SPILL illustrated in these dictionaries and the one used by the participant who produced (32b) is shown in Figure 4.10. The form c-SPILL<1h>-rt in (32c) is a one-handed version modified to show that the water was spreading from the point coinciding with the location of the laptop further to the right. In (32b-c) the two relevant senses of the English verb *to spill*, namely 'to cause to flow' and '(of liquid) to flow,' are expressed by two separate signs. The semantic contribution of SPILL in (32b-c) is to express the spreading of some quantity of the water (additionally, by modifying various phonological parameters of this sign a signer can express other aspects of spilling, such as the speed of a flow and an extant of the spill).

(32) Stimulus sentence: *The man spilled all of the water on his laptop*.

a. MAN IX-3 LAPTOP WATER CL:C'glass knocked over' (P3)
pth
ndh: (*hold*) CL:B'laptop surface'-c————>

[68] In (32), I show representative examples from two participants. Responses from the other participants that contain the classifier construction demonstrated in (32) differed in aspects that are likely irrelevant for the discussion of the universal interpretation for WATER, such as the order of the constituents or the presence of pointing signs that establish locations of the referents in space.

t
b. LAPTOP-c IX-c MAN WATER CL:C'glass knocked over' SPILL (P6)
ndh: (*hold*) CL:B'laptop surface'-c———————————>

t
c. LAPTOP-c MAN WATER CL:C'glass knocked over' c-SPILL<1h>-rt (P8)

Figure 4.10. SPILL

In all three examples in (32), it is the iconically motivated classifier construction depicting the knocked-over glass that that expresses the idea that the entire quantity of the water (from the glass) was spilled. It appears though that the universal interpretation associated with these responses may be a conversational implicature rather than an entailment. For the sentence in (32b), my consultant readily accepted both the universal readings ('all of the water was spilled') and a non-universal reading ('a good portion of the water was spilled').

At this point, I would like to revisit my earlier observation that fewer participants produced responses with a lexical universal quantifier than without one for the nouns

WATER and ENERGY (see Table 4.1). Although this preference is observed for mass nouns in my data, it does not seem to be completely explained by the mass semantics. As shown in Table 4.1, lexical quantifiers were used by all eight participants with the noun MONEY (which I believe is semantically mass because it cannot be used with numerals). Further evidence comes from my supplemental data collection (see Appendix C for the elicitation materials). For the sentence *All of the tap water in Flint was contaminated with lead*, the consultant offered several translations all of which contained a lexical quantifier (ALL or #ALL).

Another possibility to consider is that lexical quantifiers may be dispreferred with abstract nouns (like ENERGY) whose distribution in space is hard to conceptualize. While abstractness of the referent certainly plays a role in the use of lexical quantifiers (especially in spatial modifications of #ALL, which I describe in Section 4.3.1.1), it does not explain the observed pattern either. Table 4.1 shows that all participants used lexical quantifiers with the abstract noun STORY. Even when distribution of the referent in space is known, a signer may prefer to use quantificational strategies that do not involve the use of a lexical quantifier. Thus, when asked to translate sentences with WATER and TRASH describing referents with known distribution (provided as pictures describing the contextual information) my consultant provided responses without lexical quantifiers.

While future investigation may reveal more subtle ways in which noun semantics plays a role in the choice of a quantificational strategy in ASL, it is also possible that the paucity of responses with lexical quantifiers for WATER and ENERGY is at least partially explained by the fact that the use of predicates like DISAPPEAR, DISSIPATE, RUN-OUT

allows for a more concise way to express the intended meaning. Similarly, the use of the classifier construction discussed in this section allows to both clearly describe the event and to provide the quantificational information.

To summarize my description of various responses without a lexical universal quantifier, the data show that there are a number of alternative strategies that the participants used to express expressing equivalents of English universal quantifiers. Notably, these strategies provide universal interpretations to NPs that denote some specific contextually salient sets. Thus, similarly to what has been observed for English plural definites, ASL plural and mass NPs that have a definite interpretation (whether they are marked as definite by means of an accompanying pointing sign or their definite interpretation is supplied by the context) can receive a universal reading even in the absence of an overt quantifier. Furthermore, as noted in the previous literature (discussed in Section 2.1.2.1), a particular class of ASL verbs—directional verbs—exhibits aspectual morphology that utilizes space to express quantification over their relevant argument. Finally, universal interpretation can arise in sentences with predicates conveying total affectedness of the patient/theme argument. These predicates include telic predicates that contain a verb that is lexically specified for telicity (an inherently telic verb) or another lexical item that expresses that the action denoted by the verb reached a natural endpoint (a result-state marker). In one case in my data, total affectedness of the patient/theme NP was expressed by means of an iconically motivated classifier construction.

4.3. LEXICAL UNIVERSAL QUANTIFIERS

In this section, I describe ASL lexical universal quantifiers used by my participants. In terms of their morphosyntactic properties, these are D-quantifiers (as defined in Section 1.2.1.1) and floating quantifiers. In addition to quantifiers proper, I also discuss other signs modifying nouns that were used by some participants to express nominal quantification. In what follows, I use the term 'quantifier' to refer to these expressions as well.

Following D. Gil's (1995) typological account of universal quantifiers (see Section 1.2.1.2), I distinguish distributive and non-distributive quantifiers. Distributive quantifiers force distributive interpretations and non-distributive quantifiers permit both distributive and collective interpretations. This classification was initially supported by the meaning of ASL quantifiers, as indicated by (a) English glosses and/or definitions provided for them in ASL dictionaries, (b) the use of these quantifiers by participants to translate English stimuli with distributive and non-distributive quantifiers. With respect to the latter, if a particular ASL quantifier was used to translate stimuli with both non-distributive (*all*) and distributive (*every* and *each*) quantifiers, I classified it as non-distributive. Conversely, if it was only used to translate stimuli with distributive quantifiers, I classified it as distributive. Another criterion that I considered—the one that does not rely on translation—is the presence of overt distributive morphology. Following previous accounts of distributivity in different signed languages (Kimmelman, 2015; Quer, 2012), I considered spatial reduplication an overt marker of distributivity. I thus assumed that this marker can only appear on distributive quantifiers and is incompatible with quantifiers that allow non-distributive interpretation. That being said, this is a one-way implication: if a quantifier

does not have spatial reduplication, it does not mean that it is not distributive. The considerations above provide some evidence for the classification of universal quantifiers into distributive and non-distributive, however this evidence is not conclusive for quantifiers that do not show distributive modification. To collect more convincing evidence, I elicited acceptability judgments from a native signer consultant on ASL sentences containing universal quantifiers presented in contexts that favored either a distributive or a collective interpretation. The results of this elicitation support the initial classification; they will be discussed in Section 5.1.

It should be clarified that I report my results not as an inventory of ASL quantifiers corresponding to particular quantificational meanings, but rather as a description of what quantifiers were used by my participants to translate English sentences with this or that quantifier. For example, some participants used the sign #ALL to translate sentences with *all* and also sentences *each*, so this quantifier will be reported in two sections.

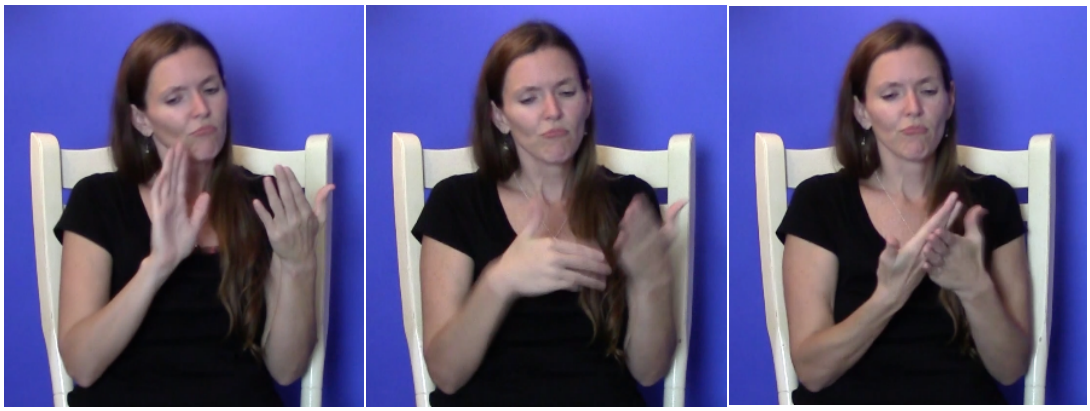
4.3.1. Quantifiers used to translate stimuli with 'all'

4.3.1.1. ALL and #ALL

ASL online and printed dictionaries (e.g., www.handspeak.com/word/, www.lifeprint.com, and *The Gallaudet Dictionary of American Sign Language* (Valli, 2005) and learner's resources like *Number Signs for Everyone* (MacDougall, 2004) list two signs as equivalents of English *all*. Both these signs were used by all eight participants in my study, and in many cases the participants indicated that either quantifier could be used to translate a particular sentence.

The first sign is ALL (Figure 4.11). The dominant hand (the right hand for the signer in Figure 4.11) in the B handshape (open hand) moves in a vertically-oriented circle in front of the signer's chest ending with a smack of its back onto the open palm of the non-dominant hand. According to www.handspeak.com/word/, ALL is "[u]sed to refer to the whole quantity or extent of a particular group or thing; the whole, entire, total amount, quantity, or extent of." Similarly, Valli (2005) lists the following words in a definition of the sign: "all, entire, total, whole" (p. 13).

Figure 4.11. ALL[69]



The second sign is #ALL (Figure 4.12). The dominant hand in the A handshape with palm facing forward (slightly towards the centerline of the signer's body) moves to the ipsilateral side (to the right for a right-handed signer, or to the left for a left-handed signer) while changing into the L handshape. In the resources referenced above, this sign is given as an alternate form meaning 'all.'

[69] The facial expression in Figure 4.11 is not an integral part of the sign ALL. The participants used various facial expressions with this sign depending on the signer's attitude toward what was being said (surprised, content, happy, etc.) and how emphatic their statement was.

Figure 4.12. #ALL

Figure 4.12 shows that the participant mouthed the English word 'all' simultaneously with the manual articulation of #ALL. Such mouthing is common with this sign but does not appear to be obligatory. No mouthing is seen in the illustrations in Valli (2005), MacDougall (2004), or www.lifeprint.com, whereas mouthing is present on the video on www.handspeak.com/word/. In my data, all participants used varying degrees of mouthing with #ALL; some signers also did so with ALL. Based on the data, it is impossible to say whether the participants used mouthing because the elicitation was conducted by a non-native signer, or whether such mouthing would occur frequently in interactions between native signers.[70]

As indicated by the #-symbol, #ALL belongs to a group of signs termed *fingerspelled loan signs* (Battison, 1977). Such signs enter ASL as fingerspelled English words. Over time they become lexicalized; as they do so, their phonological characteristics may change to match those of native ASL signs (Battison, 1977; Brentari & Padden, 2001;

[70] Interestingly, in their discussion of language contact phenomena, Lucas and Valli (1992) show that some signers use English-influenced features even when they are signing with other Deaf signers.

Padden, 1998; Sandler & Lillo-Martin, 2006). Unlike the non-lexicalized fingerspelled word A-L-L, #ALL can be (and often is) spatially modified. My data demonstrate several ways in which #ALL can be spatially modified. These modifications involve changes in movement, location, and palm orientation.[71] Below, I describe the forms of #ALL used by my participants, and propose some factors that play a role in the choice of the form used; this last issue is further addressed in Chapter 5.

Before I describe my data, I should note that there are some differences in the articulation of #ALL on the illustrations/videos given in the referenced dictionaries and the learner's resource, as compared to each other and to Figure 4.2 from my data.

- MacDougall (2004) and Valli (2005), show a version of #ALL that is identical to a fingerspelled A-L-L. The movement of the dominant hand is much shorter than in Figure 4.12, and the tip of the index finger on the L handshape points almost directly up.
- On www.lifeprint.com, the length of the movement of #ALL is similar to that in Figure 4.12 but the palm of the hand on the L handshape is turned at an about 45 degree angle downward.

[71] As discussed in Section 2.1.1.4, Davidson and Gagne (2014) report that #ALL (glossed as A-L-L in their paper) can be produced at different vertical heights, thus conveying information about relative set size and quantifier domain restrictions. With regard to the particular form of #ALL they consider, no illustration is given but they mention that the sign movement traces an arc. This suggests that they analyze one or both of the variants that I gloss below as rt-#ALL<palm in>-lf and lf-#ALL<palm out>-rt. My data elicitation did not target differences in set sizes and thus do not include examples of such semantic use of sign height. I will therefore not discuss this issue any further.

- The dictionary on www.handspeak.com/word/ shows #ALL with an arcing movement of the dominant hand from the contralateral side to the ipsilateral side, which is much longer than the movement shown in Figure 4.12.[72]

Since illustrations given in dictionaries and reference grammars are typically citation forms, the differences listed above suggest that there is at least some variation in the articulation of #ALL that may not correspond to any meaningful distinctions, unlike the grammatical inflections alluded to on www.handspeak.com/word/. I now turn to the discussion of variation in the production of #ALL with respect to my data.[73]

The forms of #ALL. One challenge with coding and analyzing various productions of #ALL is deciding when differences in articulation indicate different inflected forms of the sign (i.e. forms that are motivated by differences in semantic or grammatical information conveyed) and when they are variant articulations of the same form. In describing my data, I first take a rather conservative approach by specifying in my glosses all major changes to the articulation of #ALL as compared to the fingerspelled A-L-L (which I take to be a prototypical example of the base form).[74] With that said, in a couple cases, I made a coding decision not to indicate in my glosses minor variations in articulation. Such cases will be pointed out, either in the description of a sign or in a footnote. I refer to each version of #ALL that receives a separate gloss as a *variant*. Additionally, at several points in the data presentation, I identify variants that can be

[72] This particular form is identical to lf-#ALL<palm out>-rt described later in this section.
[73] In contrast to #ALL, my data show no significant variation in the form of ALL.
[74] There were no instances of A-L-L in my data.

grouped together because they show certain similarites in form and/or meaning, and suggest a unified gloss for them. This two-step approach will allow me: (1) to offer a detailed description of the variants of #ALL in my data, thus demonstrating variation in the form of this sign; and (2) to highlight similarities between certain variants of #ALL and to simplify the glossing system for ease of exposition.

I continue to use the gloss #ALL to talk about the sign in general, without referring to any particular variant or form. To refer to variants of #ALL, I will follow glossing convention explained in Appendix A. Indices at the beginning and at the end of the gloss indicate manual modification to a sign's location or direction (e.g., #ALL-f where 'f' stands for 'forward'). Angled brackets are used to note additional information that helps differentiate variants of the sign, such as palm orientation (e.g., rt-#ALL<palm in>-lf) and two-handedness (#ALL<2h>).

The most frequently used variant of #ALL in my data is ***rt-#ALL<palm in>-lf*** *(*Figure 4.13). Seven out of eight participants used it in their translations (see Table 4.2 below for the data on each of the quantified nouns). Unlike #ALL shown in Figure 4.12, here the dominant hand moves in a sweeping motion from the ipsilateral side to the contralateral side, the path being an arc in a horizontal plane.[75]

[75] The length of arcs in rt-#ALL<palm in>-lf and other variants produced with a sweeping movement in a horizontal plane described below varied within and across the participants. A detailed analysis of those differences lies outside the scope of this dissertation, but the following factors appear to play a role: (1) stress placed on a sign and its position in the sentence (a stressed sign, which typically occupies sentence final position, may be produced with a longer arcing movement). See Wilbur (1999) for a discussion of changes in sign displacement based on sign prominence and phrase position.; (2) co-articulation (e.g., rt-#ALL<palm in>-lf had a shorter moment when it 'blended' with the following sign STUDENT); (3) location of quantified referents in the signing space (see also the discussion of the deictic/indexical function of #ALL in Section 5.1.1); (4) a participant's signing style.

Figure 4.13. rt-#ALL<palm in>-lf[76]

Variation was observed regarding hand orientation at the beginning of the sign. The palm of the hand in the A-handshape may either face forward, away from the signer (as in Figure 4.13), or towards the signer. Since even the same participant alternated between these two ways of producing the beginning of the sign, this variation is not indicated in the gloss. Importantly though, while producing the arcing movement, the palm always faces towards the signer (depending on the angle between the signer's forearm and upper arm, it may also be turned slightly up). This is indicated by '<palm in>' in the gloss. The indices *rt-* and *-lf* show that the hand moves from right to left (from the signer's perspective). For a left-handed signer, the movement in this sign would be from left to right. All of the participants in this study were right-handed, so my data contain no examples of lf-#ALL<palm in>-rt.

[76] The turn of the head and gaze to the signer's left are not part of the sign. The participant is looking at the interviewer who is sitting on her left.

One participant used a variant of #ALL that has the same movement path and direction as the variant described above but that is produced with both hands, hence glossed as ***rt-#ALL<2h>-lf*** (Figure 4.14). A similar sign is listed in the ASL dictionary on www.lifeprint.com as a more emphatic way of signing #ALL. I should note though that there is difference in the path of movement in rt-#ALL<2h>-lf as used by my participant and the example given on www.lifeprint.com. In my data, the sign is produced with an arcing movement, while the movement in the example shown the dictionary is a straight line from right to left at a roughly 45 degree angle towards the signer's body.

Figure 4.14. rt-#ALL<2h>-lf

Another variant of #ALL that is also produced with a sweeping movement in a horizontal plane from one side of the signing space to the other is ***lf-#ALL<palm out>-rt*** (Figure 4.15). In contrast to rt-#ALL<palm in>-lf, this variant is signed with a dominant hand palm facing away from the signer (indicated as '<palm out>') and the direction of the movement is always from the signer's contralateral side to her ipsilateral side. Regarding

the path of movement, it is a shallow arc or a line. The difference in path in my data does not appear to correspond to any meaningful distinctions.

Figure 4.15. lf-#ALL<palm out>-rt

The three variants described so far have one thing in common, namely a horizontal sweeping movement from one side of the signing space to the other. Table 4.2 shows which nouns were quantified over by each of these variants and by which participants.

Table 4.2. Variants of #ALL with a sweeping movement form one side to another (#ALL<lateral>)

Variant of #ALL	**Noun**	**Used by**		
		Participants	**# of participants (out of 8)**	
rt-#ALL<palm in>-lf	STUDENT (as subject)	P4, P5, P6, P7, P8, P9	6	
	STUDENT (as indir. obj.)	P3, P4, P5, P6, P7, P8, P9	7	
	COOKIE	P3, P4, P7, P8, P9	5	**7**
	MONEY	P4	1	
	STORY	P4, P5, P7	3	
rt-#ALL<2h>-lf	STUDENT (as subject)	P4	1	**1**
	STUDENT (as indir. obj.)	P4	1	
lf-#ALL<palm out>-rt	STUDENT (as subject)	P10	1	
	STUDENT (as indir. obj.)	P3, P5, P10	3	**3**
	STORY	P10	1	

First, consider rt-#ALL<palm in>-lf and lf-#ALL<palm out>-rt. The principal difference in the articulation of the two signs is palm orientation (the difference in the movement path—arc for rt-#ALL<palm in>-lf and shallow arc or line for lf-#ALL<palm out>-rt—is likely explained by articulatory ease). Based on the data I reviewed, it appears that the choice to use one variant versus the other reflects personal preference of a signer rather than any difference in the meaning conveyed. As can be seen in Table 4.1, the only signer who consistently used lf-#ALL<palm out>-rt was P10. Two other participants, P3 and P5, used it with STUDENT in an indirect object position, but they also used rt-#ALL<palm in>-lf as an alternative translation. P5 explicitly mentioned that either variant can be used but she personally prefers to use rt-#ALL<palm in>-lf.

Comparing the nouns that were quantified with the help of the two variants, we observe that only rt-#ALL<palm in>-lf was used with COOKIE and MONEY. Note

however that this cannot be interpreted as negative evidence (evidence that lf-#ALL<palm out>-rt cannot be used with COOKIE and MONEY). As described in the methods chapter (Chapter 3), while the participants were encouraged to provide all possible translations they could think of, the data for which quantifiers could not be used with a particular noun was not collected in a systematic manner. Furthermore, with regards to the more significant difference in the use of two variants, namely for the noun COOKIE (five participants for rt-#ALL<palm in>-lf versus none for lf-#ALL<palm out>-rt), I will show below that P10, who was the main user of this variant, employed a spatially modified form similar to lf-#ALL<palm out>-rt instead. Overall, based on my data rt-#ALL<palm in>-lf and lf-#ALL<palm out>-rt appear to be variant articulations of the same form, and I will henceforth treat them as such.

Turning to rt-#ALL<2h>-lf, Table 4.2 shows that P4 used it to quantify over the noun STUDENT, in the syntactic roles of both subject and indirect object. Note that in each of those cases P4 offered translations of the given English sentence with both rt-#ALL<2h>-lf and rt-#ALL<palm in>-lf, the latter only differing from the former in that only the dominant hand is involved in the production. While the two variants may differ in meaning and/or use, my data do not offer any clues to what those differences may be. However, recall from the description above that a two-handed #ALL that is very similar to rt-#ALL<2h>-lf is listed in the ASL dictionary on www.lifeprint.com as being a more emphatic version of #ALL. The only difference between rt-#ALL<2h>-lf and the sign shown in the dictionary is in the path of movement – an arc versus a line. As I mentioned with respect to another variant (lf-#ALL<palm out>-rt), the difference between the two

trajectories for the variants of #ALL discussed so far does not seem to correspond to any distinctions in the meanings expressed. So the description of two-handed #ALL with a line path of movement as being more emphatic offered on www.lifeprint.com likely applies to the instances of two-handed rt-#ALL<2h>-lf in my data as well.[77] Thus, I consider rt-#ALL<2h>-lf and rt-#ALL<palm in>-lf to be variant articulations of the same from of #ALL, with the former possibly being used in more emphatic signing.

To sum up my discussion of the variants of #ALL with a sweeping movement from one side of the signing space to the other, their distribution in my data and the participants' comments suggest that all three variants are similar in meaning. The choice of the hand orientation (*palm in* vs. *palm out*) is likely motivated by a personal preference of a signer, and the use of two hands rather than one may indicate emphatic signing. For ease of exposition, from here on I am going to use a simplified gloss **#ALL<lateral>** to refer to all of the three variants.

Now let's consider another group of variants of #ALL that, instead of a movement from one side of the signing space to the other, have a short movement forward or to the side. My data contain a few examples of #ALL signed with a short movement directly forward, the palm of the hand facing toward the midline of the signer's body (Figure 4.16). I gloss this variant as ***#ALL-f***. A corresponding two-handed variant, ***#ALL<2h>-f*** (not

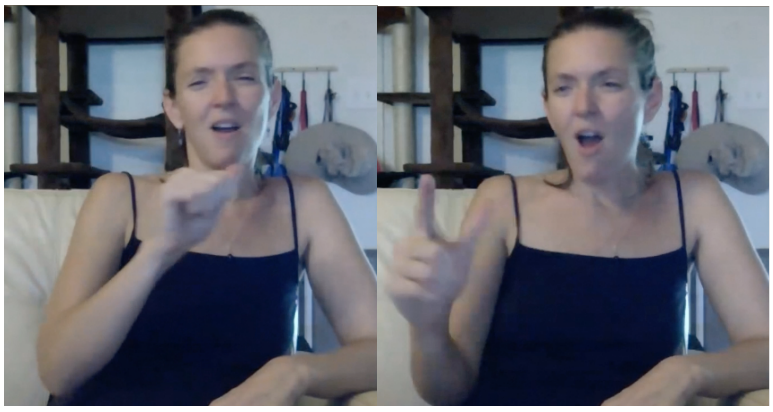
[77] Similarly, Nilsson (2007) reports examples of signs that are one-handed in citation form but are produced with two hands in Swedish Sign Language. She refers to the phenomenon as 'doubling' and notes that instances of doubling "occur in stretches of signing that are produced with a certain kind of intensity" and "seem to reinforce what is said" (p. 168). I am not aware of any discussion of this phenomenon in the ASL literature.

illustrated here because the participant requested confidentiality of their video data) was also used by another participant.

Figure 4.16. #ALL-f

Another variant is ***#ALL-rt***, demonstrated in Figure 4.17. It is minimally different from #ALL-f in that the direction of the movement is to the side, rather than directly forward. In fact, of all variants in the data this one is most similar to the fingerspelled A-L-L, the only difference being that it has a longer movement path.

Figure 4.17. #ALL-rt



As can be seen in Table 4.3, the three variants of #ALL that I have just described were not frequent in the data: #ALL-f was used by two participants, and #ALL<2h>-f and #ALL-rt were used by a single participant each. While there is no overlap in the use of the variants, that is, no two of the variants were used with the same noun, the data are too limited to draw any conclusions about possible differences in meaning conveyed by these variants.

Table 4.3. Variants of #ALL with a short movement forward or to the side (#ALL<outward>)

Variant of #ALL	**Noun**	**Used by**		
		Participants	**# of participants (out of 8)**	
#ALL-f	STUDENT (as subject) STORY	P3 P7	1 1	**2**
#ALL<2h>-f	STUDENT (as indir. obj.)	P8	1	**1**
#ALL-rt	MONEY	P6	1	**1**

That said, the explanation for the difference in the numbers of hands used in #ALL-f and #ALL<2h>-f may be the same as the one I suggested regarding one-handed and two-handed variants of #ALL<lateral>: The two-handed variant is likely used when a signer wants to reinforce or emphasize her statement.

One thing that all three variants have in common is that they are very similar in form. Their movement can be generally described as being directed outward, away from the body. Based on this similarity in form and without any evidence for possible

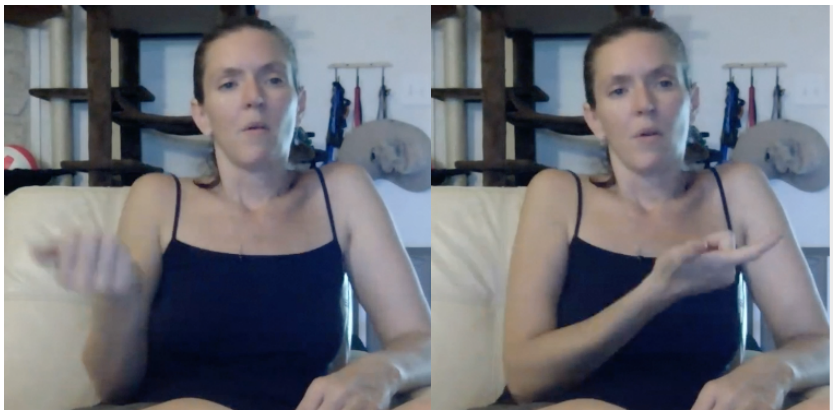
differences in meaning, in what follows I treat them together using a common a gloss **#ALL<outward>**.

Finally, I list a few variants of #ALL that differ from each other in terms of their formational characteristics (location, movement, orientation), but are similar in that their form is motivated by the location and/or layout of a quantified referent in the signing space which, in turn, corresponds topographically to the location of the referent in the real space described. Three of those variants were used to translate *all* in the stimulus sentence *The girl ate all of the cookies*. The images providing context for this sentence show an older lady holding a tray with cookies lying in rows and, next to it, the face of a girl biting into a cookie (see Appendix C). In her translation for this sentence, one signer used the variant shown in Figure 4.18a and glossed as ***lf-#ALL-f,lf***. The sign is produced on the left side of the signing space (the location the signer assigned to cookies by signing COOKIE IX-lf earlier in the same sentence); the movement path traces the distribution of a row of cookies on a tray.

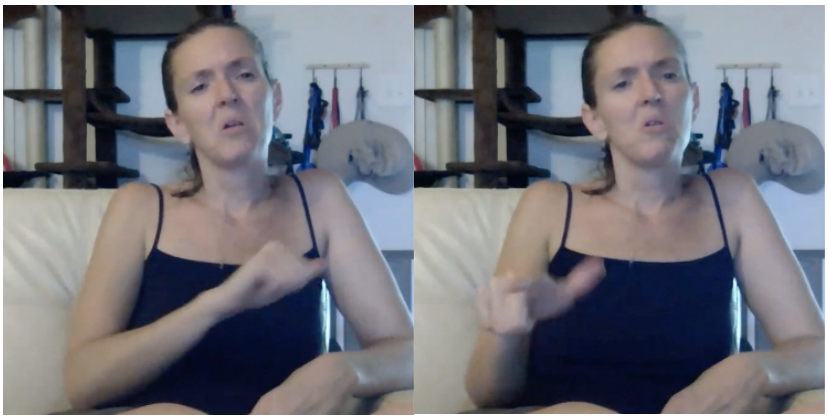
Another signer suggested two variants: ***rt-#ALL<palm up>-lf*** (Figure 4.18b) and ***lf-#ALL<palm dn>-rt*** (Figure 4.18c). In both of these variants, the hand moves in an arc over the area in space associated with the location of the cookies. The arc is lying in a horizontal plane, which shows that the referent is distributed on a flat surface. The signer who offered these variants mentioned that either one can be used when talking about cookies distributed on a horizontal surface, such as a tray. So, as in the case of the variants of #ALL<lateral>, palm orientation appears not to be contrastive here.

Figure 4.18. Variants of #ALL showing location and distribution of cookies on a tray

a. lf-#ALL-f,lf



b. rt-#ALL<palm up>-lf



c. lf-#ALL<palm dn>-rt

Another variant of #ALL whose form is also influenced by the location/distribution of a quantified referent was given by two participants in their translation of the sentence *The man spilled all of the water on his laptop*. One of the images presented along with the sentence shows a glass of water next to a laptop, and the other images show a glass falling and the water spilling out of it. The participants suggested that the amount of water spilled can be indicated by signing a variant I gloss as ***#ALL-dn***. The hand moves down representing the vertical dimension of the water in the glass. Figure 4.19 shows a signer producing #ALL-dn with her dominant hand next to her non-dominant hand, which is producing a classifier construction representing a glass. Another signer produced #ALL-dn alone but importantly at a location that she assigned to a glass of water earlier in the same sentence (the signer produced WATER followed by a classifier construction CL:B<2h>'tall object/glass").

Figure 4.19. #ALL-dn (dominant hand) + CL:C'glass'(non-dominant hand)

Table 4.4 summarizes the data on these four variants. Unlike the variants for which I have introduced the glosses #ALL<lateral> and #ALL<outward>, the variants listed here have different movement paths corresponding to different spatial arrangements of referents. To refer to them as a group I will use a gloss #ALL$_{top}$, where the subscript *top* stand for the topographic use of space.

Table 4.4. Variants of #ALL whose form is motivated by the physical location of a quantified referent (#ALL$_{top}$)

Variant of #ALL	**Noun**	**Used by**	
		Participants	**# of participants (out of 8)**
rt-#ALL<palm up>-lf	COOKIE	P6	**1**
lf-#ALL<palm dn>-rt	COOKIE	P6	**1**
lf-#ALL-f,lf	COOKIE	P10	**1**
#ALL-dn	WATER	P9, P10	**2**

The connection between the form of #ALL and the location of a quantified referent in the signing space is most apparent in the examples I have just described. It should be noted though that such a connection may in some cases also be present in the variants of #ALL<lateral> and #ALL<outward>. While the form of #ALL<outward> appears to be unmotivated in all examples in my data, it can be motivated in other uses of this sign. For example, Baker-Shenk and Cokely (1991a, pp. 23–24) note that #ALL "can indicate all of the people in the hall or auditorium by moving in a horizontal line away from the Signer. (For this meaning, Signers generally will use both hands.)." As for #ALL<lateral>, my data contain examples in which there is no connection between the form of a quantifier and the

location of a referent (e.g. with an abstract noun STORY denoting stories told by granddad) as well as those where the quantifier is produced over or towards the area in the signing space that corresponds to the physical location of the referent in the described real space (e.g. when quantifying the noun STUDENT which refers to students sitting in a circle). Additionally, as I have discussed in Section 2.1.1.4, #ALL, as well as ALL, may be produced in the arbitrary location in the signing space that has been assigned to the quantified noun for referential purposes. I will return to the discussion of these spatialized uses of #ALL and ALL in Chapter 5.

The syntax of ALL and #ALL. I now turn to the syntactic properties of the quantifiers ALL and #ALL. These quantifiers do not show any differences in their syntactic behavior and, therefore, I treat them here together. In my description, I focus on sentences with the quantified noun overtly expressed, but note that ALL and #ALL, as well as other ASL quantifiers, allow nominal ellipsis when the reference of the noun is clear from the context (Abner & Wilbur, 2017).

Consistent with previous descriptions (discussed in Sections 2.1.1.1-2.1.1.2), both quantifiers typically occur before the noun they quantify over, as demonstrated by boldfaced fragments in (33) and (34).

(33) Stimulus sentence: *All of the students know the answer*.

a. **#ALL<lateral> STUDENT** KNOW ANSWER (P4, P5, P8)

b. **ALL STUDENT** KNOW ANSWER (P5, P8)

(34) Stimulus sentence: *Bob remembers all of the stories*.

(t)
a. B-O-B REMEMBER **#ALL<lateral> STORY**[78] (P4, P8)

(t)
b. B-O-B REMEMBER **ALL STORY** (P3, P5, P8)

A quantifier can also follow the noun with which it is associated (35). Notably, however, examples of this order are rare in my data: there are two instances in the data from one participant and one instance in the data from another participant.

(35) Stimulus sentence: *The teacher gave a book to all of the students in class*.

TEACHER GIVE-OUT **STUDENT #ALL<outward>** BOOK (P8)

In examples (33)-(35) above, the quantifier and its associated noun form a continuous constituent. Alternatively, a quantified noun can be separated from its quantifier and appear in topic position at the beginning of a sentence (marked by a brow raise and a slight backwards tilt of the head).[79] The sentences in (36) illustrate the split construction with a floating quantifier.

[78] The parentheses around the non-manual marking (*t*) indicate optionality: Some of the participants listed to the left of the sentence produced it with this marking while others produced it without it.

[79] Topics in ASL have been claimed to either move to the sentence initial position through the process of topicalization or to be base-generated in that position by means of left dislocation (Fischer, 1975; Friedman, 1976; Lillo-Martin, 1986b, 1991). As noted in Section 2.1.1.2, Boster (1996) offers a movement (topicalization) analysis the quantifier-noun phrase split.

(36) Stimulus sentence: *The girl ate all of the cookies*.

t
a. **COOKIE** IX-3 GIRL EAT **#ALL<lateral>** (P7)

t
b. **COOKIE** GIRL EAT **ALL** (P6)

t
c. **COOKIE IX[pl]** GIRL EAT **ALL** (P10)

As seen in example (36c), a quantified noun may be accompanied by a pointing sign. As I already discusses in Section 4.2, the sign IX[pl], produced with a sweeping motion of the index finger over an area in space, follows the sign COOKIE and provides a definite and collective plural interpretation for the noun.[80] The IX[pl] is optional, as seen in (36a-b) and a bare noun can be interpreted as definite and plural. While pointing signs in ASL may also occur prenominally (as with IX-3 in (36a)), all instances of pointing accompanying quantified nouns in my data with ALL/#ALL occur postnominally. Additionally, almost all of them occur when a noun is in the topic position, i.e. when a noun and the associated quantifier are separated.

[80] My treatment of postnominal points contradicts some of the claims made in MacLaughlin (1997). She analyzes postnominal points as adverbials. She argues that they differ from prenominal points in terms of their articulation and that they cannot be marked for plural. My data on count nouns provides counterevidence to the latter of her claims. This is most clearly seen in the use of IX[pl] with an abstract noun STORY. Four of my participants produced the sequence STORY IX[pl] in their translations for stimulus sentences of the form *Bob remembers QUANTIFIER of the stories*. The pointing sign they used was articulated by the index finger moving in a sweep along a horizontal arc/line, thus assigning the referent (stories) to a particular area in the signing space. This, I argue, provides plural interpretation to the noun STORY. For a similar approach see Davidson and Gagne (2014) who argue that IXs with an arc-line movement (used as pronouns, as well as postnominally) delimit plural sets.

The nouns appearing in the topic position in the sentences in (36) have the syntactic role of object.[81] Examples in (37) below demonstrate that a quantified subject can also appear in the topic position.

(37) Stimulus sentence: *All of the students know the answer*.

a. t
STUDENT IX[pl] #ALL<lateral> KNOW ANSWER (P4, P6, P9, P10)

b. t
STUDENT IX[pl] ALL KNOW ANSWER (P6)

Tables 4.5 and 4.6 below characterize the data quantitatively. Syntactic constructions discussed above are listed in the first column of each table. For each construction, I report two measures. First, in the second column, I show how many of the eight participants used a particular construction in at least one of their responses. Second, in the third column, I list the percentages of participants' *first responses* out of all translations with ALL/#ALL that contained a corresponding syntactic construction. By 'first response' I mean the very first translation that a participant offered for a stimulus sentence. As described in the methodology chapter, participants often provided more than one translation for a given sentence. The number of translations varied across the participants and also across elicitation sentences. I thus chose to use only one response per

[81] More precisely, examples in (36) show quantified nouns in *direct* object position. There was one stimulus sentence in this study with a quantified noun in *indirect* object position (*The teacher gave a book to all of the students in class*). The construction with a noun separated from the quantifier was much less common in translations for this sentence – there was only one occurrence of it in the data:

(i) t t
CLASS-c IX-c STUDENT IX[pl]-c TEACHER BOOK GIVE ALL IX[pl] (P10)

participant per elicitation sentence to ensure that the data from each participant and for each sentence contribute equally to the numbers reported in the third column. By choosing to use participants' first responses I work under the premise, perhaps arguably, that in most cases, these first reactions to the stimuli were the most natural and preferred translations into ASL.

Table 4.5. Use of the quantifiers ALL and #ALL (Q) in various word order positions relative to a quantified noun (N)

Order information	**# of participants (out of 8) who used order in at least one response**	**% of first responses (across participants)**
Q-N	8	75%
N-Q	2	0%
N separated from Q	6	25%

Table 4.6. Use of pointing signs (IXs) with nouns quantified by ALL/#ALL

Presence/Position of IX with a quantified noun	**# of participants (out of 8) who used construction in at least one response**	**% of first responses (across participants)**
No IX	8	90%
IX following N	4	10%

As can be seen from Table 4.5, the Q-N word order is the most commonly used order in the data. Every one of the participants used it for at least some of their translations, and 75 percent of first responses show this order. As I have already mentioned earlier, the reverse N-Q order is rare. Only two participants used this order, but none of those instances are in their first responses. Lastly, the construction with a noun separated

from the quantifier is fairly common across participants – six out of eight signers used it and it occurred in 25 percent of first responses.

The prevalence of Q-N order and the paucity of N-Q order could be seen as a translation artifact, i.e. the participants were biased by the order used in the English stimuli. However, the Q-N order seems to be also prevalent in naturalistic data. In a small set of data from ASL vlogs that I have collected, there are fourteen tokens of ALL/#ALL used as a nominal quantifier (rather than a pronoun) produced by eleven different signers. All of these tokens demonstrate Q-N order, in contrast, there are no tokens of N-Q order. The absence of examples of N-Q order and also examples of the floating Q suggests that there may be particular discourse contexts associated with these syntactic constructions that my small sample did not include.

Table 4.6 shows that all participants used nouns quantified by ALL/#ALL that did not have an accompanying pointing sign. Quantified nouns without pointing signs occur in the overwhelming majority of first responses (90 percent). Nouns are followed by a pointing sign in the data from four out of eight participants. This construction occurs in 10 percent of first responses.

With respect to the syntax of ASL quantifiers, my goal in this dissertation is to provide a description of the relevant data. A detailed analysis of the reported syntactic structures will have to await another occasion. Importantly, my data is expanding on the previous description of the quantified noun phrases by Boster (1996), discussed in Section 2.1.1.2, by including quantified phrases with nouns accompanied by pointing signs.

4.3.1.2. ALTOGETHER<time>

In addition to ALL and #ALL described above, one additional sign was used as a quantifier expressing 'all.' This sign is listed under different glosses in ASL dictionaries. For example, it is glossed as TOTAL[-sum] on www.lifeprint.com and is described as '"total" (sum, all total).' Similarly, www.handspeak.com/word/ lists it under two entries: 'altogether' and 'sum, total.'[82] An example of the sign from my data, which I gloss as ALTOGETHER, is given in Figure 4.20a.

To produce this sign, a signer starts with her open hands apart and then brings them together, at the same time closing the fingers so to that the fingertips touch. The movement path of the sign may differ depending on the spatial properties of the referent whose sum or totality is being expressed. For example, when talking about the mathematical concept of addition, a signer will move her hands along a vertical line if the numbers added are given in column. Similarly, a signer will move her hands along a horizontal line if the numbers added are in a row.[83]

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[82] In my data, ALTOGETHER was used to quantify over a noun that refers to a plural referent (*all of the stories* in (38)). I do not know if it can also be used to quantify over a singular referent (for example, to mean *all of the story*).

[83] For a demonstration, see https://www.youtube.com/watch?v=SbqhiijIztc, *Vocabulary Builders in Sign Language: Math*.

Figure 4.20. Two forms of ALTOGETHER

a. ALTOGETHER (citation form)

b. ALTOGETHER<time>

In my data, the sign was used by two participants to translate the sentence *Bob remembers all of the stories*. The target sentence was presented in the following context: *When Bob was little, his granddad used to tell him all kinds of stories*. Importantly, both signers noted that they prefer to use a form of the sign glossed here as ALTOGETHER<time> (Figure 4.20b). In this form, the hands move at the side of the signer's head in a sagittal plane. The movement is along an imaginary *time line* that "runs through the Signer's body and into the areas in front of an in back of the body" (Baker-

Shenk & Cokely, 1991b, p. 175). This time line is evident in many ASL time signs, such as PAST, FUTURE, YESTERDAY, TOMORROW, etc. One of the participants explained that ALTOGETHER<time> is the clearest way to express the concept of the totality of stories that were told (by granddad) over time.

With regards to the syntax of ALTOGETHER, my data, albeit limited, shows that it can either precede or follow the quantified noun, as shown by example (38a) from one participant and (38b) from the other.

(38) Stimulus sentence: *Bob remembers all of the stories*.

a. t
ALTOGETHER<time> STORY B-O-B REMEMBER (P8)

b. t
STORY ALTOGETHER<time> IX-3 REMEMBER (P9)

This pattern is consistent both the syntactic distribution of quantifiers like ALL and #ALL, reported above, as well as with that of other nominal modifiers in ASL (for two different proposals for structural positions of ASL adjectives see Boster, 1996, and MacLaughlin, 1997).

4.3.1.3. Summary of quantifiers by noun type

Now that I have described the quantifiers used by the participants to translate *all*, in this section I characterize the data in terms of how the choice of a quantifier correlated with the semantic classification of nouns into count/mass and concrete/abstract. As explained in

Chapter 3, where I describe my methods, three groups of stimulus sentences were included in the data collection. Tables 4.7 and 4.8, repeated from Chapter 3 for convenience, list target nouns used in each of those groups. In my data, lexical quantifiers were used to translate sentences with all of these nouns, at least by some participants. Additionally, in some cases a participant would offer several translations of a stimulus sentence using different quantifiers with the same noun.

Table 4.7. Target nouns in stimulus sentences in Groups 1 & 2 whose translations were included in coding (repeated from Chapter 3)

	Count	**Mass**
Group 1: Concrete	*students* *cookies*	*water* *money*
Group 2: Abstract	*stories*	*energy*

Table 4.8. Target noun in stimulus sentences in Group 3 whose translations were included in coding (repeated from Chapter 3)

Focus of elicitation	**Target nouns**
Quantification in sentences with a directional verb	*students*

A note should be made regarding the target noun *students*. As shown in Tables 4.7 and 4.8, it was used in elicitation sentences of Groups 1 and 3. As explained in Chapter 3, the data elicited by sentences in Groups 3 was collected primarily to investigate quantification by means of morphology on ASL predicates, and it is not the focus of the present discussion. Since lexical quantifiers were also used in sentences of this group, here,

I examine the data for *students* in Group 3 in terms of quantifiers used. I will present these data together with those for other concrete count nouns elicited by sentences in Group 1 (*students* and *cookies*).

While the same noun *students* was used in sentences of Groups 1 and 3, it had different syntactic roles: subject in sentences of Group 1 (*All of the students know the answer*) and indirect object in sentences of Group 3 (*The teacher gave a book to all of the students*). To investigate the potential effect of this distinction on the expression quantification in ASL, I separate the data for *students* from Group 1 and Group 3 in data presentation.

Tables 4.9-4.12 below show which quantifiers were used by the participants to quantify individual target nouns. Each table presents data on one of the investigated semantic classes of nouns. I first report data on concrete nouns (count in Table 4.9 and mass in Table 4.10), and than I deal with abstract nouns (count in Table 4.11 and mass in Table 4.12).

Table 4.9. Quantifiers used to translate stimuli with 'all' quantifying over concrete count nouns

Concrete Count Noun	**Quantifier**	**Used by**		
		Participants	**# of participants (out of 8)**	
STUDENT (as subject)	#ALL<lateral> #ALL<outward>	P4, P5, P6, P7, P8, P9, P10 P3	7 1	**8**
	ALL	P5, P6, P7, P8, P9, P10	6	**6**
STUDENT (as indirect object)	#ALL<lateral> #ALL<outward>	P3, P4, P5, P6, P7, P8, P9, P10 P8	8 1	**8**
	ALL	P4, P5, P6, P10	4	**4**
COOKIE	#ALL<lateral> #ALL_{top}	P3, P4, P7, P8, P9 P6, P10	5 2	**7**
	ALL	P5, P6, P7, P8, P9, P10	6	**6**

Table 4.10. Quantifiers used to translate stimuli with 'all' quantifying over concrete mass nouns

Concrete Mass Noun	**Quantifier**	**Used by**		
		Participants	**# of participants (out of 8)**	
WATER	#ALL_{top}	P9, P10	2	**2**
	ALL	P7, P10	2	**2**
MONEY	#ALL<lateral> #ALL<outward>	P4 P6	1 1	**2**
	ALL	P3, P4, P5, P6, P7, P8, P9, P10	8	**8**

Table 4.11. Quantifiers used to translate stimuli with 'all' quantifying over the abstract count noun STORY

Abstract Count Noun	**Quantifier**	**Used by**		
		Participants	**# of participants (out of 8)**	
STORY	#ALL<lateral> #ALL<outward>	P4, P5, P7, P10 P7	3 1	**4**
	ALL	P3, P4, P5, P6, P7, P8, P10	7	**7**
	ALTOGETHER<time>	P8, P9	2	**2**

Table 4.12. Quantifiers used to translate stimuli with 'all' quantifying over the abstract mass noun ENERGY

Abstract Mass Noun	**Quantifier**	**Used by**	
		Participants	**# of participants (out of 8)**
ENERGY	ALL	P4, P5, P7, P9, P10	**5**

As mentioned earlier, lexical quantifiers were used to quantify all of the target nouns. One or more quantifier was used by all eight participants with count nouns (Tables 4.9 and 4.11) and also with the concrete mass noun MONEY (Table 4.10). The use of quantifiers was much less common across participants for the concrete mass noun WATER (Table 4.10); a total of three participants used this quantificational strategy. The abstract mass noun ENERGY (Table 4.12) was used with a quantifier by five participants. Rather than using a quantifier, participants used other strategies for quantifying WATER and ENERGY, described in Section 4.2.3.

From the tables above, one can make several further observations regarding the use of individual quantifiers. The sign ALL was used by varying number of participants with

all nouns. Various form of #ALL were used to quantify nouns of all semantic classes except abstract mass (ENERGY in Table 4.12). However looking at count/mass distinction, even for those concrete mass nouns that were used with #ALL, this quantifier was used by fewer participants than with count nouns, either concrete or mass. Only two participants used some form of #ALL with each of the concrete mass nouns WATER and MONEY (Table 4.10). Whereas eight and seven participants used #ALL with the count concrete nouns STUDENTS and COOKIE respectively (Table 4.9), and four participants used it with the count abstract noun STORY (Table 4.11).

With respect to the abstract/concrete distinction, both ALL and #ALL are used for both types of nouns. However, as noted above, in a class of abstract nouns, #ALL was only used with the count noun STORY (Table 4.11) and was not used with the mass noun ENERGY (Table 4.12). Focusing on count nouns only, #ALL was used with STORY by fewer participants than with any of the concrete nouns in Table 4.9 (four participants for STORY vs. eight for STUDENT and seven for COOKIE).

One final observation concerns the data in Table 4.9. This table includes nouns that differ in animacy and syntactic position. The use of quantifiers for these nouns does not appear to be effected by either of these parameters. Both #ALL and ALL were used with the noun STUDENT (animate, used as a subject and as an indirect object) and the noun COOKIE (inanimate, used as a direct object), and the numbers of participants who used these quantifiers for each of the nouns are similar.

To summarize the above observations about the use of ALL and #ALL by the participants, both quantifiers are used to quantify over animate and inanimate nouns in

various syntactic positions. Furthermore, the data show that the participants used ALL with nouns of all of the investigated semantic classes. The sign #ALL appears to be more restricted in its use, with no instances of it quantifying the abstract mass noun (ENERGY). The numbers of participants who used #ALL further show that in the data the use of this sign is more common with count nouns (especially concrete) and less common with mass nouns. I will come back to these observations in the discussion of the results in Chapter 5.

4.3.2. Quantifiers used to translate stimuli with 'each'

In their translations of stimulus sentences with *each,* the participants made use of several quantifiers. The most common quantifier in the data is EACH, and I will describe it first. I will then turn to other quantifiers used by the participants.

4.3.2.1. EACH

According to such ASL dictionaries as *The Gallaudet Dictionary of American Sign Language* (Valli, 2005), www.handspeak.com/word/, and www.lifeprint.com, ASL has a sign whose meaning is translated into English as 'each,' 'every,' or 'apiece.' The sign starts with both hands in the A handshape (closed fist) or A-dot/Open-A handshape (a closed fist with the thumb extended)[84] held in front of the signer's chest, the dominant hand behind and above the non-dominant hand. The dominant hand then moves down brushing against the back of the thumb of the non–dominant hand. My data do not include any examples of this particular variant of EACH but do include numerous examples of a variant of this sign

[84] The variation in the handshapes can be observed both across ASL dictionaries and in my data. The position of the thumb can be either closed against the index finger or extended, or somewhere in between.

demonstrated in Figure 4.21. It differs from the description above in the position of the two hands with respect to each other. They are held at about the same distance from the signer's chest (rather than the dominant hand behind the non-dominant hand), and the dominant hand moves down the intermediate phalanges of the non-dominant hand. One of the dictionaries I consulted, namely www.lifeprint.com, lists this variant as an alternate version of EACH. I will take this note, along with my observations of fluent signers, as an indication that the two variants are in free variation, and therefore do not differ in meaning.

Figure 4.21. EACH

Additionally, www.lifeprint.com notes that some signers produce EACH with double movement, and www.handspeak.com/word/ lists "a plural form of EACH" that is produced by repeating the sign in several locations along a horizontal arc in front of the signer. My data shows examples of both of these variants, and I will describe them in more detail in the next section.

The forms of EACH. All of the participants used one or more of the variants of EACH in their responses. The variant in Figure 4.21 was produced by seven out of eight participants. Three participants used a variant in which the movement of dominant hand was produced twice. I will gloss it as EACH+, where a '+' sign indicates one repetition. Some resources (for example, Tennant & Brown (1998) and www.lifeprint.com) attribute the difference between the number of movements to the distinction between *each* and *every*. My data do not support this claim. As will be shown in Section 4.3.3, my data have no examples of the participants using EACH+ to translate stimulus sentences with 'every.' This does not rule out the use of EACH+ to mean 'every,' but suggests that there is no clear correspondence between the number of movements in the two variants of the sign and the meanings associated with the English words *each* and *every*.

A further piece of evidence demonstrating that EACH and EACH+ are considered interchangeable by signers is that two out of three participants who produced EACH+ used both variants of the sign in different translations they offered for the same English sentence. This can be illustrated, for examples, by two translations given by one of those participants in (39).

(39) Stimulus sentence: *Each of the students knows the answer*.

a. EACH+ IX[pl] STUDENT UNDERSTAND ANSWER (P3) [85]

b. EACH IX[pl] STUDENT UNDERSTAND ANSWER (P3)

[85] The signer felt strongly that the sign commonly glossed as UNDERSTAND is the best translation for 'to know' in this particular case.

Another frequently used variant of EACH in my data (used by six participants) was the one described as "a plural form of EACH" on www.handspeak.com/word/. As mentioned above, this variant is produced by repeating EACH in several locations in space along a horizontal arc (Figure 4.22). I consider the spatial reduplication of the sign an overt expression of distributivity and hence gloss this sign as EACH[distr]. The number of repetitions is usually three or more, although in fast signing just two repetitions may be produced. Two participants (P8 and P10) noted that they consider EACH[distr] a more emphatic version of EACH. I take these comments to mean that the spatial reduplication of EACH[distr] makes the distributive meaning more explicit. As seen in Figure 4.22, such non-manual behaviors as squinting and tilting the head/torso forward may accompany the sign. I will say more about non-manual behaviors associated with EACH later in this section.

Figure 4.22. EACH[distr]

The data show that distribution along a horizontal arc in front of the signer is a default path used both when EACH[distr] quantifies over concrete nouns that refer to visible referents (e.g., STUDENT, COOKIE) and when it quantifies over abstract nouns that refer to non-visible referents (e.g. STORY). However, other paths of distribution appear to be possible. A signer may produce EACH[distr] along a path associated with the location in the signing space that she previously assigned to a quantified referent. The sentence in (40) and Figure 4.23 below demonstrate the point. In the topic part of the sentence (indicated by a top line with the label 't'), the participant introduces the referent (cookies) and assigns it to a location on the left side of the signing space by producing there the pointing sign IX[pl]-lf - the index finger sweeps forward along a line in a horizontal plane (Figure 4.23a). The signer then produces repeated movements of EACH[distr]-lf along the same line on the left (Figure 4.23b), followed by a copy of IX[pl]-lf.

(40) Stimulus sentence: *The girl ate each of the cookies*.

t
COOKIE IX[pl]-lf GIRL EAT EACH[distr]-lf IX[pl]-lf

Figure 4.23. Stills for example (40)

a. IX[pl]-lf

b. EACH[distr]-lf

Another variation in the articulation of EACH involves the handshape of the non-dominant hand. The sign is sometimes produced with the non-dominant hand in the 1 handshape (a fist with the index finger extended and pointing up) instead of the A or A-dot handshape that we saw in the examples above (Figure 4.24). I gloss this variant here as EACH<1>.

Figure 4.24. EACH<1>

Two participants produced this variant. Participant P9 used EACH<1> and/or its reduplicated form EACH<1>[distr] with STUDENT (both as a subject and as an indirect object) and COOKIE. Participant P5 used EACH<1>[distr] in one of her sentences with STUDENT in subject position.

Regarding the use of EACH<1>, its occurrence with the noun COOKIE in the data from P9 could be "a slip of the hand." The participant explicitly mentioned at another point of her interview that she only uses EACH<1> for people and would not use it for things. Since most responses with EACH<1> come from a single participant, we cannot draw any firm conclusions about possible restrictions on the use of this variant. Future studies may clarify if animate/inanimate or any other semantic distinctions place restrictions on the use of EACH<1>. They may also reveal other factors (regional or stylistic variation, individual preference, etc.) that may account for the pattern of its use.

Importantly, while there may be differences between EACH<1> and EACH in their use, the two appear not to differ in their quantificational force (and perhaps there is no

difference in their meaning at all). This is suggested by the fact that P5 used both EACH[distr] and EACH<1>[distr] in her translations for the same sentence. Additionally, P9 used EACH<1> in cases where other participants offered EACH. Therefore, I consider any possible difference between the two variants irrelevant for the present study. For simplicity of exposition, I will henceforth use the gloss EACH to refer to either of the two.

Regarding non-manual markers (facial expressions, mouth, head and body movements), my data show that no particular non-manual marking is required for EACH. However, the participant would often mouth the English word *each* or just the vowel [i]. The mouthing of *each* is also used in video demonstrations of EACH on www.handspeak.com/word/, but no mouthing is present in corresponding demonstrations on www.lifeprint.com. As noted earlier with respect to #ALL, the amount of mouthing used by my participants could be due to the fact that the interviewer was a non-native signer of ASL.

Other common, but not required, non-manual behaviors associated with EACH that the data show are squinting and tilting the head and torso forward (see, for example, Figures 4.22 and 4.24). I will tentatively suggest that these behaviors signal emphasis, but a thorough analysis of these behaviors is outside the scope of this dissertation.

The syntax of EACH. Syntactically the sign EACH behaves similarly to ALL and #ALL described in Section 4.3.1. As shown in (41), EACH, with or without distributive modification, typically occurs before the noun it quantifiers over.

(41) Stimulus sentence: *Each of the students knows the answer*.

a. **EACH STUDENT** KNOW ANSWER (P5, P8)

b. **EACH[distr] STUDENT** KNOW ANSWER (P5, P7, P8)

EACH can also occur after the noun (42). However, just like in the case of ALL and #ALL, this order is much less common in my data (quantitative characterization of the data is given below).

(42) Stimulus sentence: *The girl ate each of the cookies*.

t
COOKIE EACH[distr] GIRL DEVOUR (P4)

The quantified noun can be a bare noun (as in 41 and 42) or it can be accompanied by a pointing sign (43). A pointing sign may occur either prenominally (43a), or postnominally (43b). As already noted in the description of the syntax of ALL/#ALL, pointing signs accompanying nouns are optional, and a bare noun can be interpreted as definite and plural.

(43) Stimulus sentence: *Each of the students knows the answer*.

a. **EACH STUDENT IX[pl]** KNOW ANSWER (P6)

b. **EACH IX[distr] STUDENT** UNDERSTAND ANSWER (P3)

The pointing signs in (43a-b) differ in that IX[pl] marks collective plurality and IX[distr] marks distributive plurality. In terms of their form, IX[pl] is produced by making a sweeping movement with the pointing hand across an area in the signing space, while IX[distr] is produced by pointing to several locations in space.[86]

From examples in (43) one may conclude that IX[distr] only occurs prenominally, and IX[pl] only occurs postnominally. This however is not the case; both of them can occur in either position. Example (44a) below shows IX[distr] used in postnominal position, and example (44b) shows IX[pl] in prenominal position.

(44) a. Stimulus sentence: *The teacher gave a book to each of the students in class.*

t
STUDENT IX[distr] EACH[distr] TEACHER GIVE[distr] BOOK (P8)

b. Stimulus sentence: *Each of the students knows the answer.*

t
IX[pl] STUDENT EACH[distr] IX[pl] KNOW ANSWER[87] (P9)

My data also contains two sentences with pointing signs occurring both before and after the quantified noun (as in 45). In each of those sentences, the pointing sign used in both positions is IX[pl].

[86] The path of the sweeping movement in IX[pl] is typically an arc. However, other paths (e.g. a circle or a line, as in example (40) above) are possible as well. IX[pl] may provide information about the location and spatial arrangement of referents. Similarly, what appears to be the default path for reduplicated pointing in IX[distr] is a horizontal line, but other paths maybe used to show the spatial arrangement of individual referents.

[87] Based on the scope of topic marking, I treat the second instance of IX[pl] in (44b) as not being a part of the quantified NP.

(45) Stimulus sentence: *Each of the students knows the answer*.

t

a. **IX[pl] STUDENT IX[pl] EACH[distr] IX[pl]** KNOW ANSWER (P10)

Similarly to other quantifiers, EACH can 'float' such that the quantified noun is separated from its quantifier and appears in topic position. This construction is demonstrated by the sentence in (46). In the gloss, the non-manual topic marking 't' over a string of five signs shows breaks. The breaks correspond to such behaviors as a short pause and/or changes in the direction of eye gaze. I consider these behaviors to be the markers of separate topics.[88] The quantified noun STUDENT accompanied by a modifying classifier construction is the second topic and it is separated by several signs from EACH.

(46) Stimulus sentence: *The teacher gave a book to each of the students in class*.

t t t

CLASS **STUDENT CL:BentV'people sitting in row'** TEACHER BOOK

GIVE **EACH** GIVE[distr] (P10)

Another example of a noun separated from its quantifier is given in (47). One important observation about this sentence is that both the quantified noun STORY and the quantifier EACH are followed by the pointing sign IX[pl]. This sentence can be analyzed as an example of left-dislocation (comparable to English *As for the students, each of them knows the answer* and *As for the stories, Bob remembers each of them*), and will be

[88] A detailed analysis of topics is outside of the scope of this dissertation. I would only note here that my glossing in (46) runs counter to the claim made by Aarons (1994) that the maximum number of topics in ASL is two.

discussed in more detail in Chapter 5. A similar example is the sentence in (46) above. While the noun STUDENT with the accompanying pointing signs is adjacent to EACH, the topic marking indicates the separation between the quantifier and the noun. The quantifier is followed by a copy of IX[pl].

(47) Stimulus sentence: *Bob remembers each of the stories*.

t t
STORY IX[pl] B-O-B IX-3 REMEMBER **EACH[distr] IX[pl]** (P10)

It should be noted that sentences similar to those in (45 and 47) where EACH is separated from a noun and is also accompanied by a pointing sign are more common in my data than those like (46) with a separated EACH without a pointing sign (seven sentences WITH EACH IX vs. three sentences with EACH).

Another important observation to be made about the sentences in (43, 44, and 46) is that EACH/EACH[distr] is not always the only marker of distributive quantification in a sentence. It can occur along with IX[distr] (as in 43b), or with a verb inflected for distibutive/exhaustive aspect (e.g, GIVE[distr] in 46), or both of them (as in 44a). As we saw earlier, e.g. in (41), IX[distr] is not required when EACH is used. Rather, it appears to emphasize distributive quantification. As for distributive morphology on a verb, my data have some examples of sentences with an uninflected GIVE, but they are rare and they are perceived by some of the participants who produced them as English-influenced signing.[89]

[89] Note that in (46), the signer produced the verb GIVE twice, first uninflected and then with distributive marking. Such constructions where a verb appears first uninflected sentence-internally and then again with

So, such marking may not be completely obligatory, when there are other signs in a sentence that mark distributivity, but is clearly strongly preferred. Note that both IX[dist] and GIVE[distr] can also occur without EACH, i.e. they can themselves be the only markers of distributive quantification in a sentence.

There is one more sign in the data that expresses distributive quantification and co-occurs with EACH in the same sentence. It has the form of a numeral ONE inflected spatially with either distributive marking (reduplication in several locations in the signing space) or plural marking (sweeping movement along an arc). I gloss the two variants of the sign as ONE[distr] and ONE[pl] and describe them in more detail below in Section 4.3.2.2.

To complete the description of syntactic properties of EACH, Tables 4.13 and 4.14 provide quantitative characterization of the data with regard to syntactic constructions discussed above. The measures I am using in the second and third columns were described in Section 4.3.1.1, where I reported the data on ALL and #ALL. To remind the reader, I use the term *first response* (in the third column of each table) to refer to the very first translation that a participant offered for a target sentence. It should be noted however that in calculating the percentages of first responses containing a certain construction in Tables 4.13 and 4.14, I only consider sentences with EACH. If a participant used a quantifier other than EACH (e.g., ALL or #ALL) or no quantifier at all in her first translation for a particular stimulus sentence, I used the first of her subsequent translations that contained EACH instead. If none of a participant's translations had EACH, the participant's data for

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aspectual marking (or as a classifier construction) sentence-finally have been previously described by Fischer and Janis (1990) who labeled them 'verb sandwiches.' The use of the uninflected form of GIVE here is characteristic of ASL.

that stimulus sentence was not used in the calculation. Similarly, I eliminated from consideration translations that were either incomplete sentences or sentences where the quantified nouns was implied rather than explicitly stated, as those responses could not be analyzed with respect to the discussed constructions. Such translations were replaced with subsequent translations from the same participant that were full sentences with a quantified noun, when such translations were available.

Table 4.13. Use of the quantifier EACH (Q) in various word order positions relative to a quantified noun (N)

Order information	**# of participants (out of 8) who used order in at least one response**	**% of first responses (across participants)**
Q-N	7	68%
N-Q	4	4%
N separated from Q	3	28%

Table 4.14. Use of pointing signs (IXs) with nouns quantified by EACH

Presence/Position of IX with a quantified noun	**# of participants (out of 8) who used construction in at least one response**	**% of first responses (across participants)**
No IX	8	60%
IX preceding N:	2	8%
IX[pl]	1	4%
IX[distr]	1	4%
IX following N:	5	24%
IX[pl]	3	20%
IX[distr]	2	4%
IX preceding and following N:	2	8%
IX[pl]	2	8%
IX[distr]	0	0%

As shown in Table 4.13, EACH typically occurs before a noun (Q-N order). Seven out of eight participants used this order at least once in their responses. Looking across participants, the Q-N order occurs in 68 percent of their first responses. The only participant who did not produce any sentence with this order used the construction with a noun separated from the quantifier for all of her translations with EACH.

The N-Q order was used by half of the participants, but this order occurs in only four percent of first responses. In fact, this order is rare in the overall data for EACH (not just first responses). Three of the four participants who produced the N-Q order used it only once in their translations, and one participant used it twice.

Finally, a noun is separated from EACH in the translations from three participants, and the construction is used in 28 percent of first responses. Interestingly, this construction is particularly common in the data from two participants, one of whom, as mentioned above, used it in all of her translations with EACH.

With regard to the use of pointing signs, Table 4.14 shows that all participants produced one or more sentences with nouns quantified by EACH that did not have accompanying pointing signs. Across participants, more than a half (60 percent) of their first responses contain nouns without pointing signs. The second most frequent construction is IX following a noun. It was used by five participants and occurred in 24 percent of first responses. Lastly, the construction with IX preceding a noun and one with IX preceding and following a noun were each used by two participants. They are also equally frequent in first responses, each occurring in eight percent of sentences in this group.

Table 4.14 also provides a breakdown of the data based on the type of IX used. The most important observation here is that IX[pl] following a noun is the most frequent construction with a pointing sign in the data. It was used by three participants and, across participants, it occurs in 20 percent of first responses. The construction with IX[pl] preceding and following a noun was used by two participants (both of whom also used IX[pl] following a noun) and it occurs in eight percent of first responses. The construction with IX[distr] was also use by two participants, but it occurs in only four percent of first responses. The constructions with IX[pl] and IX[distr] preceding a noun were the least frequent: each used by one participant and occurring in 4 percent of first responses.

4.3.2.2. ONE[distr]/ONE[pl]

As mentioned in the description of syntactic properties of EACH above, distributive quantification can also be expressed using a numeral ONE (a fist with the index finger extended and pointing up, the palm facing towards the signer) inflected with either distributive marking or plural marking. Distributive marking of the variant that I gloss as ONE[distr] takes the shape of reduplications of ONE in several locations in the signing space along a horizontal arc.[90] Plural marking of the corresponding variant, glossed as ONE[pl], involves a sweeping movement of ONE along a horizontal arc. Figure 4.25 illustrates both variants. As in the case of EACH, the mouth movements on the stills in the figure - the mouthing of the word *one* - appear to be common but not required. Three

[90] The movement path of ONE[distr] and ONE[pl] in my data is an arc. However, I have seen signers use other paths with at least one of these variants, namely ONE[distr], to express spatial information about location/layout of quantified referents.

participants produced a total of four tokens of this sign. Two of these participants used mouthing and one participant used mouthing in one case and other non-manuals (namely, pursed lips) in another.

Figure 4.25. ONE[distr] (movement path shown by the upper arrows, in red)/ONE[pl] (movement path shown by the lower arrow, in blue)

* The stills are ordered chronologically from right to left.

The difference in the manner of movement between ONE[distr] and ONE[pl] described above (reduplication vs. one sweeping movement) is not always clear. It may become blurred in fast signing, making it hard to reliably distinguish between the two. This was the case for one of the participants. Rather than producing distinct repetitions of ONE, her hand moved along and arc making fast and small, hardly noticeable vibrations.

More importantly though, I did not observe any substantial difference in the meaning of ONE[distr] and ONE[pl] in my data. Similarly, Kuhn (2017) discusses both ONE[distr] and ONE[pl] (glossed as ONE-redup and ONE-arc in his work) and treats them as variants of the same sign, both marked for plural and contributing distributive reading to

the sentence in which they are used. The two forms may differ, however, in whether their referent is viewed as a collective group or as separate individuals.

A total of two participants used ONE[distr] to translate a sentence with *each*.[91] Their responses are shown below.

(48) Stimulus sentence: *The teacher gave a book to each of the students in class*.

a. TEACHER GIVE<X,2h>[92] EACH STUDENT ONE[distr] BOOK ONE[distr][93] (P3)

b. t
TEACHER GIVE[distr] BOOK EACH ONE[distr][94] (P6)

In (48a), ONE[distr] occurs twice in the sentence, before and after the sign BOOK (a similar example is reported in Section 2.1.1.1 of the literature review). Doubling of different constituents is common in ASL, and its function is to emphasize or bring into focus the reduplicated element. Similarly, in (48b), ONE[distr] occurs at the end of the sentence, which is the position associated with focused items (Wilbur, 1997, 1999).

With regard to the expression of quantification, EACH and ONE[distr] contribute to the distributive reading of the sentence in (48a), and in (48b) it is additionally expressed by GIVE[distr]. Importantly though, the use of ONE[distr] in both sentences serves yet

[91] In addition, one of these participants used ONE[pl] and another participant used ONE[distr] to translate two different sentences with *every,*

[92] In angled brackets, 'X' stands for the handshape used, and '2h' indicates that the sign was produced with both hands.

[93] A detail not indicated in the gloss in (21a) concerns the number of repetitions in ONE[distr]: The first copy of the sign had two repetitions, and the second copy had four.

[94] In (48b), EACH occurs without the noun (STUDENT) but the referent is clear from the context of the discussion.

another function. It eliminates the potential ambiguity of the stimulus. One possible, although not the most natural, interpretation of the English sentence is that the teacher gave the same book to each of the students one after another, i.e. there was a single book involved in the process of giving. An alternative, and more likely, interpretation is that the teacher gave a different book (or a different copy of the same book) to each of the students. The ASL translations in (48) only allow the second interpretation.

To finish up my description of the sign, consider interpretations of the following examples reported by Kuhn (2017).

(49) a. BOY IX[pl]-a READ ONE[pl]-a BOOK
'The boys read one book each.'

b. ALL BOY LIFT {ONE[pl]/ONE[distr]} TABLE
'The boys each lifted a table.'

(adapted from Kuhn, 2017)

Notably while examples in (48) show ONE[distr] co-occuring with GIVE[distr] and/or EACH, these examples show that ONE[distr]/ONE[pl] can be the only marker of distributive quantification in a sentence.

4.3.2.3. INDIVIDUAL[distr]

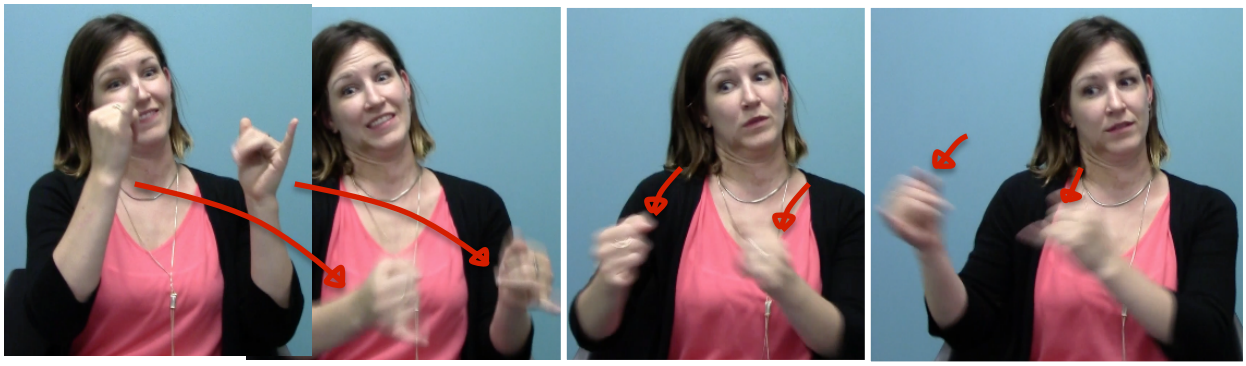
There is one more quantifier that was used by one participant to translate one of the sentences with *each*. It is the sign that I gloss as INDIVIDUAL[distr], shown in Figure 4.26. The base form of this sign—INDIVIDUAL—is produced with two hands in the I

handshape (a fist with the little finger extended) moving down in front of the signer's chest (Tennant & Brown, 1998, p. 239). It can be illustrated by the two stills on the left in Figure 4.26. The sign INDIVIDUAL belongs to a class of so-called *initialized signs* (Brentari & Padden, 2001; Frishberg & Gough, 2000, among others). That is, the handshape used in this sign is a fingerspelled equivalent of the initial letter of its English translation. Initialized signs are typically seen as examples of English influence on the ASL lexicon. I will return to the discussion of English-influenced quantificational expressions in Section 5.3 where I address the question of their place in the ASL lexicon.

In my data, the sign INDIVIDUAL shows distributive modulation, similar to what I described above for the quantifiers EACH[distr] and ONE[distr]. To produce the inflected variant INDIVIDUAL[distr], the signer repeated INDIVIDUAL in several locations along a horizontal arc. The two stills on the right in Figure 4.26 demonstrate two additional displaced repetitions of the sign.[95] As for nonmanual markers, note that raised eyebrows on the stills in the figure are not part of the sign. In the sentence that the illustrated sign is taken from, INDIVIDUAL[distr] appears in topic position which in ASL is marked with raised eyebrows. The signer accompanied the sign by mouthing *vi-dual*—a reduced form of the English word *individual*. Similarly to other signs described earlier, the mouthing is probably not a necessary component of the sign, but my data is too limited to provide solid support for this.

[95] The same sign produced with two repetitions is glossed as 'individual' on www.handspeak.com/word/.

Figure 4.26. INDIVIDUAL[distr]



The use of INDIVIDUAL[distr] is exemplified by the sentence in (50). Following the sign STUDENT, the signer points with her dominant index hand to the top of her non-dominant index hand held vertically, palm out (glossed as ONE). Similar examples of the dominant hand producing one or more signs at the non-dominant vertical index hand have been described by Liddell (2003). He termed such uses of the non-dominant index hand *theme buoy* (see more on buoys in Section 4.3.3.3). According to him, the presence of the theme buoy "signifies that an important discourse theme is being discussed" (p. 242). In (50), the discourse theme is supplied by the noun STUDENT. The sign INDIVIDUAL[distr] then expresses the idea that the predicate KNOW ANSWER applies to each individual in the set of students.

(50) Stimulus sentence: *Each of the students knows the answer*.

t
STUDENT IX-ndh INDIVIDUAL[distr] KNOW ANSWER
ndh: ONE

As mentioned above, INDIVIDUAL[distr] was used by a single participant, and she used it to translate one stimulus sentence only. Since it was such a rare occurrence in my data, it is impossible to say how common the use of this sign to express quantification is. While this sign expresses distributivity, it is not absolutely clear if it a universal quantifier. Furthermore, it may not be a D-quantifier (see Section 1.2.1.1) but rather an A-quantifier, namely, a distributive adverbial similar to English *individually*.

4.3.2.4. Non-distributive quantifiers: ALL and #ALL

In addition to distributive quantifiers described in Sections 4.3.2.1-4.3.2.3, four participants also translated the stimuli with *each* using the non-distributive quantifiers #ALL and/or ALL, described in Section 4.3.1.1. The meanings of these signs are likely not equivalent to that of *each*, yet their use is not surprising and is in line with their characterization as non-distributive (i.e. allowing both distributive and collective interpretations).

4.3.2.5. Summary of quantifiers by noun type

In parallel with Section 4.3.1.3 that describes what quantifiers are used with each target noun in the participants' translations for the stimuli with *all*, this section discusses the data on the use of quantifiers in the participants' translations for the stimuli with *each*. Table 4.15 below presents the data for concrete count nouns. Table 4.16 deals with the noun STORY, the only abstract count noun in the analyzed data.

Table 4.15. Quantifiers used to translate stimuli with 'each' quantifying over concrete count nouns

Concrete Count Noun	**Quantifier**	**Used by**		
		Participants	**# of participants (out of 8)**	
STUDENT (as subject)	EACH EACH[distr]	P3, P5, P6*, P8, P9 P5, P7, P8, P9, P10	5 5	**7**
	INDIVIDUAL[distr]	P4	1	**1**
	#ALL<lateral>	P6	1	**1**
STUDENT (as indirect object)	EACH EACH[distr]	P3, P4, P6, P8, P10 P5, P7*, P8, P9	5 5	**8**
	ONE[distr]**	P3, P6	1	**1**
	#ALL<lateral>	P6, P8	2	**2**
COOKIE	EACH EACH[distr]	P5, P6* P4, P9, P10	2 3	**5**
	#ALL<lateral> $\#ALL_{top}$	P6, P8 P8	2 1	**3**
	ALL	P5, P7	2	**2**

* P indicated it was less than fully acceptable and/or influenced by English.
** Co-occurred with EACH in the same sentence.

Table 4.16. Quantifiers used to translate stimuli with 'each' quantifying over the abstract count noun STORY

Abstract Count Noun	**Quantifier**	**Used by**		
		Participants	**# of participants (out of 8)**	
STORY	EACH EACH[distr]	P3, P4, P5, P6, P7, P9 P4, P5, P8, P10	6 4	**8**

Similarly to what was observed regarding translations for the stimuli with *all*, quantifiers were used by the participants to quantify all of the target nouns elicited by the stimuli with *each*. The participants used both distributive and non-distributive universal quantifiers in their responses.

Tables 4.15 and 4.16 show that all eight participants used some distributive quantifier with the nouns STUDENT (as a subject and as an indirect object) and STORY, and five participants used a distributive quantifier with the noun COOKIE. The most common distributive quantifier in the data is the lexically distributive EACH and its variant with overt distributive modulation EACH[distr]. Both variants occur with all of the target nouns. While some participants only used one of these variants in their responses, others provided responses with both variants. Across all nouns, for six participants there is no clear pattern as to which of the variants they preferred, and two participants (P3 and P6) consistently used lexically distributive EACH only. The data do not show any differences in the use of EACH and EACH[distr] with nouns that differ in their grammatical roles or animacy. Their use is also not affected by the concrete/abstract distinction of nouns.

There are two more distributive quantifiers reported in Table 4.15. One participant used the distributively modulated sign INDIVIDUAL[distr] to quantify the noun STUDENT in the syntactic role of subject, and two participants used the distributively marked numeral ONE[distr] with the noun STUDENT in the role of indirect object. However, ONE[distr] was never a single quantifier in their responses, it was used along with EACH in the same sentence.

Non-distributive universal quantifiers were used with all nouns in Table 4.15. The noun STUDENT was used with the quantifier #ALL by one participant when used as a subject and by two participants when used as an indirect object. For the noun COOKIE, three participants used #ALL and two participants used ALL. The fact that there are no instance of ALL or #ALL with the noun STORY in Table 4.16 should not be interpreted to

indicate that these quantifiers cannot be used with this noun. Both of these quantifiers occur with STORY in translations for the stimuli with *all* (see Section 4.3.1.3) and *every* (see Section 4.3.3.4).

4.3.3. Quantifiers used to translate stimuli with 'every'

4.3.3.1. EACH and EACH(^)ONE

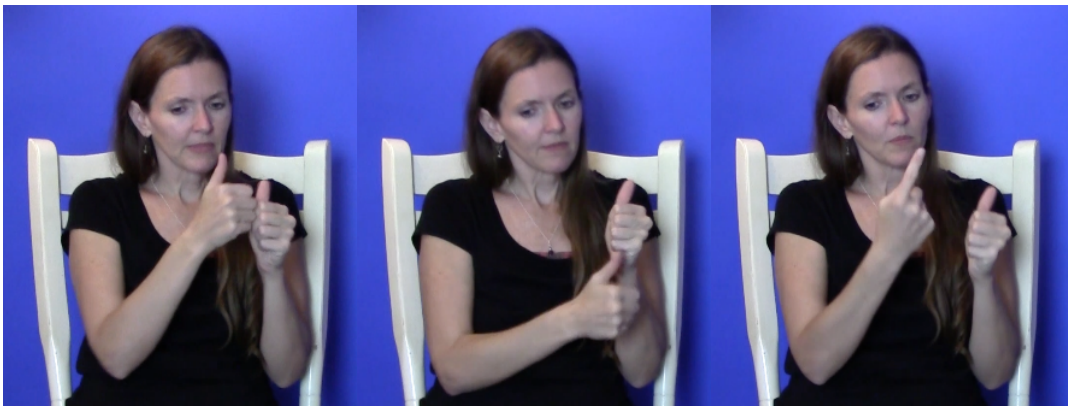
As pointed out at the beginning of the previous section, ASL dictionaries such as Valli (2005), www.handspeak.com/word/, and www.lifeprint.com list the sign glossed above as EACH (illustrated in Figure 4.21) as an equivalent for both *each* and *every*. Some resources, however, distinguish between EACH and EACH+ (produced with a double movement), listing the former as an equivalent of *each* and the latter as an equivalent of *every*. Such a distinction is made, for example, in *The American Sign Language Handshape Dictionary* (Tennant & Brown, 1998). The same distinction is also noted in the online dictionary on www.lifeprint.com, but it is offered there as a personal preference of the author of the dictionary and variation across signers in the number of movements used for both *each* and *every* is acknowledged. As I have already mentioned in the section above, none of my participants used EACH+ to translated the stimuli with *every*. This suggests that the double movement of EACH+ is not universally recognized across ASL signers as being associated with the meaning of *every*.

Corroborating the information in the ASL dictionaries I consulted, five out of eight participants used the sign EACH in their translations of the stimuli with *every* (the data on the use of quantifiers is summarized in Tables 4.17 and 4.18). The distributively marked

variant EACH[distr] was also used by five participants. As in the data described in the previous section, those signers who used EACH[distr] appear to see it as a more emphatic alternative to EACH. The form and syntactic properties of EACH are described above in Section 4.3.2.1.

The major difference between participants' translations for the stimuli with *every* from their translations for the stimuli with *each*, was the use of EACH followed by the numeral ONE (a fist with the index finger extended and pointing up, the palm facing towards the signer), demonstrated by a sequence of stills from my data in Figure 4.27.

Figure 4.27. EACH(^)ONE



The combination of these two signs produced as a single unit is listed as a separate lexical item under the gloss 'everyone' on www.handspeak.com/word/. As such, it may be analyzed as a compound sign. The morphological process of compounding appears to be quite common in ASL and has been described, for example, by Klima & Bellugi (1979) and Liddell & Johnson (1986). Klima & Bellugi showed that, in the process of lexicalization,

compound signs undergo various formational changes that lead to the reduction of their duration in comparison to the duration of two separate signs from which they are formed. Such changes may affect the movement component of the first and/or second element of the compound and shortening and smoothing of the transitional movement.[96] The sign for 'everyone' demonstrated on www.handspeak.com/word/ is produced within a single smooth down-up movement of the dominant hand. This movement appears to differ, albeit slightly, from a simple combination of downward movement of EACH and upward transitions into ONE, the main difference being the fluidity of the transitional movement. As a result, the duration of this sign as shown on www.handspeak.com/word/ appears to be shorter than that of two separate signs. Following the glossing conventions listed in Appendix A, I gloss this compound sign as EACH^ONE.

Turning to my data, four participants produced a total of six instances of the sequences of EACH + ONE. For most of those instances, it was hard to determine whether they were compound signs (EACH^ONE) or two separate signs (EACH ONE). Transitions between signs reduce in fast signing making it hard to apply the distinguishing criteria mentioned above, namely, the fluidity of the transitional movement or the overall duration of the sequence. The distinction between the two cases was not absolutely clear in my data and therefore, in what follows, I list all instances of the sequence under a gloss EACH(^)ONE. In fact, my data suggests that there may exist a continuum between more

[96] Another formational change that Klima & Bellugi describe affects compounds in which the first element is one-handed and the second element is two-handed. In such cases, the base hand that is involved in the production of the second element moves into its position earlier, at the beginning of the compound sign. This change, however, is not relevant for the present discussion, since the second element in the discussed compound, ONE, is a one-handed sign.

and less lexicalized forms of the compound.[97] Future work based on a larger data set is needed to determine if EACH ONE and EACH^ONE differ in their meaning and/or use, and whether the two cases need to be distinguished.

With regard to its syntactic distribution, in my data EACH(^)ONE directly preceded the quantified noun phrase in three out of six instances of its occurrence. This case is exemplified by the sentence in (51a). In the other three instances, the quantified noun phrase occurred at the beginning of a sentence in a topic position, while EACH(^)ONE occurred in the non-topicalized part of the sentence. Examples (51b) and (52) illustrate the point.

(51) Stimulus sentence: *Every one of the students knows the answer*.

a. EACH(^)ONE STUDENT KNOW ANSWER (P5)

t
b. STUDENT IX[pl] EACH(^)ONE KNOW ANSWER (P6)

(52) Stimulus sentence: *Bob remembers every one of the stories*.

t
STORY IX[pl]-a B-O-B REMEMBER EACH(^)ONE IX[pl]-a (P6)
ndh: SEVERAL-LIST-a

Interestingly, two out of three sentence with prenominal EACH(^)ONE were judged as less than fully acceptable by the participants who produced them. This limited evidence is by no means conclusive, but it suggests that EACH^ONE may be dispreferred in a prenominal

[97] The notion of a continuum from free syntactic expressions to fully lexicalized compounds is frequently used in studies on language change; see, e.g. Brinton and Traugott (2005) for discussion.

position and should thus be analyzed as a pronoun rather than a determiner (this is also implied in the choice of the gloss 'everyone' on www.handspeak.com/word/). This is another question that I hope future work will address.

In addition to the sequence EACH(^)ONE, the numeral ONE was also used by two participants in its inflected forms ONE[distr] and ONE[pl]. These forms have already been described in Section 4.3.2.2 where I presented the data on the participants' translations of the sentences with *each*. In my data for sentences with *every*, ONE[distr] and ONE[pl] were each used by one participant. The relevant sentences are given in (53).

(53) a. Stimulus sentence: *Every one of the students knows the answer*.

t
STUDENT IX[pl] EACH ONE[distr] KNOW ANSWER (P10)

b. Stimulus sentence: *The teacher gave a book to every one of the students in class*.

t t t
TEACHER STUDENT IX[pl] BOOK GIVE<X>[mult][98] #ALL<lateral>

GIVE<X>[mult] ONE[pl] (P6)

Neither ONE[distr] nor ONE[pl] was used as a sole indicator of quantification in any sentences in my data (but recall example (49) from Kuhn, in review, discussed earlier that indicates that it can be used as such). In (53a), ONE[distr] occurs along with the quantifier EACH. In (53b), there are two other signs that contribute to the expression of quantification in addition to ONE[pl]: the verb GIVE<X>[mult], which shows inflection for multiple

[98] In 'X' in angled brackets stands for the handshape used, and 'mult' in square brackets shows that the verb has multiple marking (discussed in Section 2.1.2.1).

aspect, and the quantifier #ALL<lateral>. Notably though, both GIVE<X>[mult] and #ALL<lateral> are compatible with either a collective or distributive interpretation of the sentence in (53b); the collective interpretation being that the students as a group received a single book, and the distributive interpretation being that each of the students received their own book. In contrast, ONE[pl] marks distributive quantification, and it is incompatible with collective interpretation. As such it is solely responsible for ruling out the collective reading of the ASL sentence.

4.3.3.2. Non-distributive quantifiers: ALL and #ALL

In addition to the distributive quantifiers described above, some participants translated sentences with *every* with non-distributive universal quantifiers ALL and #ALL (described in detail in Section 4.3.1.1). The reader may recall from Section 4.3.2.4 that these quantifiers were also used to translate the sentences with *each*. As I explained earlier, such use of ALL and #ALL is not surprising because the situations described by the elicitation sentences with *each* in my study were compatible with both collective and distributive readings. The same holds true for the sentences with *every*. For instance, the sentence *Every one of the students knows the answer* is a truthful description of the fact that each individual student knows the answer and that all students collectively know that answer.

4.3.3.3. #ALL directed at SEVERAL-LIST

One of the participants used a construction involving #ALL that has not been observed in the data reported in the previous sections. Consider the sentence in (54). At the end of the sentence, the participant simultaneously produced the sign #ALL with her

dominant hand and the sign that I gloss here as SEVERAL-LIST with her non-dominant hand. The stills in Figure 4.28 illustrate the relevant fragment of the sentence. The meaning of each of the two signs as well as their location in the signing space relative to each other contribute to the overall meaning of the resulting construction. To show how this is done, I will first describe the sign SEVERAL-LIST.

(54) Stimulus sentence: *Bob remembers every one of the stories*.

EACH[distr] STORY IX[pl]-a TRUE^WORK REMEMBER #ALL-a[99]
ndh: SEVERAL-LIST-a SEVERAL-LIST-a

Figure 4.28. #ALL (right hand) directed at SEVERAL-LIST (left hand)

[99] This sentence was provided by the participant as the last of three possible translations she offered for the given stimulus sentence. This explains the missing subject (Bob): This information was assumed by the participant to be shared knowledge between her and the interviewer, and therefore she omitted it from her translation.

The sign glossed as TRUE^WORK is added for emphasis. According to Baker-Shenk & Cokely (1991b, p. 111), its meaning can be translated as one of the following: 'really mean it, (I'm) serious about it, (I) mean what (I) say, (I'm) not joking; it's really important.'

SEVERAL-LIST belongs to a class of signs in ASL that are commonly referred to as *list buoys*, following the work of Liddell (2003). The term *buoy* was coined by Liddell to refer to signs that are produced with a non-dominant hand and held while the signer produces other signs with her dominant hand. "Semantically they help guide the discourse by serving as conceptual landmarks as the discourse continues" (p. 223).

List buoys are a very common type of buoy in ASL and other sign languages (see, for example, Liddell at al. (2007) on American, Norwegian and Swedish Sign Languages; and Johnston & Schembri (2007) on Australian Sign Language). Liddell at al. (2007) point out that although list buoys share handshapes with the numerals ONE, TWO, THREE, FOUR, and FIVE (e.g., the SEVERAL-LIST buoys in 54) has the same handshape as the numeral FIVE), there are a number of formational, grammatical, and semantic differences between these two classes of signs. What is most important for us here is that, unlike numerals that "express numerical values," list buoys "express the existence of a list of a certain length" (Liddell et al., 2007, p. 191).

In an earlier work, Liddell (2003) describes five list buoys that ASL signers use "for making associations with from one to five entities" (p. 223), namely ONE-LIST, TWO-LIST, THREE-LIST, FOUR-LIST and FIVE-LIST. In the examples he gives, the signer first makes associations with a particular entity and a digit (extended finger or thumb) "by contacting the tip of the appropriate digit and describing the entity associated with it" [ibid., 224]. The signer may then refer to the entity by touching or pointing towards the corresponding digit. In addition, the signer may direct other signs towards the digit(s) or manipulate the buoy.

The list buoy SEVERAL-LIST in Figure 4.28 is identical in form to the FIVE-LIST buoy described in Liddell (2003). Notably though, while the latter expresses the existence of a list of exactly five items, SEVERAL-LIST in (54) expresses a list of unspecified length with several items on it, which is indicated by the gloss I chose for this sign.[100] When using FIVE-LIST a signer makes associations between particular entities and the digits of the buoy by touching each of the digits and describing the corresponding entity. In the case of SEVERAL-LIST, however, individual digits of the buoy do not receive separate assignments and thus are used to represent a list of unspecified length. It appears to me that SEVERAL-LIST introduces a list of several but no fewer than five items, but it is yet to be tested if there are any restrictions on the number of items associated with this buoy and what they are.

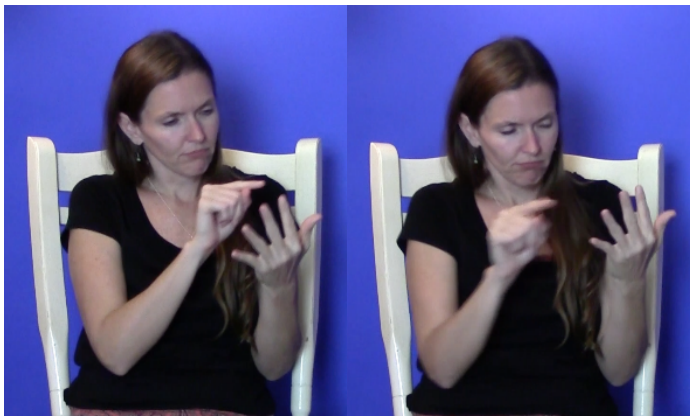
Turning to the sign #ALL that the signer produces with her right hand in Figure 4.28, its movement traces a path along the tips of the extended digits of SEVERAL-LIST. Using the terminology of Liddell (2003), #ALL is *directed* towards SEVERAL-LIST. The resulting meaning of this combination of the two signs is 'all of the items on a list of several.'

One may wonder what makes it clear that in (54) the signer refers to a list of stories, rather than a list of some other items. Consider the first occurrence of SEVERAL-LIST in the sentence. Here, the signer produced the buoy with the pointing plural sign IX[pl] directed to it (shown in Figure 4.29 below). This construction directly follows the sign

[100] Liddell at al. (2007) offer another example of a list buoy of unspecified length from Norwegian Sign Language, which they gloss as MANY-LIST.

STORY marking the noun as plural and introducing the concept of individual stories forming a list of some length. The signer then drops the buoy to produce the two-handed signs TRUE^WORK and REMEMBER. She then brings SEVERAL-LIST back while at the same time directing #ALL at it. The two occurrences of SEVERAL-LIST are produced in the same location (marked by identical indexes on the glosses), thus indicating that the same list of items is being referred to, namely a list of the stories. #ALL is then used by the signer to express universal quantification over the entities on this list.

Figure 4.29. IX[pl] (right hand) directed at SEVERAL-LIST (left hand)



One last detail remains to be pointed out regarding the sentence in (54). There are two universal D-quantifiers used in this sentence—EACH[distr] and #ALL. Interestingly, this is very similar to the examples of doubling briefly discussed in the previous section (see example (48a) above). In doubling, a particular constituent is repeated at the end of the sentence, thus emphasizing or bringing into focus the repeated constituent. Although EACH[distr] and #ALL in (54) are two different signs, their syntactic distribution and

pragmatic effect of their co-occurrence are similar to those of doubling. #ALL occurs at the end of the sentence and its function appears to be emphasizing the universal quantificational interpretation of EACH[distr].

4.3.3.4. Summary of quantifiers by noun type

The data on quantifiers that were used by the participants to express quantification over each of the elicited nouns is summarized in Tables 4.17 and 4.18 below.

Table 4.17. Quantifiers used to translate stimuli with 'every' quantifying over concrete count nouns

Concrete Count Noun	**Quantifier(s)**	**Used by**		
		Participants	**# of participants (out of 8)**	
STUDENT (as subject)	EACH EACH[distr] EACH(^)ONE	P5, P8, P10 P3, P4, P5, P9 P3*, P5*, P6	3 4 3	**7**
	ONE[distr]**	P10	1	**1**
	#ALL<lateral>	P5, P6, P7	3	**3**
STUDENT (as indirect object)	EACH EACH[distr] EACH(^)ONE	P4, P5, P8, P9 P8 P5	4 1 1	**4**
	ONE[pl]***	P6	1	**1**
	#ALL<outward> #ALL<lateral>	P3 P6, P8	1 2	**3**
COOKIE	EACH EACH[distr] EACH(^)ONE	P9 P4 P9	1 1 1	**2**
	#ALL<lateral>	P3, P7, P8	3	**6**
	ALL	P4, P5, P6, P7	4	

* P indicated it was less than fully acceptable and/or influenced by English.
** Co-occurred with EACH in the same sentence.
*** Co-occurred with #ALL<lateral> in the same sentence

Table 4.18. Quantifiers used to translate stimuli with 'every' quantifying over the abstract count noun STORY

Abstract Count Noun	**Quantifier(s)**	**Used by**		
		Participants	**# of participants (out of 8)**	
STORY	EACH EACH[distr] EACH(^)ONE	P10 P4, P8, P9, P6 P6	1 4 1	**5**
	#ALL<outward> #ALL<lateral> #ALL directed at SEVERAL-LIST	P3, P6, P7 P7 P6	3 1 1	**4**
	ALL	P5	1	

Overall, all four elicited nouns are quantified by means of both distributive and non-distributive universal quantifiers. Additionally, two participants used the inflected numeral ONE[distr]/ONE[pl], which also expresses distributive quantification.

More specifically, as seen from Tables 4.17 and 4.18, each of the target nouns was used with all of the following distributive quantifiers: lexically distributive EACH, its variant with overt distributive modulation EACH[distr], and the purported compound EACH(^)ONE. Seven out of eight participants used one or more of these quantifiers for the noun STUDENT as a subject. Four participants used them for the noun STUDENT as an indirect object. Two participants used them for the noun COOKIE, and five participants used these quantifiers for the noun STORY.

As mentioned above, distributive quantification was also expressed by the use of the inflected numeral ONE[distr]/ONE[pl]. One participant used ONE[distr] along with EACH in her translation for the sentence with STUDENT as a subject. Another participant

used ONE[pl] in the same sentence with #ALL in her translation for the sentence with STUDENT as an indirect object.

Instead of, or as an alternative to using a distributive quantifier, some participants used non-distributive #ALL and ALL. For each of the four target nouns, three participants (but not always the same three people) used a variant of #ALL. Furthermore, one participant produced #ALL directed at the list buoy SEVERAL-LIST to quantify the noun STORY. As for the sign ALL, four participants used it to quantify the noun COOKIE, and one participant used it for the noun STORY.

The data do not show any differences in the use of quantifiers that can be attributed to the difference in grammatical roles of the quantified nouns or to the animate/inanimate or concrete/abstract distinctions. Interestingly though, the data indicate preference towards the use non-distributive universal quantifiers for the noun COOKIE: six participants used #ALL or ALL versus only two participants used a distributive quantifier.

This concludes the description of lexical quantifiers that the participants used to translate universal quantifiers *all, each,* and *every*. In the next chapter, I discuss some of the described data and suggest factors that appear to play a role in the expression of universal quantification in ASL. To provide an additional dimension to my data analysis, I consider possible historical sources of ASL universal quantifiers and discuss quantifiers that contain handshapes from the ASL fingerspelled alphabet in terms of how they fit into the model of ASL lexicon proposed by Brentari and Padden (2001).

Chapter 5: Distributivity, Diachrony, and Nativization of ASL's Lexical Universal Quantifiers

5.1. THE PARAMETER OF DISTRIBUTIVITY

In the beginning of Section 4.3, I noted that, similarly to other languages, ASL universal quantifiers differ with respect to distributivity. Following D. Gil (1995), in my data I distinguished non-distributive (allowing either collective or distributive interpretations) and distributive (forcing distributive interpretations) quantifiers.[101] Focusing on universal quantifiers proper, in what follows I discuss further evidence for classifying ALL and #ALL as non-distributive and EACH as distributive.

To confirm my classification, I interviewed a deaf native signer consultant (as described in Section 3.6). I collected acceptability judgments from her on ASL sentences with the quantifiers ALL, #ALL, and EACH presented in contexts that favor either a collective or a distributive interpretation. I will refer to these contexts as collective and distributive correspondingly. The consultant's task was to judge sentences as 'fully acceptable', 'less than fully acceptable', or 'unacceptable.'

Examples of elicitation materials are given in Table 5.1 (for a complete list, see Appendix C). Without any context, the predicate BUILD RAFT is compatible with either a collective or a distributive interpretation. That is, one raft can be build collectively by a group of students; alternatively, several rafts can be built, each made by a student

[101] Based on several semantic, morphological, and morphosyntactic properties of the two types of quantifiers, as well as their distribution across languages, Gil (1995) further argues that distributive quantifiers are "more highly marked than their simple, non-distributive counterparts" (p. 322). However, the data collected for this study do not allow for the evaluation of ASL universal quantifiers with respect to markedness. Future work investigating details of their semantic and morphosyntactic behavior is needed to determine if universal quantifiers in ASL align with Gil's claim.

individually. In the collective or the distributive context, as shown in the table, only one interpretation is possible, and the quantifier has to be compatible with the interpretation favored by the context.

Table 5.1. Examples of elicitation materials used to test acceptability of universal quantifiers ALL, #ALL, and EACH in contexts favoring a collective or a distributive reading

Contextual information	**Elicitation sentences**
Collective context: Students in Mr. Smith's class were competing against students in Ms. Brown's class in a raft race. Whichever **class** won would get a trophy. The students in Mr. Smith's class were very engaged. Distributive context: Students in Mr. Smith's class were competing against each other in a raft race. Whichever **student** won would get a trophy. The students were eager to participate in the race.	• ALL STUDENT BUILD RAFT[102] • #ALL STUDENT BUILD RAFT • EACH STUDENT BUILD RAFT

The consultant judged sentences with #ALL and ALL as fully acceptable in collective contexts. In distributive contexts, she judged them as either fully or less than fully acceptable, but crucially not unacceptable. In cases when she judged a sentence with #ALL or ALL as less than fully acceptable in a distributive context, she explained that the

[102] These sentences are adapted from Link (1983).

sentence was “not clear”, that is it did not allow to differentiate between the two contexts (unlike the sentence with EACH), but it was not ‘wrong’. I take these data to support the classification of ALL and #ALL as non-distributive quantifiers. The consultant’s judgments did not differ for ALL and #ALL. With respect to sentences with EACH, she judged them as fully acceptable in distributive contexts and unacceptable in collective contexts, which supports the classification of EACH as a distributive quantifier.

In their overview of quantification in ASL, Abner and Wilbur (2017) mention the same set of three universal quantifiers and argue that “both #ALL and EACH may have distributive interpretations, but [ALL] is stubbornly collective in its universal interpretation” (p. 43). As evidence for ALL not allowing distributive interpretations, they cite its incompatibility with the predicate meaning ‘have long hair,’ as demonstrated in (55). The idea is that this predicate does not allow the collective reading, namely, that the girls as a group have long hair without each having long hair, and it is therefore a so-called “stubbornly distributive” predicate (Schwarzschild, 2009).

(55) #ALL / *ALL / EACH IX[pl]-a GIRL-a HAIR LONG-HAIR

‘All the girls have long hair.’

(adapted from Abner & Wilbur, 2017, p. 43)

Notably, the results of the acceptability judgments task that I described above disagree with Abner and Wilbur’s claim that ALL only allows collective interpretations, as my consultant

allowed sentences with ALL in distributive contexts.[103] A further piece of counterevidence to Abner and Wilbur's claim comes from my translation data (taken from the data that was not included in the description in Chapter 4 and which I analyzed specifically to address this question). As demonstrated in (56), my participants used ALL with the predicate SLEEP. In fact, six out of eight participants used ALL or accepted its use to translate the stimulus sentence in this example. Similarly to LONG-HAIR in (55), SLEEP can be characterized as "stubbornly distributive" because it does not allow a collective reading that the dogs sleep as a group without each dog being asleep. These data, thus, confirms that a distributive interpretation for ALL is possible, at least for some participants.

(56) Stimulus sentence: *All of the dogs are sleeping*.

a. ALL #DOGS SLEEP (P8)

b. $\underline{\qquad\qquad t}$
DOG IX[pl] ALL SLEEP (P10)

Together with the evidence presented by Abner and Wilbur, this suggests that there may be variation across signers as to whether ALL allows distributive interpretations. Having said that, I will continue to refer to ALL as a non-distributive for the discussion of my data.

[103] Interestingly, D. Gil's (1995) cross-linguistic study of universal quantifiers in a number of spoken languages (reported in Section 1.2.1.2) does not mention any quantifiers that only allow collective interpretations. If such quantifiers exist, they are likely rare.

5.1.1. Non-distributive universal quantifiers

So far I have discussed non-distributive quantifiers ALL and #ALL in terms of their form, their variants (for #ALL), and the nouns that they were used to quantify over. I also noted that the two signs differ in terms of their status in the ASL lexicon. Using Brentari and Padden's (2001) model of the ASL lexicon (to be discussed below in Section 5.3.1), ALL belongs to the "core" of the native ASL lexicon, whereas #ALL is part of the non-native (foreign) lexicon, by virtue of being a loan sign originating from a fingerspelled English word. Indeed, ALL may be the older of the two signs. Materials from the Historical Sign Language Database (http://hsldb.georgetown.edu) show multiple examples of ALL but no examples of #ALL: ALL is described in the three ASL dictionaries from the early twentieth century included in the database (Higgins, 1923; Long, 1918; Michaels, 1923) and there are 32 examples of this sign[104] occurring in ten films from a collection of films created at the beginning of the last century by the National Association of the Deaf (Cloud, 1913; Dougherty, 1913; Erd, 1913; Fay, 1913; Fox, 1915; Gallaudet, 1910; Hotchkiss, 1913; Hubbard, 1913; McGregor, 1913; Veditz, 1913). The films were recorded in an effort to preserve early ASL by recording master signers of the time.

Since modern ASL has two non-distributive universal quantifiers, an interesting question is what the differences between them may be. The main conclusion to be drawn from the data reported in Section 4.3 is that #ALL takes much more advantage of the spatial resources of ASL than ALL. Recall that ALL is a two-handed sign in which the movement of the dominant hand is lexically specified (a vertically-oriented circle in front

[104] As I describe below in Section 5.2.1, ALL occurs in the database in two similar forms.

of the signer's chest) and the non-dominant hand is specified for being stationary. It therefore cannot undergo spatial modification the way #ALL can. Battison (1977) makes a similar observation and proposes that this may explain why #ALL was borrowed into ASL.

In my data, ALL does not show any spatial modification. However, the following example taken from *ASL Online 2* (an online resource for students of ASL developed at the University of Texas at Austin; http://www.laits.utexas.edu/aslonline2/) shows that ALL can be spatially displaced. That is, it can be produced in a location other than its default location in front of the signer's chest.

(57) Context: *There is a sale at the store. I go in, look around.*

t
CHAIR ROCKING IX[pl]-rt ALL-rt BLUE-rt, IX[pl]-lf ALL-lf RED-lf

'As for the rocking chairs, all of those (on the right) are blue and all of those (on the left) are red.'

Of the two instances of ALL, the first is produced on the right side of the signing space, co-located with the plural pointing sign IX[pl] and BLUE, and the second is produced on the left side, co-located with IX[pl] and RED. This example shows that, when spatially displaced, ALL is produced in the location in the signing space associated with the quantified referent thus marking the domain of the quantifier.[105] This location may correspond topographically to the location of the referent in the real space described (i.e.

[105] Padden (1990) observes that adjectives, plain verbs and nouns can be signed in spatial locations associated with their arguments. She analyzes these forms as containing pronoun clitics.

blue chairs are on the right, red chairs on the left). Alternatively, it may be arbitrarily chosen by a signer and assigned to the referent for referential purposes.

As described earlier, #ALL—in particular its variants that I collectively glossed as $\#ALL_{top}$—similarly demonstrates topographic use of space. Notably though, the topographic information encoded in those forms can be much more nuanced than that of the spatially displaced ALL. While ALL only indicates the general location of the quantified referent in the signing space, the form of $\#ALL_{top}$ may also supply information about geometric properties of the referent. It does so by modifying the sign's movement path and hand orientation. Recall, for example, that one participant produced a variant of $\#ALL_{top}$ quantifying over the noun COOKIE, with the movement path being a straight line (Figure 4.18a), thus indicating that the cookies were distributed in rows. Another participant suggested two variants of $\#ALL_{top}$ with the palm of her hand facing either up (Figure 4.18b) or down (Figure 4.18c), both of which show that the cookies are distributed on a horizontal surface. Yet another participant commented that if the cookies were in a jar rather than on a tray, she would use the variant of #ALL with a direct downward movement (#ALL-dn). This is the same variant that was used by another participant to quantify over the noun WATER (Figure 4.19).

It is not only topographic information that can be encoded by means of spatial modifications of #ALL. For example, in Section 4.3.3.3, I have described how #ALL can be signed along the tips of the extended digits of the signer's hand—the SEVERAL-LIST buoy—thus expressing quantification over a list of several items (either abstract or

concrete). Similarly, other researchers have noted that #ALL can be signed along a vertical axis to indicate all items on the list (Abner & Wilbur, 2017; Battison, 1977).

As can be seen from the above discussion, #ALL can be modified spatially to indicate the referent that it quantifies over including its geometric or abstract structural properties. #ALL thus demonstrates indexical/deictic properties like those of ASL pointing signs which are "indexic[al] not only in meaning, but also in form" (Cormier, 2002, p. 5). Here I am referring to Peirce's (1932) notion of 'index', and I am using the word 'indexical' to mean that #ALL points to locations associated with what it quantifies over thus expressing quantifier domain restriction. These properties may explain some of the patterns in the use of #ALL that were observed in the data. As shown in Table 4.2, the variant #ALL<lateral> was used by seven out of eight participants for STUDENT in the role of the subject and by all participants for STUDENT in the role of an indirect object. The image accompanying the stimulus sentences eliciting STUDENT in subject position shows a classroom with students sitting in rows. Similarly, the image for the sentence with STUDENT as an indirect object shows a teacher and a few students sitting in front of her. Abstracting away from the exact details of the location and arrangement of the students, the students as a group are, in both situations, conceptualized by the signer as being distributed in space in front of the speaker/signer. The path of movement in #ALL<lateral> matches this distribution best.

That being said, some uses of such variants as #ALL<outward> and #ALL<lateral> in the data are not fully indexical. For instance, one participant used #ALL<outward> to quantify over the noun STUDENT and another one used it for the noun MONEY. The path

of the movement of the quantifier in these cases does not match the location distribution of the referents. Similarly, three participants used #ALL<lateral> to quantify over the noun STORY even though they did not assign the referent to any location in space. These data show that, at least for some signers, #ALL<outward> and #ALL<lateral> allow uses where the form of #ALL is lexically specified (see Cormier, 2002, for a similar claim regarding ASL plural pronouns; also discussed in Section 5.3.3 below).

5.1.2. Distributive universal quantifiers

As demonstrated by the data described in Sections 4.3.2 and 4.3.3, distributive quantification in ASL can be expressed by means of a lexical quantifier that I gloss here as EACH (Figure 4.21). This sign was used by all of the participants in at least some of their responses to the stimuli with *each* and *every*. Three out of eight participants also used a variant of this sign with repeated movement of the dominant hand (glossed as EACH+). As discussed in Section 4.3.2.1, while some resources, such as Tennant & Brown (1998) and www.lifeprint.com, suggest that the difference between the number of movements corresponds to the distinction between *each* and *every*, my data reveal no connection between the number of movements in the variant of the sign produced and the meanings conveyed. Furthermore, EACH is often produced with distributive modification in the form of spatial reduplication – repetitions of the sign in several locations in space – glossed above as EACH[distr] (shown in Figure 4.22). The data show no difference in the interpretation of EACH and EACH[distr].

Materials available from the Historical Sign Language Database (http://hsldb.georgetown.edu) suggest that EACH[distr] may be the older form of the sign. The database has four tokens of EACH[distr] (glossed as either EACH or EVERY in the database) taken from the following sources: two ASL dictionaries (Higgins, 1923; Long, 1918) and three videos (Cloud, 1913; Draper, 1915; Hotchkiss, 1913). Interestingly, there are no tokens of EACH without spatial modulation in the database.[106] A possible explanation for this is that EACH+ and EACH may be more recent variants of the sign and they are derived from EACH[distr]. The driving force that would explain their emergence is phonological and morphological reduction. As a result, EACH+ has no spatial displacement and the number of repetitions is typically two (in comparison to two or more repetitions in EACH[distr]), and EACH shows neither spatial displacement nor reduplication.

Additional support for the suggested historical change from EACH[distr] to EACH+ and EACH comes from Shaw and Delaporte (2010). They argue for a similar path of development for the ASL sign ANY. They show that, in the beginning of the twentieth century, ANY was produced with a dominant hand in the A-dot/Open-A handshape (a closed fist with the thumb extended) moving in shaking motion from one side of the signing space to another (Higgins, 1923; Long, 1918), whereas in contemporary in ASL, ANY is signed with a single rotation of the wrist.

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[106] Additionally, all of the tokens of EACH in the database are produced with the dominant hand brushing against the back of the thumb of the non–dominant hand, rather than against the intermediate phalanges, as in variants of EACH in my data (shown in Figure 4.21). As I noted in Section 4.3.2.1, the variants of EACH that differ in the point of contact between the two hands are probably in free variation across ASL signers. Alternatively, there may be regional variation in the use of these variants.

If the account suggesting that EACH is historically derived from EACH[distr] through the process of phonological reduction is correct, how would we explain that EACH[distr] is almost as common as EACH in my data? Would we not expect that the shorter EACH would replace EACH[distr] due to economy of effort? What we observe in the data, however, is that seven out of eight participants used both EACH and EACH[distr]. One possible explanation for this is that iconicity of the spatially distributive form works against the effect of the proposed historic change. That is, signers may choose to use EACH[distr] because it makes the relationships between the from and the distributive component of the meaning of the sign transparent. As noted earlier, this is how I interpret participants comments saying that EACH[distr] is more "emphatic" than EACH.[107]

We can further account for the fact that EACH+ was less common in the data than EACH or EACH[distr]; only three participants use this variant. EACH+ cannot make as much use of spatial recourses of ASL as EACH[distr]. At the same time, if we consider economy of effort, EACH+ is more effortful than EACH.

5.2. Diachronic Sources of ASL Universal Quantifiers

My goal in this section is to explore possible diachronic sources of ASL universal quantifiers and to compare them to sources of similar quantifiers in spoken languages. For the information on spoken languages, I draw from Haspelmath (1995) who considers sources of equivalents of English *all* and *every* in number of languages (mostly Indo-European). In making this cross-linguistic comparison, however, I will not address

[107] A possible explanation for why ANY, unlike EACH, did not retain its spatial reduplication may have to do with its indefinite effect.

how ASL compares to other signed languages. Research on quantification in sign languages is scarce, and, as far as I know, quantifiers in other signed languages have not been investigated in terms of their origin.

In my discussion of non-distributive universal quantifiers above, I have made a distinction between native and non-native lexical items. I noted that #ALL is a lexicalized loan sign that entered ASL lexicon as a fingerspelled English word. Spoken languages of literate cultures may also borrow from their writing systems (Kowalsky & Meier, 2013), however, to my knowledge, such examples are limited to acronyms and abbreviations (e.g., English *laser, AIDS, NFL, MP3*). Deriving a quantifier from a written version of a spoken language word is likely a word formation process unique to signed languages of literate cultures and the contact between signed and spoken languages. At present, I am not aware of any other signed language that has quantifiers that are fingerspelled loan signs but, as mentioned above, the available data on quantification in other signed languages is limited.[108]

Turning to the quantifiers ALL and EACH, I will show below that both these signs can be traced back to old French Sign Language (LSF). The influence of old LSF on the ASL vocabulary has to do with the historical fact that the first teacher at the American School for the Deaf in Hartford, Connecticut (the first school for the deaf in America) was a French man named Laurent Clerc. He brought old LSF with him when he came to

[108] Interestingly, fingerspelled function words like prepositions and conjunctions have been attested in such unrelated languages as ASL and British Sign Language (Brentari, 2001, and references therein).

America in 1817 and he used it when teaching. It has been shown that many signs in the ASL lexicon are historically related to old LSF (Woodward, 1978).

5.2.1. Source of ALL

Review of ASL materials in the Historical Sign Language Database (http://hsldb.georgetown.edu) shows that in the beginning of the twentieth century ALL existed in two similar forms.[109] The following quotation from Long (1918) describes these forms:

> "Bring the hands out easily, and after touching them at the forefingers, bring them around in a circle as if to include the whole. Commonly the left hand is at rest, held at a slight angle, and the right hand alone describes the circle coming to rest in the palm of the left hand."

Importantly, the form of the sign in the first sentence of this description is identical to an old LSF sign glossed as *TOUS/TOUT/ENTIER* ('everything/all/whole') in Lambert (1865).[110] Taking into account the historic connection between LSF and ASL, the above evidence suggests that the old LSF sign ALL was a lexical item that was maintained throughout the early development of ASL. The form referred to in the second sentence of Long's description is the same as the modern ALL used by my participants (shown in Figure 4.11). Long's description suggests that the first form is original and the second is derived from it. Indeed it seems plausible that over time the old LSF sign ALL underwent phonological reduction such that, instead of two hands moving in sync, only the dominant

[109] The materials that include the ALL in the database are the following: early ASL dictionaries (Higgins, 1923; Long, 1918; Michaels, 1923) and films (Cloud, 1913, 1913; Dougherty, 1913; Erd, 1913; Fay, 1913; Fox, 1915; Gallaudet, 1910; Hotchkiss, 1913; Hubbard, 1913; McGregor, 1913; Veditz, 1913).

[110] Available in an electronic form at http://hsldb.georgetown.edu/projects/sl-france/author.php?author=lambert1865.

hand movement was preserved and the movement of the non-dominant hand was lost. This change brought about the second form of ALL, which is the one used in modern ASL.

Let us further consider the meaning of ALL. In discussing my data in the previous sections, I was focused on the sign ALL in its abstract quantificational meaning. Note, however, that both contemporary ASL dictionaries (e.g., Valli, 2005; www.handspeak.com/word/; www.lifeprint.com) and old ASL dictionaries (e.g., Higgins, 1923) list another more concrete meaning of the sign, namely 'whole.' As seen above, this meaning is also part of the denotation of its source LSF sign. I suggest that 'whole' is likely the older meanings of the sign, and the meaning of 'all' developed later.

Similar developments in spoken languages lend further support for the proposed semantic change. Haspelmath (1995) shows that in a number of spoken languages (e.g., Portugese, Greek, Hindi-Urdu, etc.) words meaning 'all' come from words meaning 'whole.' He notes that the reverse change from 'all' to 'whole' is not attested. Explaining the semantic change from 'whole' to 'all,' he argues that it occurs "by way of a kind of metaphor by which a plural aggregate is treated conceptually like a single object" (Haspelmath, 1995, p. 379).

Noting that the meaning of 'whole' is already rather abstract, Haspelmath explores what other more concrete meanings it is derived from in various languages. Some of the meanings he lists include 'sound, well' (e.g., Greek *hólos*, Sanskrit *sarva-*, English *whole*) and 'uninjured'/'unharmed' (e.g., German *heil*, Russian *čelyj*). He mentions that these meanings refer to animate beings and explains that the process of semantic generalization and bleaching commonly results in person-related concepts being extended to non-animate

objects (Claudi & Heine, 1986). I propose that the concept of being well or undamaged may also be the basis for the LSF sign *TOUS/TOUT/ENTEIR*, in which the movement of the two hands in circle is a gestural representation of a protection around an entity and/or its integrity.

5.2.2. Source of EACH

In the discussion of variants of EACH above, I have already argued that EACH[distr] is the older form of the sign. Looking for a possible source of EACH[distr] in the historical texts on LSF, we find the sign CHAQUE/CHACUN 'each/every, each one' (Lambert, 1865). This sign is similar in form to EACH[distr] (Figure 4.22) except that it is produced by making displaced repetitions with a dominant hand only. There is another sign in ASL, to wit ANY,[111] that can be traced directly to CHAQUE/CHACUN. As pointed out by Shaw and Delaporte (2010), the older form of ANY is identical to CHAQUE/CHACUN. Interestingly, Haspelmath (1995) shows that in a number of spoken languages free-choice determiners (like 'any') are diachronic sources of 'every.' So we may speculate that CHAQUE/CHACUN meant 'any' around 1817 when Laurent Clerc left France and brought LSF to America, and it is with that meaning that it was adopted into ASL. We may further speculate that the old form of ANY underwent change in meaning and form at some point and gave rise to EACH[distr], but the evidence for such a historical change is lacking.

[111] Unlike English *any*, the sign ANY is a free choice item only and it does not behave like a negative polarity item (Abner & Wilbur, 2017).

Whatever the correct historical account for the development of EACH[distr] is, this sign shares with CHAQUE/CHACUN important formational characteristics, such as the handshape and the reduplicated movement, and the signs are clearly morphologically related.[112] The handshape in CHAQUE/CHACUN and EACH[distr] – a closed fist with the thumb extended (A-dot/Open-A) – deserves particular attention. It is arbitrary in ASL but it corresponds to the sign UN "one" in LSF. So CHAQUE/CHACUN is formed by means of spatial reduplication of UN. In its turn, UN has its origin in the gesture for 'one' used in the French hearing culture (Shaw & Delaporte, 2010).

Turning to spoken languages, reduplication–and numeral reduplication more specifically–is a common strategy for forming distributive expressions (D. Gil, 1995; Haspelmath, 1995). There are also known cases of when they give rise to the meaning of universal quantifier 'every.' For instance, Haspelmath offers an example of Hindi-Urdu *ek ek* (from *ek* 'one'). Thus, we see that signed language makes use of strategies similar to those used in spoken languages.[113]

In summary, in this section I showed that diachronically ASL universal quantifiers ALL and EACH appear to come from lexical sources very similar to those identified for spoken languages. With respect to ALL, I also argued that the same principles of semantic change that have been proposed for spoken languages may also account for the ASL data. I

[112] Abner and Wilbur (2017) make a similar suggestion about possible relatedness between the ASL signs EACH and ANY and the LSF signs for EACH, EACH-ONE, or ONE.

[113] In this section, I only discussed numeral reduplication with respect to the LSF sign CHAQUE/CHACUN. Recall, however, from earlier that the ASL ONE[distr] is also formed by means of numeral reduplication. Additionally, Kimmelman (2017) notes corresponding examples in Russian Sign Language.

have also discussed a typologically unusual source of the quantifier #ALL, which came into ASL from written English.

5.3. Place of Non-Native Quantificational Expressions in the Lexicon

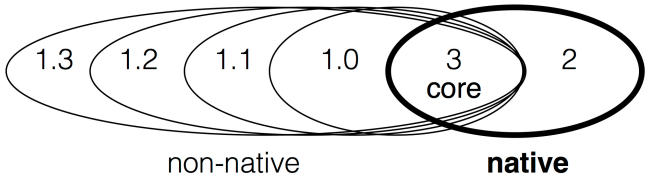
My description of ASL quantificational expressions includes two signs that exhibit influence from English in that they contain a letter or letters of the ASL fingerspelling system (that is, a handshape or handshapes whose source is ASL manual alphabet). They are the fingerspelled loan sign #ALL and the initialized sign INDIVIDUAL[distr]. Signs with fingerspelled letters are considered to be *non-native* or *foreign* by Brentari and Padden (2001). In their account of how these signs fit into the structure of the ASL lexicon, they propose a model of the ASL lexicon that combines native and non-native vocabulary. In this section, I look at how the signs #ALL and INDIVIDUAL[distr] fit into their model.

5.3.1. Brentari and Padden's model of the ASL lexicon

The structure of ASL lexicon proposed by Brentari and Padden is shown in Figure 5.1. The native lexicon is composed of two parts. Part 3 is the *core*. Part 2 is defined by Brentari and Padden as *iconic*, by which they mean that this part of the lexicon has gestural origins. Part 2 includes classifier constructions, spatial verbs (as per Padden, 1988), and pointing signs (referred to as "the pronominal system" and "predicates of locative direction"). The non-native lexicon, Part 1, includes signs with fingerspelled letters and also signs borrowed from other signed languages. The overlap between Part 3 with Parts 1 and 2 indicates that signs can move from the non-core part of the native lexicon to the core (by means of lexicalization of classifier constructions as lexical verbs, which can further be

used to form derived nouns) and from the non-native lexicon to the native core lexicon (through the process of nativization).

Figure 5.1. Components of the ASL lexicon (adapted from Brentari and Padden, 2001)



Focusing on signs with fingerspelled letters, Brentari and Padden further subdivide Part 1 into subcomponents "according to the word-formational operations involved and to phonological proximity to the core component of the native lexicon, based on how well [a subcomponent] conforms to a set of well-formedness constraints" (Brentari & Padden, 2001, p. 89).[114] Thus, in Figure 5.1, subcomponent 1.0 includes non-native vocabulary that violate none of the constraints that native vocabulary is subject to. Moving farther away from the core, the number of constraints violated by vocabulary in each subsequent subcomponent 1.1 through 1.3 increases. In other words, the closer to the core, the more native-like a subcomponent is.[115]

Importantly, while signs in that part of 1.0 that do not overlap with 3 behave identically to those in the core of the native lexicon in that they violate no constraints

[114] In addition to fingerspelled loan signs and initialized signs, Brentari and Padden (2001) also consider other typed of signs with fingerspelled letters, such as abbreviations signs, name signs, locally lexicalized loans, and compounds with fingerspelled forms.

[115] Building on Brentati and Padden (2001), Cormier, Schembri, and Tyrone (2008) propose their own a model of nativization of fingerspelling in ASL and the British Sign Language family. Crucially, their model accounts for cases where fingerspelling is performed with either one hand (as in ASL) or two hands (as in British Sign Language, Australian Sign Language and New Zealand Sign Language).

proposed for the native vocabulary, they are still part of the non-native lexicon because they involve handshapes that do not occur in native ASL vocabulary (e.g., those that correspond to the letters W, T, E). As Brentari and Padden (2001, p. 113) point out, these handshapes have "a synchronic connection with [their] English counterparts." These signs differ from those in the subcomponent 1.0 ∩ 3 (indicated in Figure 5.1 by the overlap between 1.0 and 3). The latter subcomponent contains signs with handshapes that occur in both native and non-native parts of the lexicon (e.g., A handshape, 1 handshape). Thus, despite their origin they behave like core native ASL sign.

5.3.2. INDIVIDUAL[distr]

The sign INDIVIDUAL belongs to a lexical family of signs (Fernald & Napoli, 2000; Frishberg & Gough, 2000) that includes other initialized signs, such as PERSON, HUMAN, CLIENT, and SUBJECT, which express different but semantically related concepts. These initialized signs are derived from a native sign PERSON<B>, produced with two hands in the B handshape, by means of replacing the handshape with the one that corresponds to the initial letter of their respective English translation (e.g., initialized PERSON is produced with a P handshape). The sign INDIVIDUAL, therefore, has movement path and place of articulation of a sign from the core component of the native lexicon. The I-handshape of the sign INDIVIDUAL is also one that is found in the native lexicon. It occurs, for example, in signs LAST/FINAL, ART/DRAW, and SPAGHETTI (Tennant & Brown, 1998) and in classifier constructions that describe size/shape of "very thin and long objects" (www.lifeprint.com, retrieved November 12, 2016). The sign

INDIVIDUAL has phonological parameters of a core native sign and would be placed into subcomponent 1.0 ∩ 3.

Notably, in my data (Section 4.3.2.3) INDIVIDUAL appears in an inflected form—INDIVIDUAL[distr]—that shows distributive marking in the form of spatially distributed reduplication. This demonstrates that despite its non-native status, this sign undergoes grammatical processes characteristic of the core native lexicon.[116]

It is not too surprising that INDIVIDUAL[distr] behaves like a core native sign in that it uses space to indicate grammatical information. After all, it is based on and shares formational characteristics with a native ASL sign. As pointed out by Brentari and Padden (2001, p. 104) initialized signs are "[a]mong the most frequent and well-entrenched foreign vocabulary items in ASL." More interesting in terms of how a non-native lexical items take on properties of native ASL signs are the cases of fingerspelled loan signs #ALL, to which I now turn.

5.3.3. #ALL

As first described by Battison (1977), fingerspelled loan signs originate as fully fingerspelled words that undergo restructuring to conform to the structure of native signs. The process of lexicalization of non-native signs is thus referred to as nativization. Brentari

[116] While the fact that a non-native sign undergoes grammatical processes shows that it conforms to the grammar of ASL, it alone does not indicate that the sign belongs to the core (subcomponent 1.0 ∩ 3). For example, the loan sign #BACK shows morphology of a directional verb, however, it violates some of the phonological constraints on native signs (Selected Fingers and Peripherality Constraints from Brentari, 1998; Two-Type Constraint from Perlmutter, 1993) and would be placed in non-core subcomponent 1.2.

and Padden (2001) show that fingerspelled loan signs vary in how native-like they are, and they occur in all subcomponents of the non-native lexicon.[117]

Phonologically, the sign #ALL fully conforms to all phonological constraints that native ASL vocabulary is subject to. Specifically, it does not violate any of the proposed constraints on the number of movements (Two-Movement Constrain from Brentari, 1998), number of handshapes (Two-Type Constraint from Perlmutter, 1993) or possible handshape changes (Selected Fingers and Peripherality Constraints from Brentari, 1998). The handshapes used in this sign are also the ones that the fingerspelled alphabet shares with native ASL signs. For example, the A handshape is used in such native signs as PATIENCE/PATIENT, PRIVATE, WITH; the L handshape is used in HAIR-DRYER, THEN/EITHER/OR (Tennant & Brown, 1998).

One of the arguments that have been offered for the nativized status of #ALL is that, unlike A-L-L, it is produced with a single L (Battison, 1977).[118] It appears, however, that the articulation of the double LL in A-L-L does not violate of any of the phonological constraints on the structure of native signs. When fingerspelling, a signer holds her dominant hand comfortably in front of her ipsilateral shoulder; the hand is facing forward and at a slight angle. Signers tend to move their hand slightly to the side during fingerspelling. Some ASL textbooks, e.g., Zinza (2006), point out that double letters at the end of the word do not involve repetition of a letter, rather a signer "slides" her hand

[117] Cormier, Schembri, and Tyrone (2008) further show for ASL and for the British Sign Language family that two or more forms that vary in the degree of nativization may coexist in the lexicon.

[118] Additionally, Battison points out that #ALL is often produced with the A-dot/Open-A handshape due to anticipatory coarticulation of the extended thumb of the L handshape. I have not attempted an analysis of the handshapes used in every token of #ALL in my data, but a cursory analysis shows that my participants used the A handshape (not the A-dot/Open-A handshape) in most, if not all, of their productions of #ALL.

slightly to the side. The sliding movement of a double letter and the overall movement of the hand during the production of a fingerspelled word do not constitute two separate movements, but rather blend into one continuous movement, so no violation of the constraint on the number of movement occurs. The only difference in producing a single L versus a double LL word-finally, if there is any, appears to be the length of the movement path. Thus, the phonological criteria alone do not make a case for nativization of #ALL.

A stronger argument for the nativization of #ALL is its movement pattern that is unlike the pattern of transitional movement in A-L-L. As the description of different variants of #ALL in Section 4.3.1.1 shows, its the movement can take various paths, and its place of articulation is no longer restricted to the area in front of a signer's shoulder. It is by means of its movement that #ALL makes use of space in ways that A-L-L cannot (a similar point is made by Battison, 1977). I have pointed out in earlier discussion (Section 5.1.1) that such indexical/deictic uses of #ALL are very much like those of ASL pointing signs. At this point, it is worth discussing the status of pointing signs in the ASL lexicon.

As mentioned above, Brentari and Padden (2001) place pointing signs in Part 2 of the ASL lexicon that they label as *iconic* due to their gestural origin.[119] In their discussion of the Part 2 lexicon, which focuses exclusively on classifier constructions, they claim that classifier constructions can become lexicalized as classifier verbs and move to the core

[119] Brentari and Padden (2001, p. 89) specifically refer to "the pronominal system" and "predicated of locative direction, such as UP, DOWN, THIS-WAY/THAT-WAY." Here, I use the term *pointing signs* instead. I use it to refer not only to signs that are produced with an index finger, but also to those that 'point' with other digits (number-incorporated personal pronouns, e.g. THREE-OF-US) or with an open palm (possessive pronouns, e.g. like MY).

component of the native lexicon (Part 3).[120] Notably, claims have been made that some pointing signs are also lexicalized. Cormier (2002, 2005) notes that pointing signs used as personal pronouns are typically characterized as indexical in meaning and form, that is they directly indicate their referents (by pointing at it, when the referent present, or by pointing at a location in the signing space associated with this referent). She claims however than not all pronouns are indexical in the sense described above. As argued by Meier (1990), pronouns WE and OUR are lexicalized. They are produced with two contacts on the signer's chest (with the index finger for WE, and with an open palm—a B-handshape—for OUR), and therefore are not entirely motivated indexically. Cormier furthermore shows that in neutral and exclusive contexts number-incorporated pronouns 3/4/5-OF-US and the universally quantified pronoun ALL-OF-US[121] "do not have to match the location of the referents" and thus "provide evidence for the lexical status of these pronouns, whether particular tokens are indexical or not" (Cormier, 2005, p. 258). With respect to the model of the ASL lexicon, we thus see that not all pointing signs belong to the iconic part of the lexicon (Part 2). Some pointing signs, namely, WE and OUR, are fully lexicalized and thus belongs to the core (Part 3). Other signs, like number-incorporated pronouns 3/4/5-OF-US, are lexicalized with respect to location in some of their uses, and may occupy a position somewhere in between Parts 2 and 3.

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[120] Several researchers noted there is not always enough historical evidence for a lexicalization path from classifier constructions to lexical signs, and the two may have developed independently (Cormier et al., 2012; Zwitserlood, 2003).

[121] The sign Cormier (2002, 2005) gloss as ALL-OF-US is used as a pronoun in her data. It is isomorphic to the sign I described as a nominal quantifier #ALL<lateral>. Importantly, Cormier too notes the indexical property of this fingerspelled loan sign.

As I already pointed out in Section 4.3.1, various uses of #ALL in my data can similarly be classified as either indexical or lexicalized with respect to the location and movement. In particular, examples of #ALL$_{top}$ (i.e., those examples where the form of #ALL indicates the location and distribution of a quantified referent) are indexical. The variants #ALL<lateral> and #ALL<outward> can be indexical in some of their uses, in the same way that #ALL$_{top}$ is, but their form is lexically specified in others. For example, as I mentioned earlier, #ALL<lateral> was used by some participants with the noun STUDENT whose referent – the students in a classroom – can be conceptualized as being distributed in space in front of the signer (indexical use). At the same time, some participants used #ALL<lateral> with the nouns MONEY and STORY whose referents do not have, or have not been assigned, any spatial locations or distribution (lexicalized use).

What comes out of this discussion is that #ALL is clearly a nativized ASL sign. Interestingly, based on its indexicality it patterns together with signs in the iconic/gestural component (Part 2), but it also allows non fully indexical uses which place it into subcomponent 1.0 ∩ 3. Thus, #ALL does not neatly fit into Brentari and Padden's (2001) model of the ASL lexicon in Figure 5.1, in which the iconic component (Part 2) and the non-native component (Part 1) do not overlap.

Chapter 6: Conclusion

6.1. Summary of the Results

This study has offered a description of various means that ASL signers use to encode universal quantification in the nominal domain. I first described responses that do not involve the use of a lexical quantifier but where universal interpretation is associated (1) with definite interpretation of plural and mass NPs, (2) with the use of aspectual verbal morphology on directional verbs, and (3) with various ways to convey total affectedness of the theme/patient argument. The last class of responses included sentences with inherently telic verbs or a result-state markers and sentences with an iconically motivated classifier construction.

A larger part of this dissertation focused on lexical universal quantifiers that included universal D-quantifiers (ALL, #ALL, EACH) and floating quantifiers, but also other signs that are not quantifiers proper but which can be used to express universal quantification (ALTOGETHER<time>) and/or a closely related notion of distributivity (INDIVIDUAL[distr], ONE[distr]/ONE[pl]). I described the form of quantifiers, their variation, morphological properties, and syntactic distribution.

These results show that, similarly to many other languages, ASL universal quantifiers can be classified as distributive (only allowing distributive interpretations) and non-distributive (allowing both collective and distributive interpretations). ASL has two non-distributive universal quantifiers: ALL and #ALL. They are similar in their meaning and syntactic behavior (but comparison of my data with those reported by Abner and

Wilbur (2017) show that there may be variation across signers with respect to whether they allow distributive interpretations for sentences with ALL). At the same time, they differ in a number of ways, to wit:

a. origin/status in the ASL lexicon (Brentari & Padden, 2001): ALL is a native sign while #ALL is a non-native lexicalized fingerpelled loan;
b. morphosyntactic use of space: both ALL and #ALL can be signed in the location in the signing space associated with the quantified referent, but only #ALL can be modified spatially to show information about geometric or abstract structural properties of the referent.

With respect to spatial modifications of #ALL, I showed that they demonstrate indexical properties of this sign. The particular kind of indexicality that I am concerned with here is realized not only in the meaning of this sign but also in its form. While most uses of #ALL are indexical, the data showed that some signers allow uses of the variants #ALL<outward> and #ALL<lateral> that are not fully indexical, specifically, they lexicalized with respect to the location and movement of #ALL.

ASL has a lexical distributive universal quantifier EACH. It has three forms: EACH (with a single movement), EACH+ (with repeated movement), and EACH[distr] (spatial reduplication). I proposed that EACH[distr] is the older form and EACH and EACH+ are the result of phonological and morphological reduction due to economy of effort. I also suggested that the overt distributive marking of EACH[distr] makes this form more iconic, which may explain why it has not been completely replaced by EACH in contemporary ASL. Finally, I noted that EACH+ is the most rarely used of the three forms and suggested

that its rarity may be explained by the fact that it is more effortful in its articulation than EACH and that it does not take advantage of spatial resources the way EACH[distr] does.

I also offered a discussion of possible historic sources of ASL quantifiers. Although some of the hypothesized links are tentative, overall it appears that, aside from #ALL, ASL quantifiers come from lexical sources very similar to those identified for spoken languages. This suggests that the process of semantic change is similar in spoken and signed languages. Specifically, I proposed that ALL and EACH can both be traced back to old LSF signs with the same meanings. I further suggested that the original meaning of ALL was 'whole' (still one of the sign's meanings today), and that the sign could be based on a gestural representation of the concept of being well or undamaged. For EACH, I suggested that it is a reduplication of the LSF numeral meaning 'one,' which had been claimed to come from the corresponding gesture used in the French hearing culture (Shaw & Delaporte, 2010).

6.2. REMARKS ON THE ROLE OF NOUN SEMANTICS

One of the research questions for this study was whether the choice of a particular quantificational strategy in ASL correlates with the semantics of a quantified noun. To address this question, the elicitation procedure targeted sentences with nouns that differed with respect to the count/mass, abstract/concrete, and animate/inanimate distinctions. In this dissertation, I only described a subset of the collected data that concerns universal quantification in ASL. I did not find any strong effect of the animate/inanimate distinction on universal quantification in ASL but there is a limited evidence that some signers may

use the variant I glossed as EACH<1> for animate human referents only. Additionally, there may be a weak preference for the use EACH with animate nouns, which could be related to the cross-linguistic tendency to individuate animates, such as humans and animals.

There is however an effect of the count/mass distinction on universal quantification in ASL, but the one that is not surprising given that ASL distinguishes distributive and non-distributive quantifiers. It has been noted (e.g., in D. Gil, 1996) that there is a relationship between count/mass distinction and distributivity such that count nouns that denote plural sets allow distributive interpretations but mass nouns do not (excluding mass nouns that have coerced packaging or sort readings, as in *three beers* meaning 'three glasses of beer' or *two wines* meaning 'two types of wine'). With respect to combinatorial properties of nouns and quantifiers, it means that distributive quantifiers can only occur with counts noun and cannot occur with mass nouns, as the following contrast in English demonstrates: *every/each girl* versus **every/*each sand*. In this study, the participants used universal distributive EACH (or, for one signer INDIVIDUAL[distr]) with the count nouns only. I would further predict that these quantifiers are incompatible with mass nouns, but grammaticality judgments on such collocations were not included into the design of the study.

The data also show that signers may prefer to use strategies that do not involve the use of a lexical quantifier to express universal quantification over mass nouns. This preference, however, is not absolute (as I discussed in Section 4.2.3.2). Further

investigation is needed to investigate factors that explain the observed pattern and to explore if naturalistic data confirm to this pattern.

There is also an effect of the abstract/concrete distinction that is worth pointing out. It has to do with the indexical properties of the quantifier #ALL and what kind of additional meanings it can encode vis-à-vis concrete and abstract referents. As discussed in Chapter 5, for concrete referents, spatially modified forms of #ALL may indicate topographic information about the location and geometric properties of the quantified referent. When quantifying over abstract referents, #ALL may also be used indexically, but in this case it makes reference to abstract structural properties of the referent, such as being viewed as a list of items (e.g., by using #ALL directed at SEVERAL-LIST when quantifying over a set of stories told by granddad). Note that concrete referents may also be viewed as a list. These data show how the form of a quantifier in ASL may be iconically motivated by visual or abstract structural properties of the quantified referent.

6.3. SUGGESTIONS FOR FUTURE RESEARCH

As I explained in Section 3.4.1, the data reported in this dissertation constitutes a subset of the data that I had collected for this study. In future work I hope to code and analyze the data that I could not report in this dissertation. The most immediate step in this work would concern the remaining data on universal quantification in ASL. Further work would address the data on existential and proportional quantification, which is an important task towards forming generalizations about how quantification works in ASL in general.

In considering further steps in research on universal quantification in ASL, it is worth contemplating what other methods would allow us to verify and expand on the findings reported in this dissertation. As I mentioned in Section 3.1, a concern related to the use of a translation task for elicitation has to do with a possible influence of the source language (English, in this case) on the data. Notably however my data contain a number of sentences that are clearly not English on the hands—such as sentences with a classifier construction (described in Section 4.2.3.2) or sentences showing word orders different from English (described in several places in Section 4.3). At the same time, some other sentences in the data appear to be quite English-like. While this does not automatically mean that these sentences are not ASL, such a possibility cannot be completely ruled out. One way to address this concern in future work is to collect more naturalistic data.

A growing number of ASL vlogs and other videos (public lectures, news reports, interviews, etc.) are available on the Internet. These videos are a valuable source of data, however caution should be exercised when selecting videos for analysis. One issue to keep in mind is that some videos feature signers who are less than fully fluent in ASL. Additionally, one needs to consider the register of the discourse and be careful with using videos recorded in formal situations because signing may be more English-like in such settings (Lucas & Valli, 1992). As an alternative or in addition to the analysis of videos found online, naturalistic data can be obtained by means of elicitation procedures that rely on laboriously crafted visual prompts (pictures, videos, objects, etc.) and do not involve the use of English. Creating such prompt could be a challenging task, but it may be the only option for eliciting specific types of data that rarely or never arise in spontaneous discourse.

Analyzing naturalistic data is an important next step in the research, but it is clearly not a sufficient one. The biggest limitation of naturalistic data is the lack of negative evidence.[122] In fact, this limitation characterizes not only naturalistic data, but also data collected by means of translation. Direct elicitation of signers' judgments is necessary to fill in the gaps in these types of data. Thus, as a follow-up to the translation task I elicited some judgments from one native signer (described in Section 3.6 and in Chapter 4). It is clear, however, that more work of this sort should be done. First, eliciting judgments from a larger number of signers would increase the validity of the reported results. Second, there are a number of questions regarding word order in sentences with lexical quantifiers that I left outside the scope of this dissertation (outlined below); I plan to return to them in future work.

To sum up the above discussion of methodological recommendations, each of the methods mentioned above has its advantages and limitations. It is a combination of different approaches—so-called "converging operations"—that we need to arrive at solid conclusions.

My cursory description of the syntax of the lexical quantifiers ALL, #ALL and EACH in Sections 4.3.1.1 and 4.3.2.1 left open a number of questions about both syntactic structure and semantic interpretation of sentences with the different word orders, to wit Q-NP vs. NP-Q vs. NP separated from Q ('floating' Q). Future research will involve forming specific hypotheses about factors that are involved in determining when each order is used.

[122] In addition to the lack of negative evidence, Matthewson (2004, pp. 376–377) identifies two further limitations of "pure text-gathering," namely the poverty of the data in terms of quantity and the insufficiency of the information available from the translations for semantic analysis.

These hypotheses can then be tested by eliciting felicity judgments on sentences (e.g., sentences taken from the translation task) as presented in various contexts of utterance. An additional layer of complexity in this line of investigation is related to the use of pointing signs that accompany NPs. One point of debate in the literature concerns their status: they have been analyzed as definite determiners by some researcher (Kegl, 2003; MacLaughlin, 1997; Wilbur, 1979) and as demonstratives by others (Koulidobrova & Lillo-Martin, 2016). Another interesting puzzle for their analysis is their apparent optionality.

The investigation of syntactic and semantic properties of ASL quantifiers could be informed by studies of quantifiers in spoken languages. It has already been noted by Davidson and Gagne (2014) that ASL quantified NPs show structural similarity to quantified NPs in St'át'imcets. Different analyses have been proposed for St'át'imcets in the literature (Davis, 2013; Matthewson, 2001, among others). Applying these analysis to ASL will likely be instrumental in evaluating these different proposals.

Appendix A: Glossing Conventions

Signs are denoted by their closest English equivalents in all caps. The gloss stands for the meaning of the unmodified root form of a sign. When an example was taken from a previously published source, the gloss used in the original has been modified to match the conventions outline here.

SIGN	Closest English equivalents in all caps are used as glosses for signs.
SIGN-SIGN	If more than one English word is necessary to represent the meaning of a single sign, these words are linked with a hyphen.
S-I-G-N	Fingerspelled signs
#SIGN	Fingerspelled loan signs
SIGN^SIGN	Compound signs
_____x SIGN SIGN	A top line above a sign or series of signs indicates the scope of non-manual makings. Letters at the end of the line serve as labels: t topic marking mm pursed lips rhet.q *rhetorical question* non-manual[123]
3-SIGN-1 SIGN-lf SIGN-a	Letter and number indices represent manual modification to a sign's location or direction. An index at the beginning of a gloss indicates onset location of the sign. An index at the end of the gloss indicates its endpoint location, or the location with which it is associated. • Number indices indicate 1st, 2nd, 3rd person reference.

[123] The so-called *rhetorical questions* (Baker-Shenk & Cokely, 1991b, p. 137) have been argued by Wilbur (1995) to be neither rhetorical nor questions but rather a part of the syntactic focus construction known as the *wh*-cleft or pseudocleft. The non-manual behavior associated with this structure includes a brow raise often accompanied by a head tilt.

	• Abbreviations used to represent locations/directions in the signing space (from the signer's perspective): lf left rt right dn down f forward/front bk back c center • Lowercase letter indices (a, b, c) are used for abstract reference.
IX-1 IX-lf IX-a	Pointing signs are indicated by the abbreviation IX (for 'index') followed by an index, as described above.
POSS-1	A possessive pronoun; a number index indicates person reference.
SIGN[modification]	A manual modification to a sign's form is given with the name for this modification in square brackets. pl plural distr distributive/exhaustive mult multiple dur durative
SIGN+	Repeated sign
CL:X'meaning'	Classifier constructions are indicated by the abbreviation CL. The symbol after a colon represents the handshape of the classifier used and a description of the contextual meaning is given in single quotes.
SIGN ndh: SIGN	The bottom line, labeled as *ndh* (*non-dominant hand*), is added to show that, for a part of her utterance, the participant simultaneously used two hands to produce two separate signs.

SIGN<x> IX<x>	Angle brackets are used for additional information about how a sign is produced that are relevant for either sign identification (when the same gloss is used for two signs) or the meaning of a sign. symbol for a handshape (GIVE<X>) palm orientation (rt-#ALL<palm in>-lf) movement path(#ALL<arc>) 2h sign made with two hands when a one-handed version is also possible alt the hands alternate making the movement
SIGN*	Emphasized signs
(SIGN)	Parentheses around the sign or non-manual markings indicate optionality.
gest:'meaning'	A gesture that adds a meaningful component to the utterance.

Appendix B: Participant Background Information Questionnaire

Participant's code_____

Please answer the questions below.

1. What is your age? _____

2. Are your parents hearing or deaf?

_____

3. Are your siblings, if any, hearing or deaf? Are they older or younger than you?

_____

_____

4. When were you first exposed to ASL?

_____

5. What kind of schools did you attend?

_____

Appendix C: Elicitation Materials

Group 1: Eliciting sentences with concrete nouns

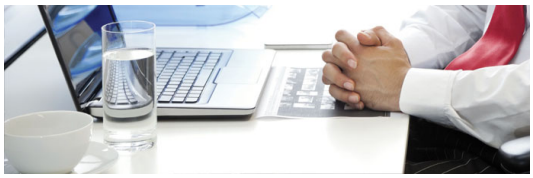
(a) Concrete count nouns

QUANTIFIERS: all, each, every one, some, several, a few, few, many, none, most

Contextual information	Elicitation sentences
 	*QUANTIFIER* of the **students** know(s) the answer. The **students** know the answer.
at 8:30 am  **at 6:30 pm…** 	*QUANTIFIER* of the **dogs** are/is sleeping. The **dogs** are sleeping.
 	The girl ate *QUANTIFIER* of the **cookies**. The girl ate the **cookies**.

(b) Concrete mass nouns

QUANTIFIERS: *all, some, a little, little, much, none, most*

Contextual information	Elicitation sentences
 	The man spilled *QUANTIFIER* of the **water** on his laptop. The man spilled the **water** on his laptop.
 	The woman needs *QUANTIFIER* of the **flour**. The woman needs the **flour**.
last month  me my friend **this month…**	My friend returned *QUANTIFIER* of the **money**. My friend returned the **money**.

Group 2: Eliciting sentences with abstract nouns

(a) Abstract count nouns

QUANTIFIERS: all, each, every one, some, several, a few, few, many, none, most

Contextual information	Elicitation sentences
When Bob was little, his granddad used to tell him all kinds of stories. 	Bob remembers *QUANTIFIER* of the **stories**. Bob remembers the **stories**.
Siblings got together to brainstorm what gift to buy their mom for her birthday. They came up with various ideas. 	*QUANTIFIER* of the **ideas** were/was good. The **ideas** were good.

(b) Abstract mass nouns

QUANTIFIERS: all, some, a little, little, much, none, most

Contextual information	Elicitation sentences
Consider the history of the human race…	*QUANTIFIER* of the **history** is evil. The **history** is evil.
You might see the following sentence in a physics problem.	When light passes through the glass wall, *QUANTIFIER* of the **energy** is lost. When light passes through the glass wall, the **energy** is lost.

Groups 3: Eliciting sentences with a directional verb or a classifier construction

(a) Sentences with a directional verb

QUANTIFIERS: all, each, every one, some, several, a few, few, many, none, most

Contextual information	Elicitation sentences
	The teacher gave a book to *QUANTIFIER* of the **students** in class. The teacher gave a book to the **students** in class.
	The teacher gave a good grade to *QUANTIFIER* of the **students**. The teacher gave a good grade to **the students**.

(b) Sentences with a classifier construction

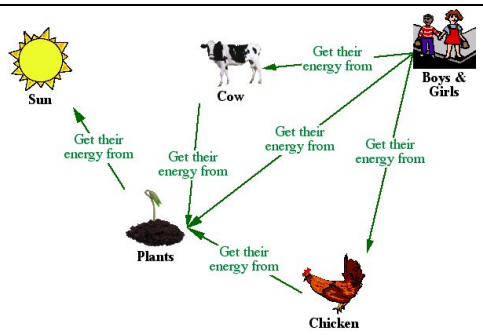
Contextual information	Elicitation sentences
	There are many/some/no **cars** on the street. Many of the **cars** on the street are old. Some/None of the **cars** on the street are new. The **cars** are old.

Supplemental Data Collection Materials

(a) Stimuli for the acceptability judgment task designed to test the distributive vs. non-distributive distinction of universal quantifiers

Contextual information	Elicitation sentences
Collective context 1: Students in Mr. Smith's class were competing against students in Ms. Brown's class in a raft race. Whichever **class** won would get a trophy. The students in Mr. Smith's class were very engaged. Distributive context 1: Students in Mr. Smith's class were competing against each other in a raft race. Whichever **student** won would get a trophy. The students were eager to participate in the race.	• ALL/#ALL/EACH STUDENT BUILD RAFT _____t • STUDENT IX[pl] ALL/#ALL/EACH BUILD RAFT
Collective context 2: Students in Ms. Bell's class worked collaboratively on a piece of artwork for an art show at their school. None of the students wanted to miss their chance to contribute to the project.  Distributive context 2: Students in Mr. Martinez's class (see the picture below) participated in an art show at their school. 	• ALL/#ALL/EACH STUDENT MAKE ARTWORK _____t • STUDENT IX[pl] ALL/#ALL/EACH MAKE ARTWORK

(b) Stimuli for the translation task

Contextual information	Elicitation sentences
	All of the energy in an ecosystem starts with the Sun.
	All of the water in this pool is distilled.
From http://www.cnn.com/2016/01/11/health/toxic-tap-water-flint-michigan/ **(CNN) —** Flint, Michigan, lies about 70 miles from the shores of the largest group of fresh water bodies in the world: the Great Lakes. Yet its residents can't get clean water from their taps. Nearly two years ago, the state decided to save money by switching Flint's water supply from Lake Huron (which they were paying the city of Detroit for), to the Flint River, a notorious tributary that runs through town known to locals for its filth.	All of the tap water in Flint was contaminated with lead.

	All of the trash in the backyard is from our student neighbors.
Consider this sad but rather typical situation.	All of the trash from local businesses ends up in a landfill.

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