Grammaticization of Indexic Signs: How American Sign Language Expresses Numerosity

by

Kearsy Annette Cormier, B.A, M.A.

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The Dissertation Committee for Kearsy Annette Cormier
Certifies that this is the approved version of the following dissertation:

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Committee:

Richard P. Meier, Supervisor

Stephen Wechsler, Co-Supervisor

Lisa Green

Elizabeth Keating

Anthony C. Woodbury
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Many researchers have noted that deixis in American Sign Language (ASL) is largely indexic; deictic signs such as pronouns and agreeing verbs “point to” locations associated with their referents. Number has traditionally been considered to have little or no effect on indexicality in signed languages. Thus, for purposes of simplicity, discussions of deixis and agreement in ASL have long focused on singulars. In this dissertation, I will show that reference to multiple entities results in a loss of indexicality, which I propose is due to the grammatical category number.

This study focuses on indexers (i.e., signs that serve to establish a referent or referents at a location in space) and on agreeing verbs; both indexers and agreeing verbs are considered highly indexic in their singular forms. Researchers often note that agreeing verbs index the same location as their coreferential
pronouns, but very little has been mentioned in the literature about how indexation applies to plural forms.

I present the results from two studies: one on plural pronouns and one on plural verbs. The results from these studies have implications for the field of sign linguistics in which the linguistic status of indexic signs has recently been a highly controversial issue. The fact that plurality affects indexicality suggests that the way that pronouns and agreeing verbs use space must be at least partly linguistic because it is affected by the grammatical category number.
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1. Opening Remarks

Many researchers have noted that deixis in American Sign Language (ASL) is largely indexic; deictic signs such as pronouns and agreeing verbs “point to” locations associated with their referents (e.g., Liddell 2000). For purposes of simplicity, discussions of deixis and agreement in ASL have long focused on singulars. Number has usually been considered to have little or no effect on indexicality (i.e., the way that signs point to their referents) in signed languages. In this dissertation, I will show that reference to multiple entities results in a loss of indexicality, which I propose is due to the grammatical category of number.

This study focuses on indexers (i.e., signs that serve to establish a referent or referents at a location in space) and on agreeing verbs; both indexers and agreeing verbs are generally considered highly indexic in their singular forms. Researchers often note that agreeing verbs index the same location as their coreferential pronouns. However, very little has been mentioned in the literature about how indexation applies to plural forms.

I present the results from two studies: one on plural pronouns and one on plural verbs. The first study identifies a set of exclusive pronouns in ASL that has not previously been described in the literature. The second study uses instrumental means to measure how precisely verbs match the locations of their referents. This type of instrumentation has never before been used to describe the way that signers use the signing space.
The results from both studies have implications for the field of sign linguistics in which the linguistic status of indexic signs has recently been a highly controversial issue (e.g., Lillo-Martin in press, Rathmann & Mathur in press). The fact that plurality affects indexicality suggests that the way that pronouns and agreeing verbs use space must be at least partly linguistic because it is affected by the grammatical category number.

2. NUMBER AS A MORPHOLOGICAL CATEGORY

Number is a much more complex category in language than one might think. Languages differ in what number values they mark. The most common number system is one that marks simply singular and plural, such as English. Singulars denote one and only one entity; plurals denote more than one entity. More complex systems have, in addition to singular and plural, a dual category indicating two distinct entities; examples include Sanskrit and Greenlandic Eskimo (Forchheimer 1953). Still more complex systems have, in addition to singular, dual and plural, a trial category indicating three distinct entities; examples include Nogogu and Worora (Forchheimer 1953). Some systems have, in addition to at the minimum singular and plural, a paucal form indicating a small number of distinct entities.

Languages also differ in which functional categories carry number marking. We might expect nouns in a given language to mark number, since number deals with entities and nouns are entities. But in many languages, verbs mark number as well as (or instead of) nouns. Verbal number relates to the
number of events rather than number of entities. Furthermore, a language can mark different number values on nouns than it does on verbs. Crosslinguistically, languages with nominal singular, dual, plural and even trial are fairly common, but languages with verbal number typically mark only singular and plural (and sometimes dual).

Some languages do not mark number at all (Corbett 2001). Everett (1986) notes that Pirahã, a language spoken in Brazil has no plural forms at all, even for pronouns. Any of the pronouns shown in Table 1.1 could be either singular or plural. Pirahã of course has ways of expressing plurality by using a particular postposition and various quantifiers. But this does not mean that Pirahã has a number category in its grammar; expression of plurality in Pirahã is not required. Likewise, English has ways of expressing reference to two entities, but it does not have a dual category in its grammar.

Table 1.1. Personal pronouns in Pirahã (Everett 1986)

<table>
<thead>
<tr>
<th>Person</th>
<th>Pronoun</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>ti</td>
</tr>
<tr>
<td>2nd</td>
<td>gíxai</td>
</tr>
<tr>
<td>3rd</td>
<td>hiapióxio</td>
</tr>
</tbody>
</table>

3. **American Sign Language**

American Sign Language is the manual-visual language used by between 200,000 and 500,000 deaf people in the United States and much of Canada. As research since the 1960's has shown, ASL is a language in its own right, distinct from the spoken language of the surrounding community (Klima & Bellugi 1979,

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1 By verbal number, I mean number that is semantically inherent to the verb, not merely marked on the verb. Many languages have only nominal number but can have number marking on the verb.
Furthermore, ASL is also distinct from other signed languages, even those used in other English-speaking countries such as Great Britain and Australia.

The phonetic properties of signed languages are of course quite different from those of spoken languages. In general, a manual sign (i.e., a lexical item) in ASL consists of a particular handshape, a location, a movement, and a palm orientation. Some signs maintain the same handshape and location throughout the articulation of the sign. Other signs involve changes in handshape and/or movement and/or location. Any sign with path movement necessarily involves movement from one location to another. This change of location through path movement is an inherent property of many agreeing verbs, as will be discussed further below.

3.1. Peirce’s “index”

Before we can look at nominals in ASL, it is important to understand what exactly an ‘index’ is, what it means for something to be indexic. According to Charles Sanders Peirce (1932), an index is “physically connected with its object” (p. 168), and is the most direct way to express what an assertion refers to. Nonlinguistic examples include thermometers and clocks, which have a direct, physical connection to temperature and time, respectively. For example, the height of the column of mercury in a thermometer is determined by the ambient temperature. In this way, there is a ‘physical connection’ between the thermometer and its referent (its ‘object’).
Peirce notes that many elements of language are indexic as well. For instance, he remarks explicitly that “a pronoun is an index” in that it “indicates anything to which the first and second persons have suitable real connections, by calling the attention of the second person to it” (p. 163). He also includes in the class of indices demonstratives, quantifiers, and other elements which today we refer to as deictic elements.

Peirce’s notion of an index is indeed very close to what we call deixis. Deixis is the name given to those aspects of language which can be interpreted only with reference to the speaker’s position in space or time (Fillmore 1997). The same restrictions hold for a linguistic index (in the sense that Peirce uses this term); pronouns, demonstratives, and quantifiers all require contextual knowledge (such as the speaker’s position in space and time) in order to be interpreted. The choice of a particular pronoun—and the interpretation of that pronoun—depends on knowledge of the context in which an utterance is produced.

Peirce applies the term ‘index’ to deictic elements in language only in terms of their meaning. The form of deictic expressions in spoken languages is largely symbolic, not indexic. There is nothing inherent about the form of the word “she” that picks out or indicates a particular referent. However, in signed languages, deictic expressions are indexic not only in meaning, but also in form. The form of a pronoun (a pointing sign) directly indicates its referent. It is this sense of indexic (indexic in form) that I will use the term “index” in this dissertation.
3.2. ASL nominals

An NP in ASL can consist of a noun by itself (e.g., GIRL, BOY, CAT, etc...), or a noun and a pointing sign that serves to establish a location in space for that noun (e.g., BOY iPT 'the boy', GIRL jPT 'the girl') or just a pointing sign used as a pronoun (e.g., iPT - see Figure 1.1).2 Within a discourse, these nominals are associated with distinct locations in space; the association between signs and locations in space is referred to as indexing. The pronouns and classifiers that serve to establish indexing will be referred to henceforth as indexers.3 Any subsequent signs that point to a location established by an indexer are interpreted as being coreferential with the indexer. If the referent is physically present (e.g., the addressee, a non-addressed individual, or the signer him/herself), the signer points to the location of that referent. If the referent is not physically present (e.g., in the case of a non-addressed individual), the signer simply chooses a location in neutral space for that referent.4 These loci remain throughout the discourse until they are actively changed (Lillo-Martin 1986).

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2 See Appendix for a description of the notation used here.
3 Note that these are not the only possible indexing devices in ASL; nonmanual features (e.g., particular facial expressions) can also act as indexers (Bahan 1996).
4 Other researchers have claimed that there are factors that determine where a locus is established in signing space (e.g., discourse factors, semantic affinity with another referent, conventional location, etc...). Thus, the establishment of loci is rarely arbitrary (Engberg-Pedersen 1993).
3.2.2. Pronouns

A personal pronoun in ASL generally takes the form of a pointing sign (index finger extended and other fingers closed) directed toward a distinct location or locations in space. In the case of self-reference, the signer points to his/her chest.

Some plural pronouns are indexic in the same way that the singular pronouns are. For example, the dual pronoun indexes the locations of two individuals being referred to. The dual pronoun is glossed as TWO-OF-US, TWO-OF-YOU, TWO-OF-THEM, etc..., depending on which referents are being indexed (see Figure 1.2 for TWO-OF-US). There is also a set of so-called “number-incorporated” pronouns (e.g., THREE-OF-US, FOUR-OF-THEM, and FIVE-OF-YOU) which are marked for number and index a single general location for the group of referents; see Figure 1.3 for THREE-OF-US. According to Baker-Shenk & Cokely (1981), the 3-handshape (palm up) “is used with a circular
movement made close to the three people or three things the Signer wishes to refer to” (p. 51). Thus for Baker-Shenk & Cokely, this pronoun indexes the location of the group of referents. The plural pronoun YOU-PL/THEY is indexic in a similar way; this pronoun also indexes a general location for the group of referents (see Figure 1.4 below). To refer to more than one addressee, the signer uses a pointing sign with a sweeping motion that indicates the addressees. Likewise, to refer to more than one non-addressed person, the signer uses a pointing sign with a sweeping motion that indicates the non-addressed individuals.

Figure 1.2. Dual first person pronoun

![Dual first person pronoun](image)
ASL also has a general first person plural form WE (and its possessive equivalent OUR). The signs WE and OUR as shown in Figure 1.5 do not specify the number or locations of their referents in any direct way; the only referent these signs point to is the signer. Meier (1990) notes that these forms are idiosyncratic in that for both signs the hand contacts the chest twice. Thus, he claims, the form
of these signs cannot be predicted based solely on what might be called a “plural marker” in other signs - that is, the sweeping horizontal movement (e.g., HE/SHE/IT vs. YOU-PL/THEY).

Figure 1.5. First person plural pronouns (non-possessive and possessive)

In addition, there are alternate ways of expressing plurality. For instance, a signer may point individually to each of the included referents (Baker & Cokely 1980, Baker-Shenk & Cokely 1981). I call this a composite form, because it is similar to composite pronominal forms that Forchheimer (1953) describes for spoken languages (e.g., Melanesian Pidgin English *yumi* “you plus me”). Thus, THEY-COMP includes points to each of a set of non-addressed referents, while WE-COMP includes points to the signer plus other referents; see Figure 1.6 for WE-COMP. Also, reference to all members of some specific set can be expressed
by the sign #ALL, a fingerspelled loan sign (Baker-Shenk & Cokely 1981); see Figure 1.7. These signs will be discussed in more detail in Part I.

Figure 1.6. Composite pronoun

Figure 1.7. Universal quantifier

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5 Fingerspelled loan signs are based on fingerspelled words, but have acquired lexical status in ASL because of their idiosyncratic movement patterns not typically found in normally fingerspelled words (Battison 1978, Padden 1999).
3.2.3. Classifiers

Another method for indexing locations is by using classifiers. Classifiers are used to establish precise locative relationships. In locative expressions, the signer provides a lexical sign for each referent (e.g., TABLE, WOMAN, etc...), then uses classifiers to express the location of the referents in space, their orientation, and their spatial relationship with each other (Emmorey 1996). For example, the classifier used to indicate an upright human is generally either a ‘maneuverable vertical object classifier’ (CL-1) or ‘legged object classifier’ (CL-legs) (Supalla 1986). These two classifiers are shown in Figure 1.8.

Figure 1.8. Classifiers for upright person

![Classifiers for upright person](image)

a) CL-1  
b) CL-legs

The maneuverable vertical object classifier (CL-1) can be pluralized by extending other fingers in addition to the index finger, to depict two, three, four, five, or more than five people. Pluralizing classifiers can also involve repeating them in different locations (Baker & Cokely 1980).

The use of classifiers for indexing gives them characteristics that are somewhat nominal. However, classifiers are also referred to generally as ‘classifier predicates’, which implies they are verbal in nature. Indeed they can be. Classifier predicates make up a class of verbs known as spatial verbs, which
vary according to the source and goal of motion. More information about classifiers, both nominal and verbal, will be given in Part II.

3.2.4. Other nominals

Non-indexic NPs in ASL can be marked for number in various ways. Number is generally not marked on nouns in ASL, except for some number-incorporated signs such as TWO-MONTH, FOUR-DOLLAR, THREE-DAY (see DAY vs. THREE-DAY in Figure 1.9 below). When number is not incorporated in the noun/pronoun, separate lexical items -- quantifiers -- can be used to indicate number (e.g., numerals, MANY, FEW, etc...). Numerals are distinct from number-incorporated pronouns in that they are generally not indexic.6 Quantifiers (such as MANY and FEW) are generally not indexic either, except for the fingerspelled loan sign #ALL which can index the location of a group.

Figure 1.9. Number incorporation in the sign DAY

a) DAY  b) THREE-DAY

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6 This is generally but not always true: When a signer is counting an array of objects, number signs can index specific objects.
Although noun phrases are generally pluralized in ASL by using indexers or separate lexical quantifiers, it is possible to pluralize some nouns directly. Nouns that are produced in neutral space (i.e., not produced on the body) can be pluralized by producing the sign several times, each in a different location.7

3.3. ASL verbs

There are three main classes of verbs that have been posited for ASL: plain verbs, spatial verbs and agreeing verbs (Padden 1983). Each class uses space somewhat differently. Plain verbs generally do not use the signing space for referential purposes. Spatial verbs and agreeing verbs both use the signing space referentially, but in slightly different ways.

3.3.1. Plain verbs

Plain verbs show no agreement with the subject or the object; these verbs require subject and object arguments that are either overtly expressed or easily retrievable from context.8 An example of a plain verb is LIKE, as shown in Figure 1.10. This verb has the same form regardless of the location or number of the subject or the object.

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7 This displacement of signs for pluralization has also been noted for Israeli Sign Language (Namir & Schlesinger 1978, Stavans 1996) and Italian Sign Language (Corazza 1990, Pizzuto & Corazza 1996). Padden (1999) notes that nouns can be pluralized by reduplicating the stem; it is not clear if the reduplication she refers to is part of the displacement described here or some other type of plural marker.

8 Bahan (1996) claims that plain verbs show nonmanual agreement (e.g., through body shift and eye gaze).
3.3.2. Spatial verbs

Spatial verbs are also known as verbs of motion and location (Padden 1983, Supalla 1982, Supalla 1986). These verbs move between locations associated with the real-world initial and final positions (as opposed to locations associated with verbal arguments: see 2.2.3). Spatial verbs include the set of classifier predicates, which as described above use handshape classifiers to describe motion and locative relationships. Liddell (1990) gives as an example of a spatial verb MOVE-FLAT-OBJECT, as shown in Figure 1.11. This verb moves from location i, associated with the initial location of some flat object, to location j, associated with the final location of this flat object. Spatial verbs can also encode plurality; see 3.3 for further description of plural marking on spatial verbs.
3.3.3. Agreeing verbs

There is a class of verbs known as agreeing verbs\(^9\) which make use of the association between locations established with indexers and sentential arguments, as opposed to real-world locations (Padden 1983, Supalla ms.). Agreeing verbs define a relationship between two locations primarily in two ways: either through the direction the fingertips are facing or through the movement between locations, referred to as path movement (Meir 1998a). An example of agreement through palm orientation is the verb LOOK-AT. In this sign, the fingertips are oriented toward the location associated with the object NP, and the back of the hand is oriented toward the location associated with the subject NP. Subject and object information can also be distinguished by differences in the endpoints of a verb’s path movement. These verbs (e.g., GIVE) involve path movement that typically

\(^9\) Agreeing verbs are also known as inflecting verbs (Padden 1983) and indicating verbs (Liddell 2000).
begins with the location associated with the subject and ends with the location associated with the object, as illustrated in Figure 1.12 where the subject is the signer and the object is the addressee. The \( s \) and \( a \) subscripts on GIVE in Figure 1.12 indicate that the verb moves from the location associated with the signer to the location associated with the addressee. Likewise, the \( i \) and \( j \) subscripts on GIVE in Figure 1.13 indicate that the verb moves from the location associated with the referent \( i \) to the location associated with referent \( j \).

Figure 1.12. Agreeing verb GIVE: “I give you”

\[ \text{a) sPT “I”} \quad \text{b) sGIVEa “I-give-you”} \]

10 With some agreeing verbs, the path movement begins with the location associated with the object and ends with the location of the subject. These verbs are known as backwards verbs (Brentari 1988, Meir 1998b, Padden 1983). For all agreeing verbs, whether backwards or not, subject agreement is optional.
Figure 1.13. Agreeing verb GIVE: “She gives him”

Agreeing verbs may also be marked for number. According to Padden (1983), agreeing verbs can be unmarked for number, as are singular verbs or verbs indicating a single event involving a group of entities acting as a whole (i.e., collective plurals). They can also be marked for dual, trial (for some signers), and plural agreement. A verb inflected for dual has movement repeated twice, one movement associated with each referent. A verb inflected for trial has movement repeated three times – again, one movement associated with each referent. Two of the most commonly described plural inflections are known as the multiple and the exhaustive. Multiple (mult) inflection on a verb indicates general plural, with number and distribution unspecified. The form of multiple inflection involves “…a sweep along an arc of the horizontal plane of indexic space perpendicular to the direction of the base movement” (Klima & Bellugi 1979, p. 283); see Figure 1.14a. Furthermore, according to Newkirk (1998), the multiple form is “a smooth sweeping arc to the ipsilateral side of the indexic plane” (p. 68), meaning that for
right-handed signers this form is produced toward the signer’s right side and for
left-handed signers, it is produced toward the signer’s left side. Exhaustive (exh)
inflection, on the other hand, indicates distributed plural (action distributed to
each of several entities). The form of exhaustive inflection involves “…multiple
iterations -- specific articulations of the verb -- in a series along an arc in the
indexic plane, with successive articulations displaced laterally” (Klima & Bellugi
1979, p. 284); see Figure 1.14b. Newkirk (1998) further notes that the exhaustive
form is produced with “one iteration at each indexic point” (p. 70). Also, the
repetition is slow and deliberate for specific, small numbers of referents (e.g.,
three or four referents); the speed increases relative to the number of referents

Figure 1.14. Plural forms of GIVE

a) GIVE[exh] "give to each of several" b) GIVE[mult] "give to many"

3.3.4. Spatial vs. agreeing verbs

Spatial verbs and agreeing verbs are similar in many ways. Notice that the
spatial verb MOVE-FLAT-OBJECT in Figure 1.11 is very similar in form to the
agreeing verb GIVE shown in Figure 1.13. For GIVE, the movement begins at the location associated with the subject and ends with the location associated with the object. For MOVE-FLAT-OBJECT, the beginning and ending points of movement represent the initial and final locations of the object being moved. However, both verbs agree with locations set up in the discourse. The locations happen to correspond to different types of arguments.

Spatial verbs show variation that looks like number inflection, but Padden (1983) has found evidence that these forms are not inflected for number. For example, she notes that phonetic variation is semantically distinctive for spatial verbs. Note the difference in meaning between Figures 1.15a and 1.15b. In 1.15a, the two path movements of the verb are approximately the same length, while in 1.15b, the second path movement is longer than the first. According to Padden (1983), the sign in Figure 1.15b indicates a very different locative relationship from that in Figure 1.15a. The distinction between the endpoints of a spatial verb is gradient; any variation of location (in Figure 1.15, the first location, second location and third location) is distinctive, such that 1.15a and 1.15b differ in meaning.
The agreeing verb GIVE can be formed in a way that looks very similar to the modification of the spatial verb PUT shown in Figure 1.15; cf. Figures 1.16a and 1.15a. However, the form shown in Figure 1.15b is a phonetic variant that is NOT semantically distinct from Figure 1.15a. Both forms in 1.15 are variants of the distributed plural form (known as the exhaustive). For spatial verbs, phonetically similar forms are distinctive in meaning, but for agreeing verbs, phonetic variants are not distinctive in meaning. Thus, the distinction between the endpoints of an agreeing verb is discrete; any variation within a discrete area (in Figure 1.16, the first location, second location and third location) is not distinctive, such that 1.16a and 1.16b are not distinctive in meaning.\textsuperscript{11}

\textsuperscript{11}Engberg-Pedersen (1986) notes the same pattern for Danish Sign Language, where “the exact number of repetitions with a spatial verb is significant; it indicates a specific number of different locations as e.g., ‘to put in three different places.’” (p. 33). Thus, Engberg-Pedersen claims, spatial verbs cannot be marked for exhaustive.
Figure 1.16. Two forms of GIVE[exh]

a) GIVE[exh] ‘give to each of several’    b) GIVE[exh] (alternate form)

3.4. Use of space for reference: Agreement?

The way that verbs like GIVE use space has typically been considered to
be a linguistic process of agreement. Under this analysis, the $s$ and $a$
subscripts on GIVE in Figure 1.12a would indicate that the verb is marked for subject
agreement with the signer and object agreement with the addressee. These
processes hold for agreement with non-addressed participants as well as
agreement with the signer and/or addressee(s), as shown in Figure 1.12b.

The way verb agreement works in ASL has been analyzed in many
different ways. The first dictionary of ASL based on linguistic principles,
considered to be one of the first acknowledgements of ASL as a true language,
describes these signs as inflected for “personal reference” (Stokoe et al. 1965).
Friedman (1975) as well as Edge & Hermann (1977) refer to these verbs as
‘multi-directional,’ and describe them only in terms of source and goal.
3.4.1. Inflection for person

Fischer & Gough (1978) describe verbs such as GIVE simply as ‘directional verbs’, only briefly mentioning that the closest analogous function to directionality in speech is “inflection for person” (p. 28). Although Friedman (1975) does not specifically refer to person inflection on these verbs, she does use a three-person system to analyze pronominal reference. Others have also used a three-person system to describe “indexical inflection”, “referential indexing” (Klima & Bellugi 1979) or “indexic reference,” (Padden 1983, Padden 1990); these are all terms for the way that pronouns as well as verbs like GIVE use space.

3.4.2. Locus feature

One problem with positing a three-person system for ASL is that if the feature in question were person, each non-signer, non-addressed participant present would have the same value (i.e., third person). However, there are theoretically an infinite number of ‘third person’ location values (i.e., locations associated with referents other than the signer or addressee) that can be assigned to an indexer or verb. Thus, following Lacy (1974), there have been several proposals that steer away from a person analysis and instead analyze the locations associated with pronouns and agreeing verbs as variables (‘loci’) whose content comes from discourse (Cormier et al. 1999, Lillo-Martin & Klima 1990). Following Emmorey (2002), I will refer to the locations that are used for referential purposes as spatial locations, since there is evidence to suggest that
these locations are not merely precise one-dimensional locations in space but rather three-dimensional regions of space (Liddell 2000: see also 3.4.4 below).

Bahan (1996) has a similar analysis in which agreement is with a bundle of phi-features, and information from this bundle “constitute(s) the ‘person’ feature” (p. 84). Bahan’s analysis is based loosely on the locative analysis of Gee & Kegl (1982). Janis (1995) also has a locative analysis of agreement (with no reference to person) in which nominals are assigned locative case and verbs agree with these locations.

3.4.3. First vs. non-first person

Although the locus feature analysis avoids the problems with an analysis that has multiple third person values, it does not address the special status of first person in ASL. As described above, Meier (1990) notes that the first person plural form WE is idiosyncratic and does not point to its referents in the way that other pronouns do. Although the first person singular form ME does follow the general pattern of a point to the referent (specifically, a point to the signer’s chest), Meier also notes that this sign does not invariably refer to the signer. In the discourse strategy known as role shift, which can function as a method of direct quotation, a point to the self refers to the person whose role the signer is assuming (i.e., the person being quoted), not the signer him/herself. Thus, a point to the self does not always indicate the signer. Meier therefore proposes a two-person system: first person and non-first person. According to this analysis, there is no grammatical distinction between second and third person, since as Meier
notes, the only factor distinguishing reference to the addressee from reference to a third person is eye gaze.

Many researchers currently follow Meier’s view about a two-person system in ASL, including Padden (1990), Lillo-Martin (1995), Emmorey (2002) and Rathmann & Mathur (in press). This two-person system has been attributed to other signed languages as well, including Danish Sign Language (Engberg-Pedersen 1993), Polish Sign Language (Farris 1994), and Taiwan Sign Language (Farris 1998). Bahan et al. (2000) and Neidle et al. (2000) subscribe to Meier’s first vs. non-first person analysis but claim that “nonfirst can be further classified into many distinct person values” (Bahan et al. 2000, p. 6). Thus it seems that Bahan et al. and Neidle et al. actually posit a multi-person system rather than a two-person system.

3.4.4. Agreement as gestural

One characteristic that all of the above analyses share is that they all consider verb agreement to be a linguistic process, either morphologically or in terms of the discourse structure. Liddell (1990 and subsequent publications) gives several reasons for rejecting the notion of the use of pronouns and verbs like GIVE as a grammatical process. Previous proposals, he says, all share the assumption that some sort of spatial morpheme is attached to the pronoun or verb. However, he claims that there can be no representation of these spatial morphemes in the grammar because a) the list of morphemes in the grammar would have to be non-discrete and infinite, while the nature of morphology is that morphemes are discrete and finite, and b) pronouns and verbs are directed, not
towards specific points in space, but towards general areas that vary depending on
the verb and on the referent. Liddell (2000) also rejects the first vs. non-first
person analysis of Meier (1990), because if there were only a two-person system,
there could be only two distinct forms: one for first person and one for non-first
person. However, because there are an infinite number of possible non-first
person forms, Liddell claims this analysis is not feasible.

To address these problems, Liddell (1990, 1995, 1996, 1998, 2000) and
Liddell & Metzger (1998) offer a very different description of the way ASL verbs
use space. Liddell claims that the relationship between indicating verbs (his term
for agreeing verbs) and location is not linguistic (and therefore not what is
normally considered ‘agreement’). Instead he claims that verbs point to people
and objects the same way that hearing people normally use gestures to point to
people and objects. He assumes that signers use these pointing gestures both
when the referents are present and also when the referents are not present (in
which case signers point to people and objects as if they were present).

Liddell claims that indicating verbs are not directed towards specific
points in space but instead towards a three-dimensional volume of space, which
he calls a ‘token’; we can see this by looking at differences across verbs.12 The
verb GIVE, for example, is produced at chest level, as shown in Figure 1.14. If a
short person was describing that she gave something to a tall person, the short
person would sign GIVE toward a higher location than if she were describing
giving something to someone her own height. Thus, Liddell argues, indicating

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12 This was also observed by Fischer & Gough (1978).
verbs are directed towards three-dimensional entities (either real or imagined) rather than points in space.

Liddell (1990, 1995, 2000) also notes that different signs are directed towards different areas of the body. Thus, he says, GIVE is produced at the height of the chest, INVITE is produced at the lower abdomen, and ASK is produced at the chin. According to Liddell (1995), the only linguistic (i.e., lexically specified) information within pronouns and indicating verbs is the hand configuration, certain movements, and possibly palm orientation.

I adopt a solution for [pronouns] and for indicating verbs in which the handshapes, certain aspects of the orientations of the hand, and types of movement are lexically specified through phonological features, but for which there are no linguistic features identifying the location the hands are directed toward. Instead, the hands are directed toward the specific part of the referent's body... by non-discrete gestural means (Liddell 1995, p. 26).

3.4.5. Problems with Liddell’s gestural analysis

It is certainly clear that there must be some mixture of language and gesture within signed languages, and the two can be difficult to distinguish within the visual/gestural modality (Haukioja 1993, Johnston 1992a). However, several researchers have noted some problems with a purely gestural account of verb agreement. For instance, Emmorey (1996, 2002) notes that at some level the association of a nominal with a location in space needs to be part of the linguistic representation in order to account for co-reference relationships and anaphora. Furthermore, according to Lillo-Martin (1997), evidence from acquisition suggests that children will not use iconic, analog mappings of space when
learning pronominal and agreeing forms (Meier 1982, Meier in press, Petitto 1987).

Although it seems likely that there is some gestural component to the agreement process, the use of the signing space must be at least somewhat linguistic. For instance, some forms seem less ‘gestural’ than others. The pronoun PRO is indeed quite gestural in the way that it uses space, and perhaps the same could be said of the verb GIVE. The fact that this verb is produced at the chest level reflects the action of handing an object to someone, which typically occurs at about the chest level. However, many other verbs are not so mimetic. There is nothing mimetic or gestural about the verb ASK being directed toward the chin, or the verb INVITE being produced at the lower abdomen. These particular locations must be encoded in the grammar. Thus, contrary to Liddell (1995), these facts suggest that the part of the body toward which the verb is directed must also be lexically specified, in addition to the lexical specification of handshape, palm orientation, and movement of these verbs.

A further problem is that Liddell also does not address how plural forms use space. Liddell & Metzger (1998) claim that “in normal discourse, the sign PRO is a grammatical entity with a superimposed deictic, gestural component” (p. 692). How does this apply to plural pronouns? There are two possibilities that I see under Liddell’s analysis. One possibility is that plural pronouns are the same as singular pronouns (PRO) in terms of the linguistic component (i.e., handshape, orientation, etc...); the gestural component just applies to several different locations. This possibility is not feasible because it does not account for the
idiosyncratic form of first person plurals like WE. Another possibility is that the sign PRO is a grammatical entity marked for number, with a superimposed deictic, gestural component. This seems more plausible than the first possibility. However, the questions remain: Does the grammatical category number affect the deictic, gestural component? If so, how? To what extent is the form of a plural verb affected by the locations associated with the referents of its argument? If the form of a plural verb is greatly affected by the locations of its referents, then the number system is more indexic. If the form of a plural verb is not very affected by the locations of its referents, then the number system is less indexic. I propose that loss of indexicality may be due to grammaticization.

4. GRAMMATICALIZATION

Grammaticization is the process by which, over time, lexical units may assume grammatical functions—e.g., verbs become auxiliaries—and grammatical units may assume a still more grammatical function—e.g., auxiliaries become verbal affixes (Diessel 1999, Heine et al. 1991, Lehmann 1985). Common examples in English include will and have, which both originated as main verbs in Anglo-Saxon. Both will and have are still in use as main verbs today (although will as a main verb is not as common as it once was); see Examples 1.1a and 1.2a. These verbs developed into auxiliaries as in Examples 1.1b and 1.2b (as free morphemes) and Examples 1.1c and 1.2c (as bound morphemes).

Example 1.1. Grammaticization of will in English
1.1a. She attempted to will herself out of bed.
1.1b. She will meet him at the party.
1.1c. She’ll meet him at the party.
Example 1.2. Grammaticization of *have* in English

1.2a. They **have** three apples.
1.2b. They **have** taken three apples.
1.2c. They’ve taken three apples.

Lexical and grammatical elements can be considered to form a cline, or continuum, of grammaticization from free content words to bound grammatical morphemes (Diessel 1999). Between the two ends of the continuum items may be more or less grammaticized. Grammaticization is the process by which an item moves toward the grammatical end of the continuum. This is a unidirectional process; content words become grammatical morphemes, but not the other way around.

**Figure 1.17. Continuum of grammaticization (A)**

<table>
<thead>
<tr>
<th>Free content words</th>
<th>Bound grammatical morphemes</th>
</tr>
</thead>
</table>

Similar types of grammaticization occur in signed languages. Smith (1990) argues that grammaticization of the verbs MEET and SEE in Taiwan Sign Language has yielded two auxiliary verbs that are now common in that language. Evidence of grammaticization has also been observed in ASL. Janzen (1995, 1999) has provided evidence for grammaticization of verbs of ability into modals and for grammaticization of the sign FINISH into a cliticized past tense marker (both of which are common grammaticization paths crosslinguistically). Janzen & Shaffer (in press) discuss grammaticization of nonmanual marking for yes/no questions into topicalization marking.
Different researchers have noted various principles which seem to characterize grammaticization. These principles include phonetic/phonological reduction and semantic reduction (Bybee et al. 1994, Heine et al. 1991, Lehmann 1985).13

4.1. Phonetic/phonological reduction

One characteristic of grammaticization is that forms become shortened. This is referred to as phonetic or phonological reduction (Bybee et al. 1994), or condensation (Lehmann 1985). Loss of phonological material is evident in Example 1.1c above, where the initial consonant and vowel of will are lost and the resulting bound morpheme consists of only the final consonant [l]. The same is true of have in Example 1.2, which loses the initial consonant and vowel such that the bound morpheme consists of only the final consonant [v].

4.2. Semantic reduction

In addition to phonetic/phonological reduction, grammaticization is often characterized by semantic reduction (Bybee et al. 1994), also known as bleaching or fading (Heine et al. 1991, Sweetser 1988). Looking at Example 1.1, the main verb in 1.1a indicates desire, while the grammaticized auxiliaries in 1.1b and 1.1c have lost that meaning and instead indicate future. In Example 1.2, the main verb in 1.2a indicates possession. The auxiliaries in 1.2b and 1.2c have lost that meaning and indicate perfect aspect instead. The spoken language examples of

13 Other principles of grammaticization have been proposed as well. These include decategorialization, which involves loss of discourse autonomy (Hopper 1991), fixation, in which free linear orders becoming fixed ones, and obligatorification, i.e., the tendency for optional forms to become obligatory (Lehmann 1985). I omit these from the present discussion because they do not bear directly to current study.
phonetic/phonological and semantic reduction both fit into the continuum of grammaticization shown in Figure 1.17. Both examples involve a change in the morphological status of an element.

The processes of phonetic/phonological and semantic reduction also apply to signed languages. Phonetic/phonological reduction occurs in ASL, for example, with the ASL sign meaning ‘we’. In the early 1900’s, the first person plural WE was a series of separate pointing signs beginning and ending with the first person singular sign ME (KLIMA & BELLUGI 1979). At that time, “(WE) was simply made up of (ME) + (YOU)₁ + (YOU)₂ + ... (YOU)ₙ + (ME). Today the sign makes two touches on the chest with a smooth (and small) sweep of the wrist or arm between the touches” (p. 80). The modern sign WE is more phonologically reduced; a series of several points has been reduced to two points of contact on the signer’s chest, as shown in Figure 1.18.

Figure 1.18. First person plural pronoun

WE (modern ASL)
Another example of phonetic/phonological reduction (specifically phonetic reduction) is dual inflection on verbs. Klima & Bellugi (1979) distinguish the dual verb form from a sequence of two predicates. Consider the verb GIVE (see Figure 1.19 below). The sequence of two predicates involves body shift from one side to another, while the dual does not. The dual inflection is also rhythmically distinct from a sequence of predicates; the sequence of predicates would have a pause between movements. Furthermore, the path movements of the dual form are reduced in length and thus shorter than the path movements of the sequence of predicates. The loss of body shift, the loss of the pause between movements, and the reduction in path movement constitutes phonetic reduction.

Figure 1.19. GIVE: two predicates vs. dual

![GIVE as two predicates vs. dual](image)

The dual form is also semantically reduced compared to two separate predicates. The use of two separate predicates indicates two separate events, while use of the dual indicates a single event. Thus although dual is marked on
the verb, this is not an instance of verbal number marking (as described in Section 2 above). Verbs that have dual marking indicate two referents, not two events.

Although the grammaticization of FINISH in ASL and auxiliaries in Taiwan Sign Language fit the grammaticization continuum shown above in Figure 1.17, these examples of plural forms in ASL do not fit so nicely into that continuum. The phonological and semantic reduction of the pronoun WE as well as the phonological reduction and layering in the dual verb form are due to changes in the way that these signs use the signing space, not changes in morphological status. Hopper (1991) claims that his grammaticization principles “speak only to the question of ‘more’ or ‘less’ grammaticized, not to the question of in or out of grammar” (p. 32). The element that is becoming grammaticized in these examples (i.e., spatial location) is, according to Liddell, not a part of the grammar at all. However, the grammaticization of elements that start outside the grammar is not unheard of, even in speech. For instance, onomatopoetic expressions like cock-a-doodle-doo presumably begin simply as imitations of sounds, but they become conventionalized as lexical items within a language. The fact that these expressions are conventionalized is evident from the fact that these expressions vary crosslinguistically. For instance, the sound a rooster makes in Spanish is kikiriki.

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14 Hopper (1991) makes this statement to distinguish his principles of grammaticization from those of others (e.g., Lehmann 1985), which only clearly apply to elements that are clearly already a grammaticized part of the language. His principles focus on grammaticization as a process; as such, his principles help identify elements which may be only partly (i.e., ‘more’ or ‘less’) grammaticized.
Whether spatial location is considered part of the linguistic system at the outset is not really relevant – what is important is that spatial location at the outset is *gradient*. What is happening in the above ASL examples is that spatial location is changing from gradient to discrete, or from discrete to more discrete. For example, the spatial location of the old ASL sign *WE* becomes reduced from a variable number of pointing movements pointed toward variable locations to a set number of pointing signs (two) at a set location (the signer’s chest). Also, the spatial locations associated with the endpoints of two separate predicates in Figure 1.19a become reduced from two longer path movements into two shorter ones as in Figure 1.19b. Therefore, I propose another way of thinking about grammaticization: grammaticization can also be the process of elements within a language becoming less gradient and more discrete.

**Figure 1.20. Continuum of grammaticization (B)**

<table>
<thead>
<tr>
<th>Gradient elements</th>
<th>Discrete elements</th>
</tr>
</thead>
</table>

This concept of grammaticization as one in which gradient elements become discrete need not be historical (as with the pronoun *WE*) but may instead be synchronic (as with singulare vs. plurals). Thus we can talk about spatial location marking as being more definitely grammaticized under particular sets of circumstances (e.g., reference to more than one referent). The grammaticization of spatial location is demonstrated by phonetic reduction, in particular by loss of indexicality.
5. Research Questions

Because we find evidence of grammaticization in the first person pronoun we and in dual inflection on agreeing verbs, we may expect to find grammaticization with plural marking in general. However, plurality in signed languages is one domain that has largely been overlooked with regard to indexic vs. non-indexic marking. The previous descriptions and analyses of spatial location and verb agreement discussed above have focused only on singular forms; none have addressed plural forms.

5.1. Type of number system

Given the criteria for number given above in Section 2, it seems that ASL has a grammatical number category, because ASL does have distinct ways in the grammar of referring to one versus more than one entity. However, it is not entirely clear what distinct number values are possible in the pronominal versus the verbal systems. Most researchers posit a singular—dual—plural system for both the pronominal and verbal systems. One goal of this dissertation is to determine if ASL does indeed have a three-way number distinction in the pronominal and verbal systems and if so, to provide evidence for such.

5.2. Phonetic description of singulars and plurals

The descriptions of plural and even singular forms in the literature are vague. Farris (1998) claims that in Danish Sign Language, the pointing sign does not have to be exactly in the direction of the referent’s location, only in the ‘general vicinity’. The term ‘general vicinity’ gives no information about where the pointing sign occurs relative to its referent. According to Lillo-Martin (in
press), “verb agreement involves modifying the form of a verb so that its beginning and ending locations correspond (usually) to the locations of the referents intended as subject and object, respectively.” Assuming she is describing a singular agreeing verb, how precise are these two ‘corresponding’ locations between which the verb moves? Under what circumstances do the locations of the verb not match the locations of the referents (as implied by her use of “usually”)? No researcher has attempted to quantify the use of space with singulars, much less with plurals.

5.3. Arcing movement as plural marker

Most discussions of number marking in ASL have suggested that plural forms are morphologically and predictably marked. Lillo-Martin (in press) claims that “plural forms (dual, exhaustive, and multiple) have specific morphological shapes which combine predictably with roots.” Emmorey (2002) claims that number is marked on pronouns in ASL by movement, such that a “pointing” movement marks a singular pronoun while an “arcing” movement marks a plural pronoun. At first glance of the data, these observations seem appropriate. Certainly other grammatical processes are marked in ASL by particular movement types. For instance, different aspectual markings on predicates are marked by particular movement patterns. The aspectual marker of continuous action has a repeated elliptical movement, while the marker indicating a predisposition to a certain act or state has a repeated circular movement (Klima & Bellugi 1979).

15 Padden (1990) makes a similar observation: “Plural agreement involves displacement, that is, movement away from a single point” (p. 121).
The plural pronouns YOU-PL/THEY, WE, OUR, and #ALL do indeed all have arcing movement as per Emmorey’s observation (see Figures 1.4, 1.5a, 1.5b and 1.7). However, arcing movement as a sole obligatory marker of plural becomes more problematic when we look at the dual and number-incorporated plurals and the composite plurals (see Figures 1.2, 1.3 and 1.6). The composite plurals could be considered as having several arcing movements. But the salient part of a composite pronoun is the individual pointing movements; the arcing movements are really just transition movements between each pointing movement. Neither the dual pronoun nor the number-incorporated pronouns have any arcing movement at all. The dual pronoun has a repeated back and forth movement between the locations associated with each referent, and the number-incorporated plurals have a small, repeated circular movement. So, unlike aspect, number on pronouns is not reliably marked with one particular movement pattern.

The fact that plural marking cannot be generalized to one particular pattern, I argue, is due to an inherent connection between number and spatial location marking. This close relationship between spatial location and number has been observed by others. For instance, Klima & Bellugi (1979) note that inflection for number “occurs in combination with referential indexing” (p. 285). As noted above, Newkirk (1998) claims that the exhaustive form is produced with “one iteration at each indexic point” (p. 70). However, no study has systematically looked at the relationship between spatial location and number.
5.4. Agreeing vs. spatial verbs

Recall the distinction between agreeing and spatial verbs set forth by Padden (1983). Padden’s claims about the gradient nature of spatial verbs may be appropriate for two, three, or four objects. But these claims become questionable when considering a large numbers of objects. Baker & Cokely (1980) note that classifiers can be pluralized by repeating them in different locations. Classifier predicates are a subset of the class of spatial verbs. According to Baker & Cokely, classifier predicates can be articulated such that the repetition and location of each classifier does not have to exactly represent the number and location of each referent. This suggests that spatial verbs can be inflected in a discrete, categorical way.

If the signer wants to focus on the exact number of referents, then s/he can use a number sign followed by the repeated classifier (which ‘agrees’ with the number sign…) In [one] example, the Signer uses the number sign FIVE to indicate the exact number of ‘pencils’ and then repeats the classifier to show that they are ‘in a row.’ However… ‘agreement’ does not mean the classifier must be articulated ‘five’ times, but that it is articulated three or more times to agree with the fact that the referent is plural (Baker & Cokely 1980).

More generally, not all sign linguists recognize the distinction between spatial and agreement verbs as posited by Padden (1983). Some have noted a considerable overlap in the way these two verb types use space in ASL (Farris 1998) and also in other signed languages, such as Sign Language of the Netherlands (Bos 1990) and Danish Sign Language (Engberg-Pedersen 1986). How restrictive is the movement between loci for agreeing verbs? Is this restriction greater for agreeing verbs than for spatial verbs?
5.5. Loss of indexicality

I propose that the loss of indexicality in ASL may be due to several different factors. One possibility is that motoric factors such as dampening of movement cause loss of indexation. This may account for the loss of indexicality seen in the different forms of GIVE shown in Figure 1.19. That is, the single predicate dual form of GIVE noted by Klima & Bellugi (1979) may less indexic than the two predicate form of GIVE due to dampening. A second possibility is that cognitive factors such as memory could be at play. A third possibility is that loss of indexicality is due to linguistic factors such as grammaticization.

6. Grammaticization of plural marking: The present studies

An investigation of plurality in ASL is most necessary for pronouns and for verbs, since these are the forms that use the signing space for referential purposes. Therefore, this dissertation consists of two studies: one focusing on plural pronouns in ASL and one on plural verbs.

The first study describes the indexicality of first person plural forms in ASL. Recall that the first person plural pronoun WE in modern ASL does not directly indicate its referents (see Figure 1.18). Therefore, for this study, I focused on first person plurals in order to determine if this is true of all pronouns that can be used to indicate first person plural. This study was also designed to determine whether ASL has an inclusive/exclusive contrast in the first person, since this is a widespread distinction within the first person plural pronouns of many spoken languages. This first study examines what effect, if any, inclusive/exclusive marking has on indexicality. The results show that ASL does
have exclusive forms of some plural pronouns. More importantly, the results show that different first person plural pronouns vary in terms of indexicality. Exclusive forms in particular can be entirely non-indexic.

The second study uses instrumental means to compare the indexicality of plural verbs and singular verbs. In particular, I compare the indexicality of verbs that have one referent with verbs that have two, three, or many referents. Another issue I address is: What differences are there (if any) in the way that spatial verbs and agreeing verbs use space? Can spatial verbs be marked for plural in the same way that agreeing verbs can?

The details of each study (including data collection and analysis) are discussed in Parts I and II, which focus on the exclusive pronoun study and the instrumental study, respectively. The final chapter of the dissertation is the conclusion in which the results and analyses from both studies are synthesized and directions for future research are discussed.
PART I. INDEXICALITY OF PLURAL PRONOUNS: EVIDENCE FROM INCLUSIVE/EXCLUSIVE PRONOUNS

1. INCLUSIVE/EXCLUSIVE DISTINCTION IN SPOKEN LANGUAGES

The inclusive/exclusive distinction in spoken languages occurs within first person plural pronouns. Unlike second and third person plurals, the first person plural category is somewhat anomalous. The English first person plural pronoun ‘we’, for example, is not plural in the same sense as an English plural noun. ‘I’ refers to the speaker, but ‘we’ does not mean ‘more than one speaker’. Benveniste (1971) notes: “‘We’ is not a multiplication of identical objects but a junction between ‘I’ and the ‘non-I’, no matter what the content of this ‘non-I’ may be” (p. 202). This is not only true of English, but of other languages as well. Because first person plurals indicate the speaker plus other non-specified participants, the reference of a first person plural is often quite vague. This potential ambiguity may be one reason why in some languages the first person plural encodes information other than just the inclusion of the speaker - e.g., information about whether the addressee is included. This is what has happened in languages that have separate categories for inclusive and exclusive pronouns.

Languages that have an inclusive/exclusive distinction in the first person have separate first person plural forms that indicate whether the addressee is included (‘we including you’) or excluded (‘we excluding you’). Many languages, such as English, do not have this distinction. Thus, English has only one first person plural form, *we*, which is not specified for inclusive or
exclusive. In contrast, Tagalog has a first person plural inclusive form *kamí* meaning ‘we including you,’ and a first person plural exclusive form *tayo* meaning ‘we excluding you.’

2. **INCLUSIVE/EXCLUSIVE DISTINCTION IN ASL**

Inclusive/exclusive marking has not been discussed frequently in the literature on signed languages. Deuchar (1984) briefly mentions inclusive/exclusive pronouns in British Sign Language but does not describe them. Wilbur & Patschke (1998) discuss the nonmanual marking of inclusive and exclusive with body leans; we will return to this topic later in Chapter 3.

The question of whether ASL has the inclusive/exclusive in its pronominal system is an interesting one; the remainder of this section details a study that addresses this question. On the one hand, we might expect that ASL would have an inclusive/exclusive distinction because the language is generally good at specifying referents through indexation, as noted in Chapter 1. On the other hand, we might expect that there would be no inclusive/exclusive variants with WE and OUR because (as also noted in Chapter 1) these particular forms do not index their referents; without indexing particular referents it may not be possible to include or exclude referents.

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16 Obviously, there is also the objective form *us*; however, here I will disregard case distinctions.
Chapter 2. Inclusive/exclusive study: Methods

1. PARTICIPANTS

For this study, I used videotaped data elicited from four deaf participants. All four participants were native ASL signers raised in signing households. These signers were recruited through personal contacts within the Deaf community in Austin, Texas.

2. STIMULI AND DATA COLLECTION

A questionnaire was devised to elicit different forms of first person plural pronouns. The participants were asked to translate English sentences - each with a specific context - into ASL. The sentences all used the English pronouns *we, us*, or *our*; since English does not have an inclusive/exclusive distinction, the participants had to rely on the context to determine the appropriate form of the ASL pronoun.

In the context given with each sentence, the number of referents was manipulated so as to elicit the following forms: dual inclusive, dual exclusive, trial inclusive, trial exclusive, plural inclusive, and plural exclusive. The inclusive contexts included the addressee; the exclusive contexts excluded the addressee. For the dual and trial forms, the context specified two and three referents, respectively. For the plural forms, the context specified either ‘ten or more’ or an indefinite ‘many’ referents. Furthermore, since the physical location of discourse participants is so crucial to how indices are set up in the signing space, a set of props were used to help the participants imagine real-world
discourse situations. These props were placed in front of the participants to represent where the referents were located with respect to the signer. The props were occasionally moved from right to left and vice-versa to see what effect the location of the referents had on the location of the pronoun.

3. CODING OF DATA

Each data collection session was videotaped with an 8mm video camera. I coded the data from each session by recording the following information for every pronoun produced by each participant: a gloss for the pronoun, the location of the pronoun (right of the signer’s midline, left of the midline, or at the midline), whether the context was inclusive or exclusive, and the location of the props (right of the signer’s midline, left of the midline, or at the midline). Further details were also coded, such as the handshape of the pronoun and any nonmanual behaviors (such as body leans and eye gaze) that may have co-occurred with the pronoun.
Chapter 3. Inclusive/exclusive study: Results

1. DESCRIPTION OF FIRST PERSON PLURAL PRONOUNS

Results from the study revealed six different forms of the first person plural pronoun in ASL, including one possessive form. Of these six forms, four were often produced at or near the center of the signer’s chest. Each of these forms had a variant that could be displaced to the signer’s left or right side, near the shoulder, as in Figure 3.1. I will refer to these forms (both central and displaced variants) as *lexical plurals* because they do not index (i.e., point to) the locations of individual referents; thus, these signs are lexicalized with respect to location. The four lexical plurals are described in Table 3.1; see Chapter 1 for illustrations of these signs.

Figure 3.1. Displaced lexical plural (ipsilateral)

![Figure 3.1. Displaced lexical plural (ipsilateral)](image)

WE -DISPLACED
Table 3.1. Lexical plural pronouns coded

<table>
<thead>
<tr>
<th>Type of first person plural</th>
<th>Variants</th>
<th>Phonetic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>First person plural</em> <em>(WE)</em>: Signer’s hand moves from one point on chest to another, both in same horizontal plane.</td>
<td>WE-CENTRAL</td>
<td>Produced at or near the center of the signer’s chest; the signer’s midline is the axis of the arc</td>
</tr>
<tr>
<td></td>
<td>WE-DISPLACED</td>
<td>Produced slightly left or right of the signer’s midline on the chest; typically involves rotation of the forearm</td>
</tr>
<tr>
<td><em>Number-incorporated first person plurals</em> <em>(3/4/5-OF-US)</em>: Signs made with 3, 4 or 5 handshape (palm up) with small circular motion</td>
<td>3/4/5-OF-US-CENTRAL</td>
<td>Produced at or near the center of the signer’s chest</td>
</tr>
<tr>
<td></td>
<td>3/4/5-OF-US-DISPLACED</td>
<td>Produced on either the signer’s left or right side</td>
</tr>
<tr>
<td><em>First person plural possessive</em> <em>(OUR)</em>: Signs made with bent-B handshape, starting with thumb-side of hand near or contacting chest with arcing forearm rotation so that pinky-side of hand ends near or contacting the chest</td>
<td>OUR-CENTRAL</td>
<td>Like WE-CENTRAL, produced at or near center of the signer’s chest such that signer’s midline is axis of arc</td>
</tr>
<tr>
<td></td>
<td>OUR-DISPLACED</td>
<td>Like WE-DISPLACED, produced slightly left or right of signer’s midline</td>
</tr>
<tr>
<td><em>Universally quantified first person plurals</em> <em>(ALL-OF-US)</em>: First person plural version of fingerspelled loan sign #ALL. Produced with A-handshape moving outward, opening to L-handshape. Not to be confused with ALL, produced with flat hand.</td>
<td>ALL-OF-US-CENTRAL</td>
<td>Produced at or near center of signer’s chest; signer’s midline is axis of arc.</td>
</tr>
<tr>
<td></td>
<td>ALL-OF-US-DISPLACED</td>
<td>Produced slightly to left or right of the signer’s midline.</td>
</tr>
</tbody>
</table>

The central variant of the first person plural pronoun WE may or may not have a large arcing motion with forearm rotation; if not, the signer merely touches
with her index finger two points in the same horizontal plane at the center of her chest. Baker-Shenk & Cokely (1981) claim that the variant with large arcing motion is used when the referents are present, while the variant without this arcing motion is used when the referents are not present. However, some of my participants claimed there is no difference between these forms; therefore, for some signers the arcing and non-arcing variants may be in free variation. Figure 3.2 shows these two variants of WE-CENTRAL.

Figure 3.2. Variants of WE-CENTRAL

There are two other pronominal forms that do not seem to be lexicalized vis-à-vis location in the way that lexical plurals are. I refer to these pronouns as *ostensive pronouns*, because in general they transparently point to the location of each referent. Table 3.2 shows descriptions of these two forms.
Table 3.2. Ostensive plural pronouns coded

<table>
<thead>
<tr>
<th>Type of first person plural</th>
<th>Phonetic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite first person plural (WE-COMP): series of pointing signs that point to each member of some set</td>
<td>Varies depending on which referents are being indexed</td>
</tr>
<tr>
<td>Dual (TWO-OF-US): Signs made with K-handshape where arm or wrist moves between locations associated with signer and some other referent.</td>
<td>Varies depending on which referents are being indexed</td>
</tr>
</tbody>
</table>

WE-COMP is a sign consisting of several pointing signs which refer exhaustively to each member of some set (cf. composite pronouns from Forchheimer 1953). This form differs from a simple concatenation of pointing signs in that the pointing signs of WE-COMP are produced in quick succession, with dampened movement (i.e., each path movement is shorter than the one before it) and sometimes with alternating hands (e.g., right hand, then left, then right, etc...). WE-COMP is shown in Chapter 1 (Figure 1.6).

For two referents, the sign TWO-OF-US is used (see Chapter 1, Figure 1.2 for illustration). Rather than a series of pointing signs, this sign has a K-handshape. To produce the K-handshape, the index and middle fingers are extended, and the thumb contacts near the base of the middle finger. The use of this handshape here is idiosyncratic; one might have expected either an index handshape pointing to each of the two referents, as with WE-COMP, or given the handshapes of the other number-incorporated signs, a V-handshape (index and middle finger extended). For instance, other signs that incorporate the number
two (e.g., TWO-WEEKS) use a V-handshape rather than a K-handshape (McBurney in press).

Facial expression and body position are important elements of ASL; these elements are referred to collectively in the literature as nonmanual signals (NMS). NMS are important for grammatical as well as affective marking. Some of the more prevalent NMS that the signers produced were: cheek-to-shoulder (CS), body shift, body lean and eyegaze. All of these signals act as grammatical markers; some may additionally indicate affect. Each of these NMS and their use with exclusive pronouns are described in the Appendix.

While these NMS and others (e.g., raised eyebrows, furrowed eyebrows, head nods and head shakes) were used extensively by the informants in this study, none were used reliably to mark inclusive or exclusive. This may be due to the fact that these NMS are used quite frequently for other grammatical and affective reasons (e.g., topic marking, affect for doubt, affirmative marking, and negation); the participants in this study used NMS for these purposes.

2. Spatial displacement of pronouns

In order to determine if the displacement occurring with the lexical plural pronouns was due to inclusive/exclusive marking, I examined the distribution of each pronoun location (at the center, displaced to the right, or displaced to the left) in terms of whether the context was inclusive (i.e., including the addressee) or exclusive (i.e., excluding the addressee). The results are shown in Figure 3.3.
In inclusive contexts, lexical pronouns tended to be central, while in exclusive contexts these pronouns tended to be displaced to the contralateral or ipsilateral side.17 In order to determine if these tendencies are due to a grammatical inclusive/exclusive distinction, I elicited further grammaticality judgments for each of the lexical plurals mentioned. Participants were shown sentences like Examples 3.1 and 3.2 and were then asked if these sentences could be used in an inclusive context, an exclusive context, or either. A summary of these grammaticality judgments is shown in Table 3.3.

17 All the participants in this study were right-handed. Therefore, pronouns produced on the signer’s ipsilateral side were on the right, while pronouns produced on the contralateral side were on the left. I suspect that the contralateral (i.e., left) side was more common for exclusive forms for articulatory reasons; pointing to the ipsilateral shoulder (in the case of WE-DISPLACED) or producing a circular movement at the ipsilateral shoulder (in the case of THREE-OF-US-DISPLACED) is a bit more awkward than producing these signs on the contralateral side.
Example 3.1  NEXT-WEEK **WE-CENTRAL** GO-OUT MOVIE

“Next week we’ll go out to see a movie.”

Example 3.2  NEXT-WEEK **WE-DISPLACED** GO-OUT MOVIE

“Next week we’ll go out to see a movie.”

Table 3.3.  Grammaticality judgments for lexical plurals in inclusive and exclusive contexts

<table>
<thead>
<tr>
<th><strong>Lexical Plurals</strong></th>
<th><strong>Inclusive context</strong></th>
<th><strong>Exclusive context</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WE-CENTRAL</strong></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>WE-DISPLACED</strong></td>
<td>*</td>
<td>√</td>
</tr>
<tr>
<td>3/4/5-OF-US-CENTRAL</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>3/4/5-OF-US-DISPLACED</td>
<td>*</td>
<td>√</td>
</tr>
<tr>
<td><strong>ALL-OF-US-CENTRAL</strong></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>ALL-OF-US-DISPLACED</strong></td>
<td>*</td>
<td>√</td>
</tr>
<tr>
<td><strong>OUR-CENTRAL</strong></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>OUR-DISPLACED</strong></td>
<td>*</td>
<td>√</td>
</tr>
</tbody>
</table>

(√ indicates grammatical; * indicates ungrammatical)

According to Table 3.3, the central forms are grammatical in inclusive and exclusive contexts. The displaced forms are grammatical in exclusive contexts only. These classifications yield the results shown in Table 3.4 (the checkmark indicates that a form for each of these pronouns exists for the category given).

Since there is no form that is grammatical for inclusive but ungrammatical for exclusive, we cannot posit a distinct inclusive category for lexical plurals. However, the fact that the displaced forms of the lexical plurals are grammatical in the exclusive context and ungrammatical in the inclusive context shows that there is a distinct exclusive category for lexical plurals.
Table 3.4. Inclusive/exclusive categories in lexical plurals

<table>
<thead>
<tr>
<th>Lexical Plural</th>
<th>Inclusive</th>
<th>Exclusive</th>
<th>Unmarked</th>
</tr>
</thead>
<tbody>
<tr>
<td>WE</td>
<td>√</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>3/4/5-OF-US</td>
<td>√</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>ALL-OF-US</td>
<td>√</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>OUR</td>
<td></td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>

For the ostensive plurals WE-COMP and TWO-OF-US, it seems inappropriate to posit any sort of inclusive/exclusive distinction, since these forms pick out certain referents but do not particularly include or exclude anyone. These forms include all and only the referents that they point to, as described in Table 3.5. Other referents are ‘excluded’ only in the sense that they happen to not be included.

Table 3.5. Semantic description of ostensive pronouns coded

<table>
<thead>
<tr>
<th>Type of first person plural</th>
<th>Semantic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Composite plural</em></td>
<td>Includes all and only referents that are pointed to. If point to self is included, then this is a first person plural (WE-COMP: ‘me, him, her, and him’).</td>
</tr>
<tr>
<td><em>Dual</em></td>
<td>Includes both and only the two referents that are pointed to. If point to self is included, then this is a first person dual (TWO-OF-US).</td>
</tr>
</tbody>
</table>

The results so far suggest that the displaced forms are exclusive in the same sense that spoken languages with an inclusive/exclusive distinction have exclusive forms. However, this is not exactly true. Wilbur & Patschke (1998) noted than body leans in ASL indicate inclusive/exclusive on a broader basis. A lean forward indicates inclusion, while a lean backward indicates exclusion. These leans can be used with any noun (not just first person pronouns) to indicate
inclusion or exclusion of whatever referent is salient in the discourse. Thus a lean forward can include the addressee, or it can include the signer or a non-addressed third participant.

The study described in this chapter was initially designed to elicit forms that included or excluded only the addressee, since the addressee is the referent that is included or excluded in spoken languages that have an inclusive/exclusive distinction. However, following Wilbur & Patschke’s (1998) finding that forward and backward leans can indicate inclusion or exclusion of participants other than just the addressee, it became clear that it was necessary to see if the forms identified as exclusive can be used to include or exclude discourse participants other than the addressee as well. Consultations with my native signer participants about other possible meanings of the displaced pronouns revealed that these exclusive forms can indeed exclude any referent that is salient in the discourse situation, not just the addressee.18 This salient referent can be someone who has not been explicitly mentioned in the discourse. Furthermore, the excluded referent can be someone not present. Thus, in Example 3.3, assuming a discourse situation with three present participants (i.e., the signer, X, and Y as shown in Figure 3.4) and also another non-present referent Z, the form THREE-OF-US-DISPLACED can exclude X, Y, or Z, as shown in Table 3.6.19 However, Table 3.6 also reveals that if there is no salient referent other than the signer, X, and Y,

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18 Since I had found no systematic use of body leans in my data, I simply asked the participants about other possible meanings of the displaced exclusive pronouns produced without any particular use of body leans.
19 The location of THREE-OF-US-DISPLACED, shown on the signer’s ipsilateral side in Figure 3.4, could alternatively be on the contralateral side, in which case, the same grammaticality judgements in Table 3.6 would hold.
THREE-OF-US-DISPLACED is ungrammatical, because this form must exclude someone.20

Example 3.3  NEXT-WEEK THREE-OF-US-DISPLACED GO-OUT MOVIE

“Next week the three of us will go out to see a movie.”

Figure 3.4. Bird’s-eye view of discourse situation for example (3.3).

(The location of the pronoun THREE-OF-US-DISPLACED is marked by ‘*’.)

Table 3.6. Grammaticality judgments of Example 3.3, based on discourse situation shown in Figure 3.4.

<table>
<thead>
<tr>
<th>Referents (with Z introduced as non-present participant)</th>
<th>Grammatical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signer + X + Y (excluding Z)</td>
<td>√</td>
</tr>
<tr>
<td>Signer + X + Z (excluding Y)</td>
<td>√</td>
</tr>
<tr>
<td>Signer + Y + Z (excluding X)</td>
<td>√</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Referents (no other salient referent in discourse)</th>
<th>Grammatical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signer + X + Y</td>
<td>*</td>
</tr>
</tbody>
</table>

Based on the grammaticality judgments summarized in Tables 3.3 and 3.6, a semantic description of the lexical plural variants is shown in Table 3.7. This

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20 Of course, X + Y + Z (excluding Signer) would also be ungrammatical, since these are first person forms.
The table indicates that the exclusive forms can exclude any salient referent, not just the addressee. Any form that is specifically marked [-SR] (i.e., any displaced form) is exclusive in that it excludes some salient referent. All other forms are unmarked (i.e., neither inclusive nor exclusive).

Table 3.7. Semantic description of lexical pronouns coded

<table>
<thead>
<tr>
<th>Type of first person plural</th>
<th>Unmarked / exclusive variants</th>
<th>Semantic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>First person plural (WE)</td>
<td>WE-CENTRAL</td>
<td>Same semantics as English ‘we’: signer + other</td>
</tr>
<tr>
<td></td>
<td>WE-DISPLACED</td>
<td>Signer + other, excluding some salient referent</td>
</tr>
<tr>
<td></td>
<td>3/4/5-OF-US-DISPLACED</td>
<td>Signer + other (cardinality specified), excluding some salient referent</td>
</tr>
<tr>
<td>First person plural possessive (OUR)</td>
<td>OUR-CENTRAL</td>
<td>Same semantics as English ‘our’: signer + other</td>
</tr>
<tr>
<td></td>
<td>OUR-DISPLACED</td>
<td>Signer + other, excluding some salient referent</td>
</tr>
<tr>
<td>Universally quantified first person plurals (ALL-OF-US)</td>
<td>ALL-OF-US-CENTRAL</td>
<td>All of a given set including signer + other</td>
</tr>
<tr>
<td></td>
<td>ALL-OF-US-DISPLACED</td>
<td>All of a given set including signer + other, excluding some salient referent</td>
</tr>
</tbody>
</table>

(some salient referent = any referent salient in the discourse other than the signer)

In this section we have seen that ASL lexical pronouns like WE can be displaced to the signer’s ipsilateral or contralateral side; these displaced forms are marked for exclusive. Furthermore, unlike spoken languages that have inclusive/exclusive marking, the excluded referent for these forms can be not only the addressee, but any referent that is salient in the discourse.
3. DISCUSSION

So far I have defined lexical plurals as plural forms that do not point to the locations of their individual referents. Lexical plural pronouns (WE, 3/4/5-OF-US, OUR, and ALL-OF-US) do not point to each referent. However, in a non-exclusive context, these forms can index the general location of the referents as a group. For example, the number-incorporated forms can be used indexically to distinguish between a group of three on the signer’s left versus a group of three on the signer’s right, as shown by the juxtaposition of the two forms of THREE-OF-US in Figures 3.5 and 3.6. Baker-Shenk & Cokely (1981) claim that, regardless of person, the location of the referents determines the location of the pronouns, such that in Figure 3.7, the pronoun THREE-OF-US at Location 1 (shown in Figure 3.5) would include (signer + Y + Z), and the same form at Location 2 shown in Figure 3.6 would include (signer + X + Y).

Figure 3.5. THREE-OF-US-DISPLACED (Location 1 in Figure 3.7)
I agree with Baker-Shenk & Cokely (1981) that the pronoun THREE-OF-US produced on the signer’s right or left side can indeed index a group of referents. If articulated at Location 1 in Figure 3.7, for example, this pronoun refers to the signer + Y + Z because Y is directly in front of the signer and Z is to
the signer’s right; taken together the group is basically on the signer’s right side. My data included several instances of lexical pronouns that were indexic of a general location in this way, as in Example 3.4 below. In Example 3.4, the referents of the pronoun THREE-OF-US (i.e., the props) were generally to the right of the signer (signer + X + Y), as shown in Figure 3.8. The signer produced a pronoun that was also on her right side.

Example 3.4 THREE-OF-US-DISPLACED LIKE CAT
‘The three of us like cats.’

Figure 3.8. Bird’s-eye view of discourse situation during production of Example 3.4. X and Y are referents; X represents the addressee.

However, THREE-OF-US-DISPLACED can also be exclusive, in which case it need not indicate the location of its referents. For instance, the pronoun at Location 1 in Figure 3.7 could include (signer + X + Y), in which case Z or some non-present referent must be excluded. In this situation, the pronoun is not at all indexic because the pronoun is being produced on the signer’s right side while the referents are directly in front of her and to her left.
The following example from my data illustrates exactly this point. In Example 3.5, the referents of the pronoun THREE-OF-US (i.e., the props) are to the signer’s right (signer + Y + Z), as shown in Figure 3.9. A pronoun matching the location of the referents in this instance would be on the signer’s right side (as in Figure 3.8 above). One of the participants of this study, however, produced a pronoun not only on her left side (represented in Figure 3.9 by ‘*’), but also with her left hand (despite the fact that she is normally right-handed). Specifically, the participant produced the sign THREE-OF-US-DISPLACED with her left hand, then holding her left hand in place produced the rest of the sentence (FOND-OF CAT) with her right hand.

Example 3.5

Left hand: THREE-OF-US-DISPLACED
Right hand: FOND-OF CAT
‘The three of us (excl) love cats.’

Figure 3.9. Bird’s-eye view of discourse situation during production of Example 3.5. X, Y, and Z are referents; X represents the addressee.

(The location of the pronoun THREE-OF-US-DISPLACED is marked by ‘*’.)
These examples reveal two functions of displacement for these pronouns: indexation of groups and exclusive marking. Indexation is fairly gradient for 3/4/5-OF-US and ALL-OF-US; that is, these forms can be produced at any location in the signing space and have a distinct meaning. Indexation is not gradient with WE and OUR since these forms are body-anchored and are more restricted in the extent to which they can be spatially modified. Only two indexic forms are possible for WE and OUR: ipsilateral and contralateral.

Examples like 3.5 show that an exclusive context requires displacement of the pronoun to the ipsilateral or contralateral side and that the pronoun’s location does not have to match the location of the referents. In a context which is neither inclusive or exclusive, the pronouns WE, OUR, 3/4/5-OF-US, and ALL-OF-US can either be produced in the unmarked (i.e., central) form, which is not indexic, or they may index the general location of their referents. However, modulations for exclusive interfere with any default indexic properties that these pronouns may have, resulting in examples like 3.5. The fact that it is possible to produce non-indexic forms in both neutral and exclusive contexts is compelling evidence for the lexical rather than ostensive status of these pronouns. The unmarked and exclusive forms together provide evidence for the lexical status of these pronouns, whether particular tokens are indexic or not.

4. LATERAL INDEXICALITY

Example 3.3 and Figure 3.9 demonstrate that lexical pronouns do not have to match the location of their referents. This observation can be quantified by calculating how many pronoun tokens in this study match the location of the
props that represent the referents (i.e., right, left or center). This is a measurement of what I will refer to as lateral indexicality: i.e., how indexic a sign is in terms of the side of the signer’s midline on which it is produced. This will address the question of how closely pronouns match the location of their referents.

4.1. Lateral indexicality for ostensive vs. lexical pronouns

We would of course expect that ostensive pronouns are more laterally indexic than lexical plurals, since ostensive plurals point to each of their referents while lexical plurals do not. This does indeed turn out to be the case, as shown in Figure 3.10. According to Figure 3.10, 76% of ostensive pronouns (including the dual and composite forms) match the location of the props (right, left, or crossing the midline), while 52% of lexical pronouns (including WE, OUR, 3/4/5-OF-US, and ALL-OF-US) match the location of the props. Thus the lateral indexicality of the lexical plurals is no better than chance.
While Figure 3.10 shows that the ostensive pronouns are clearly more indexic than the lexical pronouns, it does seem curious that the ostensive pronouns are not 100% indexic as we might assume. Table 3.8 lists 11 ostensive pronoun tokens from this study that are not laterally indexic.

Of the 11 ostensive pronoun tokens that did not match the location of the referents, two were tokens of WE-COMP and nine were tokens of TWO-OF-US. The two WE-COMP tokens (type C) did not match because in both cases the referents were located on the signer’s right side while the pronoun started on the left and ended on the right. So these tokens are at least partially indexic.
Table 3.8. Non-indexic ostensive pronouns

<table>
<thead>
<tr>
<th>Type</th>
<th>Pronoun</th>
<th>Location of referents</th>
<th>Location of pronoun</th>
<th>Tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>TWO-OF-US</td>
<td>center</td>
<td>ipsilateral</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>TWO-OF-US</td>
<td>contralateral</td>
<td>ipsilateral</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>WE-COMP</td>
<td>ipsilateral</td>
<td>contralateral to ipsilateral</td>
<td>2</td>
</tr>
</tbody>
</table>

For seven of the nine non-matching TWO-OF-US tokens (type A), the props were located directly in front of the signer, while the pronouns were produced on the signer’s right side, as shown in Figure 3.11. However, note that although the hand is on the right side of the torso, the path of the pronoun moves straight ahead of the signer rather than towards the right as in Figure 3.12. Even though the signer’s hand is offset in these cases to the ipsilateral (i.e., right) side, the forward path movement indicates that the signer is indexing the referent directly in front of her. The hand is offset toward the ipsilateral side for ease of articulation, such that the signer need not bring her hand all the way to the midline.

Figure 3.11. TWO-OF-US (ipsilateral side but forward movement)
The other two of the nine non-matching TWO-OF-US tokens (type B) are somewhat more perplexing. With these tokens, the referents were located on the contralateral side while the signer produced a pronoun on the ipsilateral side. These tokens are different from the other non-matching TWO-OF-US tokens in that the path of the pronoun moves in the ipsilateral direction as well (as in Figure 3.12), i.e., in the direction opposite of the referents, similar to the discourse situation shown above in Figure 3.9. The signer’s eye gaze in these tokens was also toward the ipsilateral side, rather than toward the location of the referents. So it seems that these tokens are more like the exclusive lexical forms than ostensive forms. Indeed, both of these type B tokens were used in exclusive contexts.

These examples show that while the pronouns WE-COMP and TWO-OF-US are generally indexic, they are perhaps not fully indexic. The type A tokens are still in a sense indexic because of forward/backward movement of the hand even though they are not technically laterally indexic because the signing hand is offset to the ipsilateral side. The two type B tokens however are truly non-indexic. One possible explanation may be that the locations associated with ostensive signs have become or are in the process of becoming grammaticized,
such that it may be possible for these signs not to point to their referents but instead to act like lexical plurals. This use of non-indexic ostensive pronouns in exclusive contexts may be possible for only some signers. Furthermore, the fact that only two out of 45 ostensive tokens were non-indexic suggests this is not at all common. Nonetheless, these two tokens may be examples of grammaticization in which ostensive plurals are becoming lexical plurals under certain conditions such as an exclusive context.

The non-indexic WE-COMP tokens (type C) included points that span across the signing space even though the referents were located only on the signer’s right side. In both tokens, the number of referents was ‘many’, rather than only two or three. Therefore, it may be the case that reference to a group of many referents is less indexic than reference to a small number (i.e., two or three) of referents. The following analysis addresses this issue.

4.2. Lateral indexicality by number of referents

Figure 3.13 shows the percentage of pronouns that match the location of their referents. Pronouns indicating two referents most closely matched the location of their referents (72%), followed by pronouns indicating three referents at 56%. Pronouns indicating many referents matched their locations the least at 42%. Thus, lateral indexicality does differ according to the number of referents.
One could assume that the varying lateral indexicality values for two, three and many referents may be due to a difference in ostensive versus lexical pronouns. For instance, the pronoun indicating two referents might be the most laterally indexic because the dual pronoun TWO-OF-US is an ostensive pronoun, whereas the pronoun WE which might be used for three or many referents is a lexical pronoun. However, Table 3.9 below lists the pronouns used for each number of referents presented in the contexts of the questionnaire. Note that a variety of pronouns were used with each number of referents, such that the difference between ostensive and lexical pronouns cannot be the only reason for the pattern shown in Figure 3.13. We will come back to indexicality of small versus large numbers of referents in Part II.
Table 3.9. Lexical and ostensive pronouns used with different numbers of referents

<table>
<thead>
<tr>
<th>Number of referents</th>
<th>Lexical pronouns used</th>
<th>Ostensive pronouns used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>WE, OUR</td>
<td>TWO-OF-US</td>
</tr>
<tr>
<td>Three</td>
<td>THREE-OF-US, WE, ALL-OF-US, OUR</td>
<td>WE-COMP</td>
</tr>
<tr>
<td>Many</td>
<td>WE, ALL-OF-US, OUR</td>
<td>WE-COMP</td>
</tr>
</tbody>
</table>

5. THE GRAMMATICAL STATUS OF NUMBER IN PRONOUNS

These findings on exclusive marking in plurals have implications for the status of number marking on pronouns in ASL. From this study, it seems clear that the lexical plurals WE and the possessive OUR are both grammatically marked for plural number. These forms are both formationally quite different from other pronouns, singular or plural, and do not at all index their referents, in either unmarked or exclusive form.

McBurney (in press) claims that the dual form TWO-OF-US is grammatically marked for number because a) the K-handshape is idiosyncratic and b) its use is obligatory in a dual context. Table 3.9 above shows that the use of TWO-OF-US is not obligatory - the general plural form WE can also be used for two referents. However, it is clear that the K-handshape is unpredictable and must be specified somehow in the grammar, presumably as a dual number marker.

The issue of number marking on the number-incorporated plurals is even more complex. McBurney (in press) claims that these number-incorporated pronouns are not grammatically marked for number. For McBurney, these pronouns exist “outside the core of the pronominal system” for several reasons. First of all, she notes that in spoken languages, dual and trial forms are not
historically related to the numerals two and three, but in ASL the number-incorporated pronouns share the handshapes of the corresponding numeral. Also, she notes that the number-incorporated pronouns are fully componential in form just like number-incorporated nouns (such as TWO-WEEK, AGE-THREE, FOUR-DOLLAR, etc...). Furthermore, if the number-incorporated pronouns are analyzed as grammatically marked for number, distinct grammatical categories for trial, quadral and quintal must be posited. There are no other reasons to argue for so many distinct number categories; certainly the verb agreement system does not distinguish grammatically among three, four, and five referents (see Part II).

However, we have seen that when marked for exclusive, these number-incorporated pronouns lose their indexicality such that the displacement of the pronoun need not be indexic. Thus, these pronouns pattern very similarly to other pronouns that are lexically marked for plural (like WE and OUR). I agree with McBurney that these pronouns are not grammatically marked for trial, quadral, or quintal, but I argue that these forms are indeed part of the pronominal system. Specifically, I propose that the number-incorporated pronouns are marked for plural as cardinal plurals (i.e., cardinality—e.g., three, four or five—is specified), while the other lexical plurals, (WE, OUR and ALL-OF-US) are simply plural, but are not cardinal plurals (i.e., for these forms, cardinality is unspecified). Under this analysis, the number-incorporated forms get their cardinality (i.e., three, four, or five) from the same morphological process that incorporates

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21 Although McBurney does not address the form ALL-OF-US, it behaves very much like the number-incorporated plural pronouns. That is, in a neutral context, the sign ALL (i.e., the fingerspelled loan sign) can index the general location of its referents, but in an exclusive context this indexation is often lost.
number on nouns like THREE-DAY, FOUR-MONTH, etc...., while the plural number marking allows these forms to undergo displacement for exclusive marking.

I propose that the composite pronoun WE-COMP is also marked for plural. One could argue that the numerosity of the referents should be retrievable from the number of points within this sign, and thus this form could be a cardinal plural. That is true for two or three referents. But, I argue, pronominal reference to a small number of people is achieved through multiple tokens of a singular pronoun (e.g., ME, HIM, HER), rather than the composite pronoun WE-COMP. As the number of referents increases, the number of points within WE-COMP increases but does not necessarily match the number of referents (i.e., for 20 referents, WE-COMP might only have seven or eight points). This is evidence that the composite pronoun is a plural form but not a cardinal plural.

Thus, I propose the following number values for ASL pronouns: singular, dual, and plural. The plural category can be further broken down into simply plural (without cardinality specified) and cardinal plural (with cardinality specified).

6. SUMMARY

In this chapter we have seen that exclusive marking in ASL is quite different from inclusive/exclusive marking in spoken languages, which include or exclude the addressee. The results here are consistent with (Meier 1990), according to which ASL has no distinct second person but instead only marks first versus non-first person. The fact that these exclusive forms exclude any salient
referent rather than just the addressee reinforces Meier’s argument that second person has no special grammatical status in ASL.

We have also seen that ASL has a set of first person plural pronouns that index their referents and a set of pronouns that do not. Furthermore, the lexical pronouns have exclusive forms that are slightly displaced to the signer’s left or right side, and the displacement itself is not necessarily indexic. Exclusive marking, then, has become grammaticized as part of the language, certainly for lexical plurals and possibly for ostensive plurals, as evidenced by the few tokens of non-indexic ostensive plurals in exclusive contexts.

These exclusive forms have also shed light on number marking in ASL. The pronominal system marks plural (as with WE, OUR, ALL-OF-US, and WE-COMP). Some forms are more specifically cardinal plurals (as with the number-incorporated plurals). The issue of number marking on TWO-OF-US is not so clear because of its high degree of indexicality, although the idiosyncratic handshape is one piece of evidence suggesting dual marking. To further investigate how grammatical number marking works in ASL, I turn to plural forms of verbs, which will be discussed in Part II.
PART II. INDEXICALITY OF PLURAL VERBS:
INSTRUMENTAL STUDY

In Part I we saw that exclusive marking leads to loss of indexicality for first person plural pronouns in ASL. Furthermore, the evidence from lateral indexicality suggested that the higher the number of referents, the less indexic the pronoun. In order to investigate this further, I designed a second study to quantify these findings. For this second study I used instrumental methods to precisely determine the indexicality of plurals.

In order to generalize the indexicality of plural forms beyond just first person forms, I developed a task in which participants would describe scenarios involving third person referents. The scenarios that I designed depicted actions that would elicit particular verbs. Participants described what was happening in each scenario and were recorded using a motion analysis system to capture their hand movements in three-dimensional space. The locations of indexers (i.e., pronouns and classifiers) were then compared with the locations of each “agreeing” verb.

This is the first known instrumental analysis of the use of space in a signed language. For somewhat related studies on movement in ASL morphological patterns using incandescent point-light displays, see Poizner (1981) and Bellman, Poizner & Bellugi (1983).
Chapter 4. Instrumental study: Methods

1. Participants

Three native ASL signers were the participants for this study: JC, MM and RE. These signers were recruited through personal contacts within the deaf community in Austin, Texas. They all grew up in deaf families and were exposed to ASL from birth. Table 4.1 gives more information about each participant, including their sex, age at the initial time of data collection, dominant hand, and how many generations of deafness there are on both their maternal and paternal sides.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Sex</th>
<th>Age</th>
<th>Dom. hand</th>
<th>Maternal</th>
<th>Paternal</th>
</tr>
</thead>
<tbody>
<tr>
<td>JC</td>
<td>M</td>
<td>32</td>
<td>right</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>MM</td>
<td>F</td>
<td>29</td>
<td>right</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>RE</td>
<td>F</td>
<td>29</td>
<td>right</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

The assistant for this study was a deaf, fluent signer of ASL. His primary duty was to take on the role of the addressee (the person to whom the participants’ responses were directed) and to provide conversational feedback to the participants during data collection.

2. Stimuli

Stimuli were presented to the participants to elicit responses which would later be coded for verb and indexer locations. These stimuli consisted of many
short skits, each one depicting different numbers of actors/objects either performing or undergoing certain actions. Each participant faced the monitor that showed these skits, and the assistant (acting as the addressee) faced the participant. I sat behind the participant, behind a curtain that acted as a backdrop for the cameras. There was a break in the curtain just wide enough for the assistant to see me; I cued the assistant so he could cue the participant to start signing at approximately the same moment the data capture began. Figure 4.1 shows the positions of the participant, assistant, and the experimenter (myself), relative to each other and to the curtain.

Figure 4.1. Bird's-eye view of the setup for data collection

(P is the participant, A is the assistant/addresssee, E is the experimenter standing behind the curtain, and M is the monitor facing the participant.)

The assistant was not able to see the monitor, and the participant was not able to see the experimenter. Prior to data collection, the participant was asked to
describe to the assistant what was happening in the skits. Having a fluent, deaf signer was helpful for several reasons: a) this gave the participant a specific task – to describe the situation so that the addressee could understand it and b) having a conversational partner made it more likely that the signer would be explicit in establishing some kind of spatial perspective (Emmorey 1996). Furthermore, the participant, in signing to another fluent deaf signer of ASL, was less likely to shift to a more English-based sign system to accommodate me, a hearing experimenter. This method of data collection using native or near-native deaf signers as both participants and as data collectors is strongly recommended by current sign linguists (e.g., Neidle et al. 2000). In fact, one participant of this study explicitly commented that she was glad she was signing to someone deaf, because when signing to hearing people she always had to remind herself to use ASL and not shift into a more English-based sign system. With deaf signers, she said, she felt completely comfortable using her own ASL.

2.1. Normal (unmarked) perspective

The stimuli consisted of a set of videotaped skits depicting actors performing and undergoing certain actions - specifically, giving (papers), putting (papers on a table), and hiding (plastic Easter eggs under objects). These actions were used in order to elicit three ASL verbs: the agreeing verb GIVE, the spatial verb PUT and the plain verb HIDE, shown in Figure 4.2. I looked for verbs that were as similar to each other as possible. These particular verbs were chosen because they are similar in transitivity (they are all transitive), picturability (they are all fairly easy to depict pictorially), and the animacy of their arguments (they
all allow at least one animate argument). GIVE is a transitive agreeing verb, clearly picturable, with two animate arguments. PUT is also transitive and picturable, and was selected in order to determine if spatial verbs inflect for number in the same way that agreeing verbs do. Spatial verbs like PUT are claimed to be unlike agreeing verbs such as GIVE in that spatial verbs represent location and movement in a gradient rather than discrete way, as previously described in Chapter 1. Finally, HIDE, a picturable transitive plain verb, was chosen in order to test whether plain verbs show number agreement. Prior work has suggested that HIDE and similar verbs do not show number agreement (Padden 1983).

Figure 4.2. Citation forms for verbs elicited

| a) GIVE | b) PUT | c) HIDE |

Note that PUT and HIDE each only have one animate argument (the subject).²² No ASL spatial or plain verb could be identified that had both an animate subject and object (either direct or indirect). Nonetheless, I attempted to

²² The verb HIDE could feasibly have two animate arguments, but this would not be easily picturable.
set up the PUT and HIDE stimuli so that they matched the GIVE stimuli as closely as possible. To that end, since the semantics of these three verbs are somewhat different, I will hereafter refer to their arguments of all three verbs in terms of source and goal.

Sixty-six different skits were videotaped. Table 4.2 is a sample list of the stimuli, showing the number of referents (in these examples, many referents) and location of referents (in these examples, the left) for the actions of giving, hiding (specifically, hiding plastic Easter eggs under objects on a table), and putting (specifically putting papers on a table). Figures 4.3-4.5 show clips from these skits.23

Table 4.2. Sample of 6 out of 66 stimuli shown to participants

<table>
<thead>
<tr>
<th>Action</th>
<th>Source/goal manipulated?</th>
<th>Number of referents</th>
<th>Location of referents</th>
<th>See Figure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. giving</td>
<td>goal</td>
<td>many</td>
<td>left</td>
<td>4.3a</td>
</tr>
<tr>
<td>2. giving</td>
<td>source</td>
<td>many</td>
<td>left</td>
<td>4.3b</td>
</tr>
<tr>
<td>3. hiding</td>
<td>goal</td>
<td>many</td>
<td>left</td>
<td>4.4a</td>
</tr>
<tr>
<td>4. hiding</td>
<td>source</td>
<td>many</td>
<td>left</td>
<td>4.4b</td>
</tr>
<tr>
<td>5. putting</td>
<td>goal</td>
<td>many</td>
<td>left</td>
<td>4.5a</td>
</tr>
<tr>
<td>6. putting</td>
<td>source</td>
<td>many</td>
<td>left</td>
<td>4.5b</td>
</tr>
</tbody>
</table>

23 Note that right and left are determined from the woman’s perspective in categories 1, 2, 3 and 5 from Table 4.2 (corresponding to Figures 4.3a, 4.3b, 4.4a and 4.5a). Since there was not just one individual performing or undergoing an action in categories 4 and 6 (corresponding to Figures 4.4b and 4.5b), right and left was determined with respect to the camera. That is, the woman who acted as a single individual in Figures 4.3a, 4.3b, 4.4a and 4.5a was instead a part of a group of people in Figures 4.4b and 4.5b.
Figure 4.3. Action: giving papers

a) A woman gives many people on her left a piece of paper

b) Many people on the woman’s left give her a piece of paper

Figure 4.4. Action: hiding eggs

a) A woman hides many eggs on her left

b) Many people on the left hide eggs
Figure 4.5. Action: putting papers

a) A woman puts many pieces of paper on her left
b) Many people on the left put down papers.

Table 4.3 shows the stimuli for giving in which the number and location of referents for the goal (in this case, the indirect object or recipient) were manipulated. Variants of these same 11 scenes were generated with the source (i.e., the agent) being manipulated for the number and location of referents (e.g., Many people give a woman a piece of paper), resulting in 22 scenes. These same 22 situations were repeated for the other two actions of putting (specifically, putting papers on a table) and hiding (specifically, hiding plastic Easter eggs under objects on a table), for a total of 66 different skits. Each skit was approximately 3-10 seconds long.
Table 4.3. Sample of 11 out of 66 stimuli shown to participants

<table>
<thead>
<tr>
<th>Action</th>
<th>Source/goal manipulated?</th>
<th>Number of referents</th>
<th>Location of referents</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. giving</td>
<td>goal</td>
<td>one</td>
<td>left</td>
<td>A woman gives one person on her left a piece of paper</td>
</tr>
<tr>
<td>2. giving</td>
<td>goal</td>
<td>one</td>
<td>right</td>
<td>A woman gives one person on her right a piece of paper</td>
</tr>
<tr>
<td>3. giving</td>
<td>goal</td>
<td>two</td>
<td>left</td>
<td>A woman gives two people on her left a piece of paper</td>
</tr>
<tr>
<td>4. giving</td>
<td>goal</td>
<td>two</td>
<td>right</td>
<td>A woman gives two people on her right a piece of paper</td>
</tr>
<tr>
<td>5. giving</td>
<td>goal</td>
<td>two</td>
<td>scattered</td>
<td>A woman gives two people, one on each side, a piece of paper</td>
</tr>
<tr>
<td>6. giving</td>
<td>goal</td>
<td>three</td>
<td>left</td>
<td>A woman gives three people on her left a piece of paper</td>
</tr>
<tr>
<td>7. giving</td>
<td>goal</td>
<td>three</td>
<td>right</td>
<td>A woman gives three people on her right a piece of paper</td>
</tr>
<tr>
<td>8. giving</td>
<td>goal</td>
<td>three</td>
<td>scattered</td>
<td>A woman gives three people (scattered around) a piece of paper</td>
</tr>
<tr>
<td>9. giving</td>
<td>goal</td>
<td>many</td>
<td>left</td>
<td>A woman gives many people on her left a piece of paper</td>
</tr>
<tr>
<td>10. giving</td>
<td>goal</td>
<td>many</td>
<td>right</td>
<td>A woman gives many people on her right a piece of paper</td>
</tr>
<tr>
<td>11. giving</td>
<td>goal</td>
<td>many</td>
<td>scattered</td>
<td>A woman gives many people (scattered around) a piece of paper</td>
</tr>
</tbody>
</table>
One reason for eliciting forms indicating two, three, and many referents is that non-singular agreeing verbs are generally considered marked for dual, plural, or (for some signers) trial (Klima & Bellugi 1979). Also, dual pronouns seem to be generally marked for locus, while trial and plural pronouns may not always be marked for locus (cf. evidence from Part I). Thus this study would help determine if dual and trial verbs pattern with singular verbs or with plurals.

Since there were only four stimuli that had one referent for each verb, and six for the other number values, the four one-referent skits were shown to each participant twice to increase the likelihood of getting usable data for this category. Thus, a total of 70 skits were shown to each participant. The stimulus set, including the repeated one-referent skits, was randomized separately for each participant.

In order to elicit signing that was as natural as possible, the participants were given very little instruction before data collection. Before each session, I randomly chose one stimulus of each verb type (one that showed giving, one that showed putting and one that showed hiding) to show to the participant, and I explained that all the stimuli consisted of skits showing these three actions (I used the citation form for each of these signs). Participants were then asked simply to watch each skit and describe to the assistant what he/she saw. In the event that participants did not specify locations for referents, data collection was paused and participants were explicitly asked to specify locations for referents. It was important that the participants specified locations of the referents using some kind of indexer. Otherwise, for example, if a participant used a bare noun phrase such
as WOMAN without an indexer (bare noun phrases did occur fairly frequently), no verb/indexer distance could be measured.

2.2. Reverse perspective

With the minimal instructions for the original set of 70 stimuli skits, I had expected the participants to describe each event in the third person, or perhaps from the perspective of the woman, since the camera was directly behind her, and the other people were facing the camera and her. For the most part, the participants adopted the perspective of the woman. In order to force a different perspective, I then presented the set of ‘giving’ stimuli (22 skits with the 4 one-referent skits shown twice, 26 skits in all) again, this time with more specific instructions. I asked each participant to pretend that he/she was one of the actors in the skit who was facing the camera, then to explain what happened. I did this in order to elicit first person plural forms (e.g., WE GIVE PAPER) to see if the same patterns occurred with first person as opposed to third person forms.

3. Data collection

Each session of data collection for this phase of the study lasted approximately two hours. Participants could take breaks whenever they needed them, or whenever there were technical difficulties that needed attention.

As mentioned before, the stimuli were presented to the participants to elicit responses (signed descriptions) that would later be coded for verb and indexer locations. Each response was recorded by five infrared-sensitive cameras, each equipped with an infrared strobe around the lens, part of the Vicon System
The responses were also recorded with two digital video cameras. One video camera was used by the Vicon software to collect movie data that could later be synchronized with the kinematic data to aid with coding. These movies were captured in MPG format, a compressed video format that cannot be edited. The other camera was for collecting video that could be edited later as stimuli to be presented for eliciting grammaticality judgments.

Before data collection, each infrared camera required two different types of calibration: stationary and dynamic. Both types are required in order to determine the exact position of all the cameras with respect to the location where the signer would be sitting. The stationary calibration determines the zero-point, the point of origin from which all absolute distances will be taken. Calibration scores for each camera must be less than 1.0 for the Vicon system to calibrate. Calibration scores for data collection sessions for this study were all below 1.0.

The infrared cameras of the Vicon system record the location in space of special reflective markers. The reflective markers for this study (25mm spherical markers) were attached at the base of the pinky finger on each hand using double-sided tape. Other marker locations such as the center of the back of the hand and the base of the index finger were also attempted. However, preliminary data captures revealed that placing the marker on the base of the pinky finger seemed to produce the best results (i.e., the markers were most visible to the cameras); therefore this marker placement was used for every session. Three other reflective

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24 The Vicon System is part of Dr. Jody Jensen’s Developmental Motor Control Laboratory in the Department of Kinesiology & Health Education at UT-Austin. Dr. Jensen kindly made her equipment available to me for my research. Other studies have been done with this same system on phonetic and phonological properties of ASL signs (Cheek 2001, Mauk in progress).
markers were also used; these were placed at the center of the signer’s chest, and one on each shoulder. These markers were used as reference points during coding. Figure 4.6 illustrates the location of all five reflective markers: one on each shoulder, one at the center of the chest, and one at the base of each pinky finger.

Figure 4.6. Placement of reflective markers

For each data capture (known as a trial), the Vicon system tracks the trajectories of the reflective markers in the field of view of all five cameras. This information is then fed into a computer that integrates this information to yield three-dimensional motion data which can be used for kinematic analysis. This system is well suited for measuring precise locations in three-dimensional space. The location of the participant’s hand (represented by the reflective marker at the base of the pinky) can be measured in millimeters from the point of origin (zero point), which is established during calibration and remains constant through the
entire session. For these participants, the point of origin was located in the area behind and slightly below their right hips (note that the participants were seated during data collection), as shown in Figure 4.7. Vicon samples the kinematic data at 60 frames/sec.

Figure 4.7. Approximate point of origin and set-up of axes in relation to signer

Another property of these three-dimensional images is that they can be viewed from various angles. Thus the image could be rotated to allow for a bird’s-eye view during analysis. All measurements were taken at particular landmarks during the sign; these landmarks were determined by the movement of the sign (see below for more about coding).

4. CODING OF DATA

The Vicon software was used to reconstruct a three-dimensional image of each captured trial for coding. Kinematic data were synchronized with the video from one of the video cameras so that the video data could help identify different
signs within the trial. Before any measurements could be taken, all markers appearing in the reconstructed computer image throughout each trial had to be labeled. Each marker was labeled with one of five labels: right hand, left hand, center of the chest, right shoulder, and left shoulder. If fewer than two infrared cameras were able to see a marker at any given time, data was lost for the duration of those frames, creating a gap in the data.\(^{25}\) When such gaps occur in the data, the marker loses its assigned label within Vicon and needs to be relabeled.

The Vicon system can interpolate a trajectory across a gap; this feature was used several times in my analysis when the gaps were very short in duration. Gaps were filled within a trial only if the gap occurred at a frame where I needed to take a measurement and if the gap was 20 frames or fewer. Note that since Vicon records data at a rate of 60 frames/second, this means that only gaps up to 1/3 of a second in duration were filled. Gaps of more than 20 frames were not filled. Twenty measurements were taken from filled gaps, out of a total 2056 measurements (1028 indexer measurements and 1028 verb measurements). Each measurement taken from a filled gap was compared with the video data to ensure that the information had been interpolated accurately (i.e., that the frame within the filled gap where the landmark to be measured occurred was the same frame, plus or minus one frame, in which that landmark occurred in the video data).

The measurements provided by the Vicon system allow comparisons between the locations of the hand at specific landmarks during a trial. That is, one can measure the location of an indexer (let’s call this location 1, represented

\(^{25}\) Occlusion might occur if, for example, a marker on one hand was occluded by the signer’s other hand.
by the X, Y and Z coordinates of the location of the marker on the hand producing that indexer) at, say, frame 120. Then, one could measure the X, Y and Z coordinates of the location of the agreeing verb (let’s call this location 2), for example at frame 542. By using a three-dimensional version of the Pythagorean theorem (see Figure 4.23 later in section 4.5 of this chapter), one can obtain the distance between the locations identified at frames 120 and 542. The Vicon system is actually sophisticated enough to determine the distance between two markers at any given frame; however, this feature is only useful if the indexer and verb locations to be measured occur in the same frame (i.e., at the same moment in time). This does often happen, but not always. The formula in Figure 4.23 provides a way to calculate the distance between two locations no matter when they occur relative to each other.

From each of the informants' descriptions, I coded the starting point and ending point of each path movement of each verb; I also coded each indexer corresponding to those verbs’ arguments. The verb locations were coded by taking the X, Y, and Z coordinates at specific locations during the production of the verb, according to criteria that are sensitive to the movement type of the verb (typically the starting point and endpoint of the each of the verb’s path movements). I also measured the coordinates for the indexers, according to certain criteria depending on the movement type of each indexer (typically, stamping, arcing, or linear; see below). I then calculated the distance between each verb location and its corresponding indexer (henceforth known as verb/indexer distance), in order to determine if the verb/indexer distance
indicating a single referent is significantly smaller than the verb/indexer distance indicating more than one referent.

All verbs were coded (with a few exceptions, as noted below). All indexers representing the arguments of these verbs were also coded. Measurements were taken only if there was a peak or trough in the X, Y, or Z-axis during that sign; peaks and troughs represent extremes within a particular axis. Figure 4.8 shows a token of a plural form of GIVE. Figure 4.9 shows the movement of the right hand within the Y-axis (i.e., the inward/outward movement) of this token and also shows peaks and troughs in this axis where measurements were taken. Figure 4.10 shows a bird’s-eye (i.e., two-dimensional) view of the movement trajectory of this token.

Figure 4.8. GIVE[exhaustive]
Figure 4.9. Movement trajectory of right hand in Y-axis for verb shown in Figure 4.8.

![Graph showing movement trajectory in Y-axis.](image)

- Time (frames)
- Millimeters outwards

Figure 4.10. Bird’s-eye view of movement trajectory for verb shown in Figure 4.8.

![Bird’s-eye view graph](image)

- X-axis (millimeters sideways)
- Y-axis (millimeters front-to-back)

(The square marks the start of the movement; the circle marks the end of the movement.)
For all signs, if a peak or trough lasted for more than one frame (i.e., if the sign was held in exactly the same location), I took the measurement at the first frame where the peak or trough occurred. Also, if the two hands were producing symmetrical movements, but a clear peak was visible in the data for only one hand (A), I took the measurement for the other hand (B) at the same frame as the measurement for A. Even with perfectly symmetrical movements, it is possible for data to be captured from one hand but lost from the other, since neither the Vicon cameras nor the markers were necessarily perfectly symmetrical with respect to the signer’s body.

4.1. Indexers coded

The indexers used by the participants in this study fell into two major categories: classifiers and pronouns. Table 4.4 shows a list and description of all the indexers coded for this study, broken down into categories suggested by Supalla (1982, 1986). The indexer types and movement types are defined below. For descriptions of individual indexers, see Chapter 5.
Table 4.4. List of movement types for indexers identified.

<table>
<thead>
<tr>
<th>Movement type</th>
<th>Possible indexer types</th>
<th>Indexers</th>
</tr>
</thead>
<tbody>
<tr>
<td>stamping</td>
<td>semantic classifiers, specific-number classifiers, SASS, collection classifier sign used as indexer</td>
<td>CL-legs, CL-1, CL-2, CL-3, CL-table, CL-object, CL-hat, CL-shoe(s), CL-camera, CL-people, TABLE</td>
</tr>
<tr>
<td>arcing</td>
<td>collection classifier</td>
<td>CL-people2</td>
</tr>
<tr>
<td>tracing</td>
<td>tracing SASS</td>
<td>CL-table2, CL-hat2</td>
</tr>
<tr>
<td>linear</td>
<td>semantic classifier, specific-number classifier, collection classifier</td>
<td>CL-1, CL-2, CL-3, CL-people</td>
</tr>
<tr>
<td>towards body</td>
<td>pronoun</td>
<td>,PT (first person pronoun)</td>
</tr>
<tr>
<td>away from body</td>
<td>pronoun</td>
<td>,PT (nonfirst person pronoun)</td>
</tr>
<tr>
<td>sideways</td>
<td>sign used as indexer</td>
<td>SHOES</td>
</tr>
<tr>
<td>repeating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ASL has many different types of classifiers. The types shown here are the ones that were produced by the participants in this study: semantic classifiers, specific-number classifiers, SASSes (size and shape specifiers), tracing SASSes, and collection classifiers. These classifier types are described in Supalla (1982, 1986). Semantic classifiers indicate the semantic class of the referent (e.g., vehicle, small animal, seated person, upright person, etc...). Specific-number classifiers indicate a specific number of people, between two and five. The semantic classifier CL-1, typically considered to be a semantic classifier indicating an upright person, could also be considered a specific-number classifier because it also indicates one person.

Another type of classifier indicates information about the size and shape of its referent; this is known as a SASS (size and shape specifier). SASSes are
typically used for inanimate objects but can be used for animate referents (such as
collection classifiers: see below). Signers use particular handshapes to express the
size and shape of these objects. The SASSes used by the participants for this
study included classifiers for a table, for an upside-down bicycle helmet, for a
shoe, and for a camera.

With one particular type of SASS, the signer uses both hands to outline the
size and shape of an object in the air. This is known as a tracing SASS. The
participants in this study used two tracing SASSes: one that outlined the shape of
a table (CL-table2) and one that outlined the shape of an upside down bicycle
helmet (CL-hat2).

Another type of classifier, the collection classifier, is used to represent a
group of people. According to Supalla (1986), this classifier type does not
represent the semantic category of the referents but rather outlines the shape of
the group. These classifiers “originate derivationally as SASSes which then
combine with certain tracing and stamping movements to represent the shape and
size of the crowd” (p. 200).

Finally, the participants also produced a few pronouns, including a
pointing sign to a third person referent and a first person pointing sign to the self.

4.2. Coding methods for indexers

All indexers were coded based on the type of movement used. For
classifiers, the movement types observed were stamping, arcing, tracing, and
linear (see Table 4.4). These movement types each correspond to the predicate
types for classifiers described in Supalla (1982).
4.2.1. Stamping movement

Classifiers with stamping movement have a very brief downward bouncing motion in the vertical axis that is used to establish a referent at a particular location. Stamping was by far the most common movement type for all the indexers used by the participants in this study. For these classifiers, I took the measurement at the trough in the Z-axis (i.e., the low point in the vertical axis) if there was one. (If there was no trough in the Z-axis, I looked for peaks or troughs in the other axes; see below.) The trough in the Z-axis is the lowest point of the ‘stamping’ movement that is characteristic of these classifiers that are otherwise statically held in space. Schick (1990) categorizes this ‘stamping’ movement as part of “a locative representing the spatial position of a stationary element” (p. 19). Supalla (1982) refers to this movement as characteristic of a location predicate consisting of a contact root, since this hand performs a very brief stamp in space, as if to contact something.

One could argue that the trough in the Z-axis might not be the exact locus that the signer intends to associate with the classifier – presumably that target locus would be just after that trough in the Z-axis, at a location a bit higher than that trough being measured (see Figures 4.11 and 4.12). However, this target location is not clearly identifiable by instrumental means. Since I only took measurements at peaks or troughs of movement, if a classifier was stamped with a bounce and then held at a location a few millimeters above that low point in the vertical axis, there would be no clear place to take the measurement. Therefore, the Z coordinates could be slightly lower than the intended locus for a classifier. I
attempt to correct for this possible discrepancy in one set of analyses described in the Appendix.

Figure 4.11. Movement trajectory of 3-CL in Z-axis

![Graph showing movement trajectory of 3-CL in Z-axis]

Figure 4.12. Stamping movement of indexer

![Images showing peak and trough of CL-3 in Z-axis]

a) Peak of CL-3 in Z-axis  b) Trough of CL-3 in Z-axis
This stamping movement usually occurs within the Z-axis; that is, the movement is usually downward. But it doesn’t have to be; classifiers can be stamped in space by a brief movement outward (in front of the body), or to either side of the body. Therefore, if there was no trough in the Z-axis for a classifier, I looked for peaks or troughs in other axes (e.g., possibly a peak in the Y-axis, if the classifier was established at a location away from the signer’s body).

### 4.2.2. Arcing movement

Sometimes the signers used mechanisms other than this stamping movement to set up the locus for indexers. In particular, one indexer that was used to refer to a group of people (generally more than 3) was a classifier with a bent-4 or bent-5 handshape (4 or 5 fingers extended and bent in a claw-like handshape, with the knuckles facing upward), glossed as CL-people (and its two-handed variant, CL-people2). This indexer, a collection classifier, could be produced with an arcing movement within the horizontal plane, as in Figures 4.13 and 4.14 below. Since collection classifiers do not specify locations for individual referents, there was no clear way to code the individual referents of these indexers. Therefore, I coded only the endpoints of these arcs. For the one-handed CL-people (as shown in Figure 4.13), I measured the beginning and end of the arc, henceforth known as the *edgemost* arc locations. For the two-handed CL-people2, the two hands begin close together representing the middle of the arc and then spread outward, as shown in Figure 4.14. The endpoints of these outward movements (shown in Figure 4.14b) represent the edges of the arc; therefore for
these two-handed arcing movements, I measured these endpoints as the edgemost arc locations.

Figure 4.13. CL-people, beginning and end

a) start (coded)  b) end (coded)

Figure 4.14. CL-people2, beginning and end

a) start (not coded)  b) end (both hands coded)

All edgemost arc locations were coded at peaks or troughs in the X or Y (or sometimes Z) plane. The Vicon equipment was particularly helpful for taking these measurements, because the three-dimensional image could be rotated for a
bird’s eye view of the movement, thus indicating the appropriate axis in which to take the measurement.

Sometimes the participants used CL-people with both an arcing movement and with a small bounce (stamping movement) at the end, as if to establish the classifier at that final location. This combination seems to give conflicting information; a group of people is outlined from location A to location B, but then the signer stamps the classifier at location B. When this occurred, I coded the edgemost locations of the arc and not the bounce in the Z-axis, because the arcing movement spans more than one location in space and presumably the referents also take up more than one location in space.

4.2.3. Tracing movement

The indexers with tracing movement (CL-table2 and CL-hat2) had to be coded a bit differently from each other, based on the inherent properties of tables and hats. CL-hat2 was used to describe plastic eggs that were hidden under objects on a table. For this classifier, I coded the two innermost locations of the arc (where the two hands are closest). I used this method because the only logical location for an egg to be inside a hat would be at the bottom, and the place where the two hands are closest in CL-hat2 represents this location. CL-table2 was used to describe putting papers on a table. For this classifier, I coded the two innermost locations where the two hands were closest to each other, and also the two outermost locations (where the two hands were farthest apart), because a piece of paper can be placed anywhere on a table. By coding four locations for
the table, I was able to maximize the number of locations with which the verb could be matched up.

4.2.4. Towards/Away from body movement

For pronouns, I coded any slight movement away from the signer’s body in the X or Y-axis (or towards the body if the sign was the first person pronoun meaning ‘me’). This could be considered problematic, since pronouns need only point toward the perceived locus for a referent; the hand does not need to actually achieve this locus in space. However, pronouns accounted for so few of the total number of indexers in my data that their influence in the final results turned out to be minimal.

4.2.5. Linear movements

One participant’s responses were much more detailed than those of the other two. This participant incorporated information about the movements of the actors as well as their location. This meant that his classifiers were often not stamped in one location, but moved forward and backward to indicate, for instance, that the referent stepped forward, handed the woman the piece of paper, then stepped back. For these linear path movements (as opposed to the arcing movements described above), I coded the end of the forward movement of the hand, since this location most accurately represents the beginning of the action. That is, when performing the act of giving, putting or hiding, a person may step forward, perform the action, then step back. Thus, the most logical place to take a measurement for the indexer in these circumstances would be at the end of the forward movement. This linear path movement has been described by Padden
(1983) as ‘locus shifting,’ a phenomenon in which a signer uses a classifier or spatial verb to shift an established locus from one location to another.

Figure 4.15 shows the initial forward movement of CL-1 before the verb (meaning roughly, “One person approached a group of three people”). For this token, I coded the classifier at the end of this movement (at 4.15b), when the right hand is closest to the left hand.

![Figure 4.15. CL-1 with linear movement]

Sometimes this participant would repeat an indexer during a trial, once with a stamping movement and once with a linear movement. In this situation I coded the first available linear movement version, because although the stamping movement establishes a single location in space for the referent(s), the linear movement indicates that the referent(s) moved from one location to another. Since both cannot logically be the case, I coded the linear movement (i.e., the end of the movement of the hand in the direction that the palm was facing), because this gives more specific information.
4.2.6. **Sideways movement**

For the 2-handed indexer with repeated inward movement (i.e., the lexical sign SHOES used as a indexer), I took the measurement of each hand at the first frame number where the distance between the two hands was smallest.

4.2.7. **Indexers held in place during verb**

Indexers generally establish locations for referents at the beginning of a signed discourse, and verbs and pronouns are used to refer to those locations. It is, however, possible for an indexer to be held in place while the other hand is producing the verb. When this occurred, I measured the indexer location in each frame in which the verb path(s) were measured. This criterion took precedence over measuring indexers with stamping movement at the trough in the Z-axis, because even if the signer has stamped the indexer in place, the indexer - if held longer - could move slightly in space and be at a different location when the verb that is supposed to match it is produced. In fact, that indexer could move quite a bit between the time it is stamped in place and the time when the verb is produced, as shown in Figure 4.16. For this token, the indexer shifted 162.1mm from its location at 4.16a to its location at 4.16b. The indexer was coded at the frame shown in 4.16b, the same frame where the start of the verb GIVE was coded.
Note this movement is not the type of movement described by Padden as locus-shifting. This signer is not intending to indicate a change in locus of the referent represented by CL-1.

4.2.8. Repeated indexers

Quite often the participants repeated an indexer during a trial, or produced several different indexers to refer to the same referent during a trial. In general I attempted to code the most precise indexer available, according to the continuum shown in Figure 4.17. For example, if a signer used a pronoun and later a classifier when alluding to a particular referent, I coded the classifier rather than the pronoun. Classifiers are articulated at a particular locus (e.g., with stamping movement) or loci (e.g., with arcing movement), whereas pronouns generally only point toward the locus the signer is establishing. In this sense, classifiers are more precise in establishing locus.
I also considered figure referents to be more precise than background referents. If both a classifier for a table (CL-table) and a classifier for objects on the table (CL-object) were produced within a trial, I coded the classifier(s) for objects on a table, since CL-object is more precise (see Figure 4.18). Both the tables and objects are ground (i.e., backgrounded) rather than figure (i.e., foregrounded) objects, but the objects on the table are more foregrounded, because these objects are where the people hide the eggs in the skits. Even if the less precise indexer was held during the production of the verb, I coded the more precise indexer(s) instead.

If a classifier for a hat (CL-hat) or classifier for an object on the table (CL-object), or a set of these signs, was repeated during a trial, once with one hand and once with two hands, I coded the one-handed version. The one-handed versions of these signs have the characteristic stamping movement in the Z-axis. This single

<table>
<thead>
<tr>
<th>Least precise</th>
<th>Most precise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pronoun (inward/outward)</td>
<td>CL-1 (stamping)</td>
</tr>
<tr>
<td>CL-people or CL-people2 (arcing)</td>
<td>CL-people (stamping)</td>
</tr>
<tr>
<td>CL-table2 (tracing)</td>
<td>CL-table (stamping)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Least precise</th>
<th>Most precise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classifiers for table (ground)</td>
<td>Classifiers for objects on table: e.g., hats (figure)</td>
</tr>
</tbody>
</table>

Figure 4.17. Continuum of least to most precise indexer (by movement type)

Figure 4.18. Continuum of least to most precise indexer (by figure/ground)
trough in the Z-axis indicates a single locus, unlike the two-handed versions, where a single locus is difficult to pinpoint.

For all other repetitions of an indexer during a trial, I used the following rubric: If a signer repeated an indexer during a trial at the same general location to refer to the same person or object, I coded the first instance of the indexer, unless a later instance looked like a self-correction. In that case, I coded the later, corrected version. Signs that are repeated within a discourse tend to become more dampened in movement, and this dampening could result in a less precise establishment of the locus. For this reason, I only coded later instances of a repeated indexer if the signer seemed to be correcting him/herself.

4.2.9. *Simultaneously-produced classifiers*

Spatial relationships between two referents are often established by producing classifiers for those referents (one with each hand) at the same time. If there were no peaks or troughs in any axis for an indexer (A) and this indexer was held in place while the other hand produced another indexer (B) that did have a measurable peak or trough, I took the measurement for indexer A at the same frame where I measured B (see Figure 4.19). If there were no peaks or troughs in any axis for an indexer and no other indexer was produced at the same time (i.e., no spatial relationship was being established), I did not code that indexer.
4.3. Verbs coded

For every verb token produced during a trial, a gloss for that verb was recorded. Each path movement within the verb was coded for whether the path was produced with the right or left hand. For individual locations within the verb path (i.e., the start and end of the path), I coded whether that path began at a location proximal to the signer (typically near the 1st person locus), ended at this proximal location, began at a location distal to (away from) the signer, or ended at a distal location. The matching indexer location values for both the start and end of the verb path were also coded according to the criteria described in the following section. For each verb path I also coded whether the matching indexer was held in place during the production of that verb path.

4.4. Coding methods for verbs

Like the indexers, verbs were also coded according to movement type. The two types observed in this study were linear and arcing. For verbs with a single linear path movement from one singular argument to another (e.g., a
singular verb), I coded the starting point and endpoint of that path movement, based on peaks or troughs in the X or Y (or sometimes Z) axis. Figure 4.20 shows a verb path starting at a peak in the X-axis (the signer’s left side) and ending at a trough in the X-axis (the signer’s right side). Figure 4.21 shows a verb path starting at a peak in the Y-axis (away from the signer) and ending at a trough in the Y-axis (close to the signer).

Figure 4.20. Peak and trough in X-axis (side-to-side axis)

a) Start of GIVE: Peak in X-axis  
b) End of GIVE: Trough in X-axis
For verbs with several linear path movements moving towards and away from the signer (e.g., a verb with exhaustive plural marking, as previously shown in Figure 4.8), I coded the starting point and endpoint of each path movement based on peaks or troughs in the X or Y (or sometimes Z) axis.

For verbs with an arcing movement in the horizontal plane (e.g., a verb marked for multiple—i.e., undistributed—plural), I took the measurements the same way I coded arcing movements for indexers. That is, I measured the edgemost locations of the arc (i.e., beginning and end of the arc, which corresponded to peaks or troughs in the X or Y axes).

4.5. Matching up indexers and verbs

After coding all the verb paths and corresponding indexers, I then matched up each verb path endpoint with an appropriate indexer. For instance, if the signer produced one indexer in neutral space close to her body (A) and another
one further away from her body (B), and the verb path moved inward towards her body (from location C to D), I would have four measurements: one for each indexer (A and B) and one each for the beginning (C) and end point (D) of the verb path; see Figure 4.22. I would then match up the beginning of the verb path (C) with the distal indexer (B) since the verb path is starting at a distal location, and I would match up the end of the verb path (D) with the proximal indexer (A), since the verb path ends at a proximal location.

![Figure 4.22. Verb/indexer match-up process](image)

I then measured the distance between each matched-up verb and indexer location by using the formula shown in Figure 4.23, where $X_i$ is the X-coordinate of the location of the indexer, $X_v$ is the X-coordinate of the location of the verb, etc.…

![Figure 4.23. Formula used to calculate verb/indexer distance](image)

$$\sqrt{(X_i - X_v)^2 + (Y_i - Y_v)^2 + (Z_i - Z_v)^2}$$
4.5.1 Verbs with stamping or linear movement

For indexers with stamping or linear movement, the process of matching up indexer and verb locations was fairly straightforward, because only one location was coded for each indexer. If there was only one indexer for a given argument, I matched up each verb location with that indexer. Typically if there was only one indexer, there was only one verb location, but sometimes verbs were repeated. In this case, each verb location was coded and matched up with the single indexer. If there were two indexers, I matched up the rightmost verb location of each verb with the rightmost indexer, and the leftmost verb location of each verb with the leftmost indexer.\(^\text{26}\) If there were three indexers, I matched the rightmost verb location of each verb with the rightmost indexer, the leftmost verb location with the leftmost indexer, and the middle verb location of each verb with the middle indexer.

4.5.2. Verbs with arcing movement

For indexers with arcing movement, the same general principles were applied. That is, I matched up the leftmost verb location with the leftmost indexer location of the arc and the rightmost verb location with the leftmost indexer location of the arc. For all two-handed indexers other than those with arcing movements (i.e., CL-table2, CL-hat2, CL-camera, SHOES, TABLE), I matched up the verb path with whichever hand would result in the smallest distance.

\(^{26}\) Occasionally, the signer chose to set up indexers along the Y-axis (i.e., front to back). In this case, I used innermost and outermost locations instead of rightmost and leftmost.
This method of matching up the leftmost verb locations with leftmost indexer locations and likewise for rightmost locations was used regardless of the number of path movements produced during a verb. This means that, although all peaks and troughs were coded, only the leftmost and rightmost verb paths of a verb with 5 or 6 path movements would be matched up with any indexer locations (leftmost and rightmost, respectively).

4.5.3. Multiple indexer or verb tokens

Often there were several distinct descriptions of a stimulus during a trial. This might have occurred if for some reason the assistant/addressee asked for clarification. When this happened, I coded these descriptions separately. That is, I matched up verb paths with indexers that were produced during that particular description. I only matched up a verb location with indexers from a different description if none were available in the current description.

If there was one verb path and more than one indexer location, as sometimes occurred with collective verbs, I matched up the verb path with the closest indexer location.

4.5.4. Matching up verbs with classifiers representing objects on a table

Matching up verbs with classifiers for objects on a table required its own set of guidelines, since the signers often set up indexers for all of the objects on the table, even if the hidden items (i.e., the plastic eggs) were only hidden under a few of those objects.
4.5.4.1. *Verb paths span only one object*

If a description included several classifiers for hats or objects and the verb path(s) spanned the area of just one hat, I matched up the leftmost verb path with the leftmost location of that hat and the rightmost verb path with the rightmost location of that hat. For example, in analyzing the description shown in Figure 4.24, I matched the verb shown in 4.24d with the classifier shown in 4.24c, since the verb was produced on the signer’s far left and 4.24c was the leftmost classifier.

Figure 4.24. Verb paths span area of only one classifier

![Figure 4.24. Verb paths span area of only one classifier](image)

a) CL-hat2 b) CL-hat2 c) CL-hat2 d) verb: PUT-EGG

4.5.4.2. *Verb paths span several objects on one side*

If there were several classifiers for hats or objects and if the verb paths spanned the area of more than one hat but stayed on one side of the signer’s midline (i.e., the signer’s right or left side), I matched up the leftmost verb path with the leftmost classifier location and the rightmost verb path with the rightmost classifier location out of the set of classifiers that occurred on that side of the signer’s midline. For example, for the description shown in Figure 4.25, I
matched up the leftmost verb path (4.25d) with the leftmost classifier (4.25b) and the rightmost verb path (4.25c) with the rightmost classifier (4.25a).

Figure 4.25. Verb paths span area of several classifiers on one side of signer’s midline

4.5.4.3. Verb paths span several objects on both sides

If there were classifiers for hats or objects and the verb paths spanned the area of more than one hat but spanned across the midline, I matched up the leftmost verb path with the leftmost classifier location, and the rightmost verb path with the rightmost classifier location out of all the classifiers for hats and objects produced during that trial. For example, for the description shown in Figure 4.26, I matched up the leftmost verb path (4.26d) with the leftmost classifier (4.26a) and the rightmost verb path (4.26c) with the rightmost classifier (4.26b)
4.5.4.4. Signer explicitly specifies how to match up verb paths with classifiers

If the signer explicitly specified which verb paths matched which referents, this overrode the endmost criteria described above. For example, if the participant set up several classifiers, but then explicitly specified the third object (e.g., by using the sign THIRD) and then produced a verb with only one path, I matched up that verb path with the location of the third indexer, regardless of whether that indexer was leftmost or rightmost.
5. INTERCODER AGREEMENT

In order to obtain a measure of the reliability of the coding methods described above, I enlisted the assistance of a second coder. That coder recoded 25% of each participant’s data, without referring to the original coding done by me, the primary coder. I compared the two sets of coding to determine intercoder agreement.

Table 4.5 shows the intercoder agreement scores for data from each of the three participants. There are four scores for indexers, four for verbs, and one for both indexers and verbs. For indexers and verbs, I calculated the number of tokens that both coders agreed should be coded, as well as the total number of landmarks that both coders agreed should be coded. Some signs had only one landmark each, but many had several landmarks (e.g., CL-people has two landmarks, one at the beginning and one at the end of the arcing movement). Therefore the denominators for the landmark scores are substantially larger than those of the token scores.

For each landmark, I also compared the frame numbers measured by each coder. For the raw score, the frame numbers coded had to match exactly in order to count as agreed. For the adjusted score (shown in Table 4.5 in parentheses), the frame numbers coded could be within two frames of each other and still count as agreed. The reason for allowing leeway of two frames is that inspection of the coding revealed that allowing only one frame difference did not substantially change most of the raw scores. However, allowing two frames difference greatly improved most of the raw scores. Two frames constitute only 1/30th of a second,
so this difference is still quite small. Finally, overall intercoder agreement scores are given by calculating the number of Vicon trials in which the same landmarks were coded.

Table 4.5. Intercoder agreement scores

<table>
<thead>
<tr>
<th></th>
<th>MM Raw (Adjusted)</th>
<th>RE Raw (Adjusted)</th>
<th>JC Raw (Adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indexer tokens agreed to be coded:</td>
<td>93.8%</td>
<td>86.7%</td>
<td>94.7%</td>
</tr>
<tr>
<td>Verb tokens agreed to be coded:</td>
<td>88.0%</td>
<td>71.4%</td>
<td>97.9%</td>
</tr>
<tr>
<td>Indexer landmarks agreed to be coded:</td>
<td>93.8%</td>
<td>83.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Verb landmarks agreed to be coded:</td>
<td>80.8%</td>
<td>94.4%</td>
<td>93.8%</td>
</tr>
<tr>
<td>Measurements of indexer landmarks agreed:</td>
<td>31.3% (37.5%)</td>
<td>65.7% (71.4%)</td>
<td>61.1% (66.7%)</td>
</tr>
<tr>
<td>Measurements of verb landmarks agreed:</td>
<td>47.4% (63.2%)</td>
<td>61.1% (75.0%)</td>
<td>78.7% (87.2%)</td>
</tr>
</tbody>
</table>

Intercoder agreement was established gradually by calculating scores after primary coding for each participant and then resolving conflicts (including improving procedures and any necessary recoding) before primary coding for the next participant. That is, primary coding was done for MM’s data, followed by reliability coding for MM’s data and calculation of intercoder agreement for MM’s data. I then met with the second coder to discuss and resolve all conflicts that arose in calculating intercoder agreement for MM’s data. After conflicts were resolved for MM’s data, the same process occurred for RE’s data and then for JC’s data. This method of conflict resolution resulted in an overall improvement in intercoder agreement scores for each participant. Table 4.5 shows this improvement; note that while the agreement scores for MM were fairly low (as low as 31%), the scores improved with RE and JC. Also, the token and landmark scores are all quite high, most in the 80% or 90% range.
Chapter 5. Instrumental study: Results

1. DESCRIPTION OF DATA

1.1. Indexers

Table 5.1 lists all the indexers produced by the participants of this study along with the indexer type (e.g., semantic classifier), movement type (e.g., stamping movement), description, and number of tokens coded for each.

Table 5.1. List of indexers coded

<table>
<thead>
<tr>
<th>Indexer gloss</th>
<th>Indexer type</th>
<th>Movement types</th>
<th>Description</th>
<th>Tokens coded</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL-legs</td>
<td>semantic classifier</td>
<td>stamping</td>
<td>Classifier for 1 person standing, V-hand pointing down.</td>
<td>13</td>
</tr>
<tr>
<td>CL-1</td>
<td>semantic classifier</td>
<td>stamping or linear</td>
<td>Classifier for 1 upright person, index-hand pointing up.</td>
<td>235</td>
</tr>
<tr>
<td>CL-2</td>
<td>specific-number classifier</td>
<td>stamping or linear</td>
<td>Classifier for 2 people, V-handshape.</td>
<td>28</td>
</tr>
<tr>
<td>CL-3</td>
<td>specific-number classifier</td>
<td>stamping or linear</td>
<td>Classifier for 3 people, 3-handshape.</td>
<td>40</td>
</tr>
<tr>
<td>CL-table²⁷</td>
<td>SASS</td>
<td>stamping</td>
<td>Classifier for table – typically a B-hand, palm down.</td>
<td>53</td>
</tr>
</tbody>
</table>

²⁷ The glosses used in Tables 5.1 and 5.2 are only for the purposes of describing the data for this study. These glosses may or may not conform with the standard glosses for these signs. For instance, a classifier for a table would typically be referred to as CL-B rather than CL-table. In this system, I use the glosses shown in Tables 5.1 and 5.2 in order to group semantically-similar signs together (such as CL-table and CL-table2) and also to distinguish signs which can have different meanings in different contexts. If I were to use conventional notation, CL-B could indicate a table, a piece of paper, or a shoe; the labels I use here distinguish the different meanings of this classifier.
| CL-table2  | tracing | tracing | 2-handed classifier for table, either B-hand, C-hand or bent-L, palm down. 2 hands start together and move away from each other. | 3 |
| CL-object | SASS    | stamping | Classifier for random objects on the table, bent-5 handshape, palm down. | 17 |
| CL-hat    | SASS    | stamping | Classifier for bicycle helmet, bent-5 handshape, palm up. | 33 |
| CL-hat2   | tracing | tracing | 2-handed arcing classifier for upside-down helmet, palms up to mid. | 21 |
| CL-shoe(s)| SASS    | stamping | Classifier for a shoe or pair of shoes, B-hand, palm down. | 5 |
| CL-camera | SASS    | stamping | Two-handed classifier representing a camera. | 1 |
| CL-people | collection classifier | stamping, linear, or arcing | One-handed classifier for several/many people, bent-5 or bent-4 handshape. | 29 |
| CL-people2| collection classifier | arcing | Two-handed classifier for several/many people, bent-5 or bent-4 handshape. | 23 |
| TABLE     | sign used as indexer | stamping | Lexical sign TABLE used as indexer. | 1 |
| SHOES     | sign used as indexer | sideways repeating | Lexical sign SHOES used as indexer. | 1 |
| .PT       | pronoun | away from body | Pronoun, pointing sign establishing a referent in space. | 11 |
| .PT       | pronoun | toward body | First person pronoun, point to self. | 7 |
Table 5.1 reveals that classifiers were used far more than pronouns. It seems that, for this particular study, since the stimuli showed people arranged in particular locative relationships (i.e., some facing the camera, some with their backs to the camera, some on the right side of the screen, some on the left side of the screen), the ASL classifier system provided a convenient way of conveying those relationships to the addressee.

Table 5.1 also shows that the vast preponderance of indexers were tokens of CL-1. One reason why CL-1 was used so much more often than any other indexer may be that most of the stimuli showed, in addition to the set of referents manipulated for number, one referent that was not manipulated for number (i.e., the woman). The descriptions for most of these stimuli included a CL-1 representing the woman in addition to whatever indexer was used for the set of referents manipulated for number.

Note also that Table 5.1 does not list any plural pronouns, and it lists only a few singular pronouns. I was not able to elicit first person plural pronouns as I had hoped by using the reverse perspective (i.e., by requesting that the participant imagine that she was one of the referents facing the camera: see Chapter 4). Instead, the participants used classifiers in this reverse perspective as well. They simply reversed the facing of the classifiers. Thus, classifiers that faced toward the signer him/herself in normal perspective faced the addressee in reverse perspective, and vice-versa.
1.2. Verbs

Table 5.2 shows the different verbs that were produced by the participants in this study. The verbs marked with ‘cf’ denote the canonical forms of those signs. Note that the canonical form of GIVE was used to describe stimuli showing giving as well as putting and (in a few cases) hiding. I suspect that GIVE-cf was the preferred form for both giving and putting because this form originated as a classifier form, specifically a ‘handle’ classifier depicting a ‘thin flattish wide object.’ (Schick 1990, Wilcox 1998). In both the GIVE and PUT stimuli, the material being given or put was paper: a thin, flat, wide object. Therefore, it is perhaps natural that this form was used whether giving papers to people or putting papers on a table. This form has also acquired a ‘frozen’ lexical status and can be used to depict giving anything.

Table 5.2. List of verbs coded

<table>
<thead>
<tr>
<th>Verbs gloss</th>
<th>Description</th>
<th>No. of tokens produced for each stimulus type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>giving</td>
</tr>
<tr>
<td>GIVE-cf</td>
<td>Flat-O, palm up</td>
<td>115</td>
</tr>
<tr>
<td>HIDE-cf</td>
<td>A-hand, starting near mouth and moving under non-dominant flat hand.</td>
<td>0</td>
</tr>
<tr>
<td>PUT-cf</td>
<td>Flat-O, palm down and/or mid</td>
<td>0</td>
</tr>
</tbody>
</table>

28 I use the term ‘canonical form’ here rather than ‘citation form’ because a citation form is uninflected for agreement or location. Particular tokens of these canonical forms may or may not have been inflected, but at the very least, each form labeled as ‘cf’ uses the canonical handshape and palm orientation associated with GIVE, HIDE or PUT. Since plain verbs do not show agreement within the signing space, the canonical form of HIDE is also the citation form. See Figure 4.2 for the citation forms (each of which is a subset of the canonical forms) of these signs.
The canonical form of PUT was used only to describe the hiding scenes, and was not used to describe the putting scenes. One reason that PUT-cf was used only for hiding may be that, although it shares the flat-O handshape of GIVE and probably also derived from a handle classifier, this form has become a frozen lexical form, so that it can be used to depict putting any object, such as candles (Padden 1983) or plastic Easter eggs. Apparently, what was most salient to the participants about the stimuli that showed plastic eggs being placed inside objects on a table was simply that the eggs were put in objects, not that the eggs were being hidden.

Only two tokens of the canonical form of HIDE were produced. The verb PUT-nd is similar to PUT-cf but also involves the use of the non-dominant hand. For purposes of simplicity, the labels GIVE, HIDE, and PUT will be used.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>0</th>
<th>13</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUT-nd</td>
<td>Flat-O, palm down and/or mid, with non-dom hand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIVE-comp</td>
<td>Flat-O to 5-hand, palm up</td>
<td>45</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>PUT-comp</td>
<td>Flat-O to 5-hand, palm down</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CL-paper-handle</td>
<td>Closed-X, palm mid, with optional non-dom hand</td>
<td>25</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>CL-paper</td>
<td>B-hand or 5-hand, palm down</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>CL-egg</td>
<td>Spread-C hand, palm down</td>
<td>0</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>DROP</td>
<td>Fist to 5-hand, palm down</td>
<td>0</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>TAKE</td>
<td>5-hand to fist, palm mid</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
hereafter to indicate the verbs in this study that were used to describe giving, hiding and putting (respectively).

The verbs marked as ‘comp’ in Table 5.2 (GIVE-comp and PUT-comp) are completive forms. Wilcox (1998) notes that completive forms indicate “either plurality or a sense of finality” (p. 186). The completive forms produced by the participants of this study were used with singulars as well as plurals. Neidle et al. (2000) consider this form to be indefinite. Since the participants were describing scenarios with definite referents, this form likely did not indicate indefinite referents, but perhaps an indefinite number of referents in some cases (as with the plurals).

The three classifiers listed in Table 5.2 were coded as verbs rather than indexers because each of these classifiers represents the semantic theme – i.e., the object that is being given, hidden, or put. The movement of these classifiers in space represents the movement of the theme from the source to the goal. This is the type of movement that is typically associated with spatial verbs. The paper handle classifier is produced with a closed-X handshape, as if the signer is holding a piece of paper. In contrast, the paper classifier is produced with a B-hand or 5-hand, and represents the sheet of paper itself. The egg classifier is produced with a claw-like hand, as if holding an egg.

The verb DROP (the one-handed variant) was used to describe both hiding and putting. The single token of the verb TAKE was used collectively (i.e., this form was not marked for plural but was used in a plural context) after an

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29 The classifiers coded as indexers, on the other hand, represent other semantic roles, such as actors, sources, and goals (e.g., CL-people, CL-table, CL-object).
exhaustive form of the verb GIVE-cf. The entire description meant roughly, “The people gave papers to the woman, and she took them.”

2. HIERARCHICAL LINEAR MODELS

In order to analyze the results of this study, I used a type of statistical analysis known as a hierarchical linear model (also known as a multilevel model). Hierarchical models are typically used in cases where data structures are organized hierarchically, e.g., where there are larger units consisting of smaller units, and variables describing both the smaller and larger units. This model is often used in the field of education, where students are grouped in classes and it is useful to have variables describing students and also variables describing the classes. Hierarchical models are also used for repeated measurements. “If we follow individuals over time, then the measurements for any particular individual are a group, in the same way as the school class is a group” (Bryk & Raudenbush 1992, p. xiv). Thus, hierarchical analyses are appropriate for use in developmental research, “where multiple observations are gathered over time on a set of persons” (p. 1). For example, Huttenlocher et al. (1991) in a longitudinal study used a hierarchical model in examining how differences in language exposure in the home influenced the development of each child’s vocabulary over time. Bryk & Raudenbush note that a traditional repeated measures analysis of variance (repeated measures ANOVA) would not be appropriate for the Huttenlocher et al. study because of the uneven number of observations and occasions during which those observations were made.
When every person is observed at the same fixed number of time points, it is conventional to view the design as occasions crossed by persons. But when the number and spacing of time points vary from person to person, we may view occasions as nested within persons (p. 2).

The traditional repeated measures model would also be inadequate for the data from the current study because it would require equal numbers of observations per participant on each variable, which is clearly impossible in a naturalistic setting. In this study, the number of observations gathered varies greatly across the three participants. Although one trial was recorded for each stimulus presented to each participant, the number of observations (i.e., verb/indexer pairs) within each trial varied greatly, both within the set of data from each participant and also across participants. Thus, individual responses (i.e., each verb/indexer pair) can be considered to be nested within participants.

Furthermore, one reason that hierarchical models are used is to separate the variance accounted for by clusters, such as classrooms, or in this case individuals, from the effects of the variables being studied. In this study, I am trying to separate the variance in the verb/indexer distances that can be accounted for by the number of referents and other variables from individual differences across the signers. By using this particular model, I was able to separate the effect of the individual participants (some signers happen to have larger verb/indexer distances than others, for whatever reason) from the effect of the number of referents or other variables.
3. Analysis

My main hypothesis is that the verb/indexer distance differs according to the number of referents, specifically that the verb/indexer distance is significantly smaller for one referent than for many referents. Since ASL has dual forms and (for some signers) trial forms, I also analyzed the verb/indexer distance for two referents and for three referents. Presumably, two and three referents could pattern with many referents (i.e., one referent vs. more than one referent), or they could pattern with one referent (i.e., a specified number of referents vs. an unspecified number of referents). Therefore, in every analysis I performed, I looked for both of these contrasts.

Each of the following analyses includes data from all three participants, with the verb/indexer distance as the dependent variable. In each analysis, the distance measurements (level-1 units) are nested within participants (level-2 units); this accounts for any variation between participants. The fixed factors (i.e., independent variables) that were used varied with each analysis. All factors are shown in Table 5.3.
Table 5.3.  Factors used in analyses

<table>
<thead>
<tr>
<th>Factor</th>
<th>Type</th>
<th>Possible Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verb/indexer distance</td>
<td>Dependent variable</td>
<td>(distances in millimeters)</td>
</tr>
<tr>
<td>Number of referents</td>
<td>Fixed factor</td>
<td>1, 2, 3, many</td>
</tr>
<tr>
<td>Verb</td>
<td>Fixed factor</td>
<td>GIVE, HIDE, PUT</td>
</tr>
<tr>
<td>Verbpath</td>
<td>Fixed factor</td>
<td>Beginning distally, Ending distally, Beginning proximally, Ending proximally</td>
</tr>
<tr>
<td>Indexer held (during verb)</td>
<td>Fixed factor</td>
<td>Indexer held, Indexer not held</td>
</tr>
<tr>
<td>Verb hand</td>
<td>Fixed factor</td>
<td>Dominant hand, Non-dominant hand</td>
</tr>
</tbody>
</table>

The following sections contain analyses on several different data sets. One data set includes distances at distal locations for all verbs, and another includes distances at distal locations for the verb GIVE (normal perspective). The distal locations for these data sets represent the set of referents that was manipulated for number and location. A third data set includes distances at proximal locations for the verb GIVE (reverse perspective); for this data set, the proximal locations represent the set of referents manipulated for number and location. Effects are considered to be significant if $p \leq 0.05$ and approaching significant if $p \leq 0.08$.

3.1. All verbs, normal perspective, distal locations

To begin with, let us look at an overall picture of the data. Table 5.4 shows English translations of some typical descriptions (i.e., responses to the stimuli) that the participants produced for this data set.
Table 5.4. Typical descriptions for data set containing all verbs (English translations)

<table>
<thead>
<tr>
<th></th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>The woman <em>gives him/them</em> paper.</td>
</tr>
<tr>
<td>b.</td>
<td><em>He/they give</em> the woman paper.</td>
</tr>
<tr>
<td>c.</td>
<td>The woman <em>puts a paper/papers</em> on the table.</td>
</tr>
<tr>
<td>d.</td>
<td><em>He/they put</em> paper on the table.</td>
</tr>
<tr>
<td>e.</td>
<td>The woman <em>hides an egg/eggs</em> on the table.</td>
</tr>
<tr>
<td>f.</td>
<td><em>He/they hide</em> eggs on the table.</td>
</tr>
</tbody>
</table>

3.1.1. Significant main effects

Figure 5.1 shows the mean verb/indexer distances for all verbs in normal (unmarked) perspective at distal verb locations.

Figure 5.1. Mean verb/indexer distance (all verbs, normal perspective, distal locations): by number of referents

Table 5.5 shows the results of a hierarchical analysis with four fixed factors: number of referents, verb, verbpath, and indexer held. This table reveals a significant main effect for number of referents, the means for which are shown
in Figure 5.1. The specific vs. non-specific number contrast (i.e., many referents vs. one, two, or three referents) is approaching significance, whereas the singular vs. non-singular contrast (i.e., one referent vs. more than one referent) is not significant.

Table 5.5. All verbs, normal perspective, distal locations.
Main effects & contrasts: All factors

<table>
<thead>
<tr>
<th>Fixed Factors</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of referents</td>
<td>3</td>
<td>1.44</td>
<td>0.0484</td>
</tr>
<tr>
<td>1 vs. 2, 3, many</td>
<td>1</td>
<td>0.92</td>
<td>0.3388</td>
</tr>
<tr>
<td>many vs. 1, 2, 3</td>
<td>1</td>
<td>3.84</td>
<td>0.0506</td>
</tr>
<tr>
<td>Verb</td>
<td>2</td>
<td>1.43</td>
<td>0.2405</td>
</tr>
<tr>
<td>Verbpath (beginning or ending distal)</td>
<td>1</td>
<td>13.45</td>
<td>0.0003</td>
</tr>
<tr>
<td>Indexer held (during verb)</td>
<td>1</td>
<td>5.65</td>
<td>0.0179</td>
</tr>
<tr>
<td>Error</td>
<td>570</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.5 above also shows that there are significant effects for indexer held and for verbpath. By examining Figure 5.2, we see that the mean distance for indexer not held is larger than the mean distance for indexer held. Thus, when signers held the indexer in place during the verb, these distances were significantly smaller (i.e., verbs were significantly closer to their indexers) than when signers did not hold the indexer in place. This suggests that having an overt indexer at the target location during the production of the verb aids in achieving that target location (cf. Figures 5.3 and 5.4).
Figure 5.2. Verb/indexer distance (all verbs, normal perspective, distal locations):
by indexer held

Figure 5.3. Indexer held through end of verb

a) start GIVE
b) end GIVE at B, indexer held at A
Furthermore, Table 5.5 also shows a significant effect for verbpath. Thus, the mean verb/indexer distance for verbs that end at a distal location is significantly larger than the mean distance for verbs that begin at a distal location, as we can see in Figure 5.5.

**Figure 5.5.** Verb/indexer distance (all verbs, normal perspective, distal locations): by verbpath
One reason for this difference may be that verbs are often produced immediately after the indexers representing their arguments. Verbs that begin distally, then, often are produced immediately after distal indexers, as shown in Figure 5.6. Since the following verb path would most likely begin at least somewhat near the indexer location, the transition movement (from indexer location to resting position) is likely to be omitted. This results in the following verb beginning at approximately the same place where the indexer was produced. Thus in Figure 5.6, verb location B is fairly close to indexer A. This may explain the smaller mean distance for those verbs beginning at distal locations. Note also that the participant in Figure 5.6 produces the verb with her left hand even though she is right-handed. This suggests that the verb beginning at distal location B is a perseveration effect from the distal indexer A.

Figure 5.6. Verb path beginning distally

Contrast this with the mean distance for verbs ending at a distal location. These verbs begin at a proximal location, as shown in Figure 5.7. In this example, even if the matching distal indexer A is produced immediately before
the verb, the signer’s hand must first move away from that distal indexer location to the proximal location B for the beginning of the verb. So, the verb ending at the distal location C may not approach the target indexer location A as closely as a verb starting there, as in Figure 5.6 above.

Figure 5.7. Verbpath ending distally

![Verbpath ending distally](image)

a) Distal indexer A  b) GIVE, starting at proximal B and ending at distal C

3.1.2. Differences across verbs

Although Table 5.5 shows no significant main effect for verb, by looking at Figure 5.8, we see that the mean distances for HIDE and PUT are both larger than the mean distance for GIVE. Recall from Chapter 1 that one key difference between agreeing verbs and spatial verbs according to Padden (1983) is that spatial verbs use space in a gradient way (i.e., small differences in location affect the meaning), whereas agreeing verbs use space in a discrete way (i.e., such small differences do not affect the meaning). Following Padden’s argument, we might expect spatial verbs to be more precise, i.e., more indexic, than agreeing verbs. The pattern in Figure 5.8 shows the opposite. That is, this figure suggests that
spatial verbs if anything may be less indexic than agreeing verbs. This is an important result; we will revisit this issue in the discussion.

Figure 5.8. Verb/indexer distance (all verbs, normal perspective, distal locations):
   by verb

3.1.3. Differences within the verb PUT

Recall that Table 5.5 above showed a nearly significant contrast for specific vs. non-specific number (i.e., many referents vs. one, two, or three referents), such that the mean distance for many referents is almost significantly smaller than the mean distance for one, two, and three referents. It is clear when looking at the number of referents within each verb that the small mean distance for many referents is due to the verb PUT, as shown in Figure 5.9. Closer examination of the data from the verb PUT reveals several possible reasons for
this pattern. The first possible reason requires a discussion of reference scale in ASL.

Figure 5.9. Verb/indexer distance (all verbs, normal perspective, distal locations): number of referents by verb

Schick (1990) describes two different reference scales in ASL: one called a ‘Model scale’ in which classifiers are established as miniature versions of their actual referents, and another called a ‘Real-world scale’ in which classifiers are meant to be “analogue to”, i.e., in the same scale as, the real world. Model scale “allows a speaker at a long-range perspective point to look down on a scene rather than participating in it” (p. 32). Sizes and distances expressed with classifiers in model scale are meant to be relative rather than absolute. On the other hand, “the speaker in real-world scale constructions has only a close-up perspective point with a local scope of attention” (p. 32).
The relevance of these two scales can be seen when we further break down the PUT data by verbpath (i.e., whether the verb began or ended distally). Figure 5.10 shows the mean distances for each value of number of referents by verbpath. For those tokens of PUT in which the verbpath ended distally, the distances are quite high, due largely to differences in scale. Specifically, for one and two referents, the participants used model scale for establishing the classifiers for the woman and the table in space. For example, Figure 5.11a shows the indexers CL-1 and CL-table at a very condensed area of space directly in front of the signer. Then, after establishing the locations of indexers, the participants tended to shift even within the same description to the real-world scale, so that the path movement of the verb PUT corresponds to the actual path of the woman’s hand in the stimulus video. So, in Figure 5.11b, the two paths of the verb PUT begin at the signer’s torso and move away so that, at the end of the verb path movements, the signer’s arms are fully extended. These ending locations are both quite far from the location established by the indexer CL-table in Figure 5.11a (474mm for the right hand and 446mm for the left hand, to be exact).
Figure 5.10. Verb/indexer distance (PUT, normal perspective, distal locations): number of referents by verbpath

![Graph showing verb/indexer distance with number of referents by verbpath]

Figure 5.11. Shift from model scale to real-world scale: object argument

a) Indexers (model scale)       b) start and end of PUT (real-world scale)

Figure 5.10 also shows that as the number of referents increases for verbpaths ending distally, the mean distance between a verb and its indexer decreases. Closer examination of the data reveals that for three and many
referents, the set of indexers and the set of verbs are often both produced in model scale, which results in smaller verb/indexer distances for these number values. Also, for three and many referents, the signers often produced the two-handed CL-table2 rather than the one-handed CL-table; this helped provide several different locations with which the ending verb locations could be matched up.

Finally, Figure 5.10 also shows that, for verbs beginning distally, the mean distance for three referents is larger than that of one, two, or many referents. There are only five distance measurements that contribute to this larger mean for three referents, one from RE and four from MM. The larger distances of these five tokens were due to a shift in reference scale and/or a doubling of the hands in the verb. In one trial, MM produced a CL-3 indexer in model scale, and then her verb movement paths in real-world scale, as shown in Figure 5.12. Both the first (5.12b) and last (5.12d) path movements of the verb were quite far from the CL-3 indexer (5.12a). The verb/indexer distance for the first starting verb location was 491mm; the marker on the right hand was occluded during the last path movement of this verb.
In another token, RE produced a 3-CL indexer on her right side, and then produced a two-handed version of PUT. The distance between her right verb location and the indexer was relatively small (108mm, well below the mean of about 200mm), but the distance between her left hand verb location and the indexer was much larger (381mm). MM produced a token similar to this as well in which the distance between indexer and the non-dominant hand during the verb was 376mm. In another trial, MM produced a two-handed version of PUT that also had a shift in reference scale; the verb/indexer distances for each of the two
hands were large (444mm and 494mm). Thus, the non-dominant hand seems to be more poorly controlled than the dominant hand. Excluding these five tokens, the mean distance for three referents is 140mm, very close to the means for one, two, and many referents. Thus, the seemingly odd significant effect for specific vs. non-specific number of referents within the verb PUT stems largely from a shift in reference scale from a smaller scale for the indexers to a larger scale for the verb and also from the use of the non-dominant hand in productions of the verb.

3.1.4. Dominant vs. non-dominant hand

In order to determine if the non-dominant hand is indeed less controlled than the dominant hand, I also ran analyses with verb and verb hand as the independent variables (verb hand is the hand that produces the verb: dominant hand or non-dominant hand). Figure 5.13 shows the mean verb/indexer distances for all verbs in normal (unmarked) perspective at distal locations, by verb hand.
Figure 5.13. Verb/indexer distance (all verbs, normal perspective, distal locations): by verb hand

Table 5.6 shows the results of a hierarchical analysis with one fixed factor: verb hand. This table reveals a significant main effect for verb hand. This indicates that the two columns shown in Figure 5.13 are significantly different from each other – specifically, that the distance for the dominant hand is significantly smaller and thus more precise than the non-dominant hand. Figure 5.14 shows the mean distances for verb by verb hand.

Table 5.6. All verbs, normal perspective, distal locations. Main effects & interactions: Verb hand

<table>
<thead>
<tr>
<th>Fixed Factors</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verb hand</td>
<td>1</td>
<td>32.78</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Verb hand * Verb</td>
<td>2</td>
<td>3.57</td>
<td>0.0287</td>
</tr>
<tr>
<td>Error</td>
<td>785</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

138
Table 5.6 also shows a significant interaction between verb hand and verb. In order to determine which values are contributing to this interaction, we can look at within-category effects by performing tests of effect slices. These tests compare means within levels of an interaction and are analogous to post hoc tests used with regular analyses of variance. For example, suppose that interaction A*B is significant. The test of effect slices can be used to test for the effect of A within each level of B. So, in this case, we can test for the effect of verb hand within each level of verb, and vice versa. For tests of effect slices, I report only effects that are significant at the p≤0.05 level.

Table 5.7 shows the results of the test of effect slices for the effect of verb hand within each verb. For both GIVE and PUT, the mean verb/indexer distance
for the dominant hand is significantly less than the mean distance for the non-
dominant hand. (For HIDE, there is no significant difference between the
dominant and non-dominant hands.) Thus, data from both GIVE and PUT are
contributing to the overall pattern shown above in Figure 5.13. Furthermore, the
fact that the distances are significantly larger with the non-dominant hand
supports the assertion above that the non-dominant hand seems to be more poorly
controlled, especially for the PUT data.

Table 5.7. Within-category effects: Verb hand * Verb
(within Verb)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verb hand * Verb GIVE</td>
<td>1</td>
<td>4.49</td>
<td>0.0344</td>
<td></td>
</tr>
<tr>
<td>PUT</td>
<td>1</td>
<td>25.86</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td></td>
<td>785</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.5. Summary

So far, we have seen several different trends over all verbs. We have seen
a significant effect for number of referents for all verbs at distal locations.
However, neither the singular vs. non-singular nor the specific vs. non-specific
number contrast was significant. We have also seen a significant effect for
indexer held; the mean verb/indexer distance is significantly smaller when the
indexer is held in place during the verb than when the indexer is not held in place
during the verb. This suggests that having an overt target makes it possible to
more closely achieve a particular location. Also, verbs that begin at a distal
location have significantly smaller distances than verbs ending at a distal location.
Since verbs tend to immediately follow their matching indexers, this could be
considered to be perseveration of the distal location from the verb onto the indexer. In addition, the mean verb/indexer distance for the dominant hand is smaller than the distance for the non-dominant hand, suggesting that the non-dominant hand is less precisely able to achieve the target location than the dominant hand.

We have also seen that the mean distance for GIVE is somewhat smaller than the distances for HIDE and PUT. Although this difference is not significant, it suggests that the argument that spatial verbs use space in a more gradient way than agreeing verbs may not be true, if agreeing verbs are the ones with a smaller (i.e., more precise) mean verb/indexer distance. Now we will look at the data for GIVE more closely.

3.2. GIVE

3.2.1. Normal perspective, distal locations

The question of a singular vs. non-singular contrast or a specific vs. non-specific number contrast is perhaps most interesting with respect to the verb GIVE, an agreeing verb. Although it may be debatable whether spatial verbs are grammatically inflected for plural, agreeing verbs like GIVE are assumed to have a grammatical plural (both a distributed and non-distributed form). Looking at these contrasts within the GIVE data alone could shed some light on whether there is a grammaticized plural category for agreeing verbs and what that category entails. Therefore, I ran analyses on the GIVE data alone. Table 5.8 shows some English translations of typical descriptions (i.e., responses to the stimuli) for this data set.
Table 5.8. Typical descriptions for data set containing GIVE, normal perspective (English translations)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>The woman gives him/them paper.</td>
</tr>
<tr>
<td>b.</td>
<td>He/they give the woman paper.</td>
</tr>
</tbody>
</table>

Figure 5.15 shows the mean verb/indexer distances for the GIVE data in normal (unmarked) perspective at distal locations, by number of referents. Note that the mean distance for two referents is highest. This could be evidence for a distinct dual category in ASL; we will return to this issue later.

Figure 5.15. Verb/indexer distance (GIVE, normal perspective, distal locations): by number of referents

Table 5.9 shows the results of a hierarchical analysis of the GIVE data with three fixed factors (number of referents, verbpath, and indexer held), as well as all two-way interactions between these factors. This table reveals that there is a significant main effect for number of referents. Furthermore, the singular vs. non-
singular contrast (one referent vs. more than one referent) is also significant. Thus, in Figure 5.16 (which shows the same information as Figure 5.15 with the means of two, three, and many referents collapsed into one category), the first column is significantly different from the second column. The specific vs. non-specific number contrast is not significant. There are no significant main effects for verbpath or indexer held. However, there is a significant interaction between indexer held and verbpath. Figure 5.17 shows the mean distances for verbpath by indexer held.

Figure 5.16. Verb/indexer distance (GIVE, normal perspective, distal locations): by number of referents (contrast)
Table 5.9.  GIVE, normal perspective, distal locations.  
Main effects & contrasts: All factors with interactions

<table>
<thead>
<tr>
<th>Fixed Factors</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of referents</td>
<td>3</td>
<td>3.21</td>
<td>0.0245</td>
</tr>
<tr>
<td>1 vs. 2, 3, many</td>
<td>1</td>
<td>9.54</td>
<td>0.0024</td>
</tr>
<tr>
<td>many vs. 1, 2, 3</td>
<td>1</td>
<td>0.85</td>
<td>0.3570</td>
</tr>
<tr>
<td>Verbpath</td>
<td>1</td>
<td>0.08</td>
<td>0.7736</td>
</tr>
<tr>
<td>Indexer held (during verb)</td>
<td>1</td>
<td>1.66</td>
<td>0.1995</td>
</tr>
<tr>
<td>Number of referents * Indexer held</td>
<td>3</td>
<td>0.57</td>
<td>0.6355</td>
</tr>
<tr>
<td>Number of referents * Verbpath</td>
<td>3</td>
<td>1.37</td>
<td>0.2546</td>
</tr>
<tr>
<td>Indexer held * Verbpath</td>
<td>1</td>
<td>4.35</td>
<td>0.0386</td>
</tr>
<tr>
<td>Error</td>
<td>158</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.17. Verb/indexer distance (GIVE, normal perspective, distal locations): verbpath by indexer held

Table 5.10 shows the results of the test of effect slices for verbpath within each level of indexer held. Within the group ‘not held’ (i.e., when the indexer is not held during the verb), the mean verb/indexer distance for a verbpath beginning at a distal location is significantly different from the mean distance for
a verbpath ending distally. This is consistent with the results from the previous section, i.e., elimination of the transition movement between the indexer and the start of the verb results in a very small distance between these two locations. Note that this only makes sense when the indexer is produced immediately before the verb, i.e., when the indexer is not held in place during the verb.

Table 5.10. Within-category effects: Indexer held * Verbpath (within Indexer held)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indexer held * Verbpath</td>
<td>Not held</td>
<td>1</td>
<td>4.51</td>
<td>0.033</td>
</tr>
<tr>
<td>Error</td>
<td></td>
<td>158</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We can also test for the effect of indexer held within each level of verbpath. Figure 5.18 shows the mean distances for indexer held by verbpath. Table 5.11 shows the results of the test of effect slices for the effect of indexer held within each level of verbpath. Within the group ‘ends distal’ (i.e., when the verb ends at a distal location), the verb/indexer distances for indexers that are held in place during a verb are significantly different from distances for indexers that are not held during the verb. From Figure 5.18 we see that when the verb ends at a distal location, the mean distance when the indexer is held in place during the verb is significantly smaller than the distance when the indexer is not held during the verb. This follows the same pattern that we found with the larger data set containing all verbs: namely, that the verbs with an overt target (indexer held during the verb) more precisely attain that target location than verbs without an overt target.
Thus for the verb GIVE, there is a significant effect for the singular vs. non-singular contrast, and this effect is not qualified by any interactions. This is an important finding. This significant contrast suggests a) that there is a clear phonetic difference between singular and plural and b) that duals and trials pattern with the plural rather than the singular category. The other results are consistent with those from the full data set: namely, that verbs beginning at distal locations are closer to their indexers than verbs ending at distal locations, and that distances between verbs and indexers held in place during the verb are smaller than the distances between verbs and indexers not held in place.
3.2.2. Reverse perspective, proximal locations

Recall from the previous chapter that I also elicited all the GIVE forms under a reversed perspective – that is, I requested that the participants take the perspective of one member of the group of referents who were facing the camera in the stimulus videos. I did this primarily to elicit plural first person pronouns. Table 5.12 shows the type of descriptions I had hoped to elicit as well as some typical descriptions (i.e., responses to the stimuli) that the participants actually produced.

Table 5.12. Typical descriptions for data set containing GIVE, reverse perspective (English translations)

<table>
<thead>
<tr>
<th>Descriptions desired</th>
<th>Descriptions produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The woman gives us paper.</td>
<td>The woman gives people paper, and I’m one of those people.</td>
</tr>
<tr>
<td>b. We give the woman paper.</td>
<td>People give the woman paper, and I’m one of those people.</td>
</tr>
</tbody>
</table>

Figure 5.19 shows the means for all verb/indexer distances for the GIVE data in reverse perspective at proximal locations. The proximal locations rather than distal locations are relevant to this data set because these are the locations where the participants established the set of referents manipulated for number.
Figure 5.19. Verb/indexer distance (GIVE, reverse perspective, proximal locations): by number of referents

Table 5.13 shows the results of a hierarchical analysis with three fixed factors: number of referents, indexer held, and verbpath. There are no significant main effects with these factors.

Table 5.13. GIVE, reverse perspective, proximal locations. Main effects & contrasts: All factors

<table>
<thead>
<tr>
<th>Fixed Factors</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of referents</td>
<td>3</td>
<td>1.91</td>
<td>0.1317</td>
</tr>
<tr>
<td>1 vs. 2, 3, many</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>many vs. 1, 2, 3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Verbpath</td>
<td>1</td>
<td>0.30</td>
<td>0.5871</td>
</tr>
<tr>
<td>Indexer held (during verb)</td>
<td>1</td>
<td>0.41</td>
<td>0.5232</td>
</tr>
<tr>
<td>Error</td>
<td>135</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2.3. Summary

Because the participants did not produce any first person pronouns in reverse perspective, and also because there were no significant results, we can
make no conclusions about agreement with first person indexers. However, the data from GIVE in normal perspective shed some light on the issue of plurality with agreeing verbs.

Specifically, the results from GIVE in normal perspective show a clear difference between singular and non-singular verbs. These results give us the first concrete estimate of the precision with which verbs agree with previously established locations. The mean distance between singular indexers and verbs is 124.9mm (SD=58.4). In contrast, the mean distance for plurals was 176.6mm (SD=84.9), as shown in Figure 5.16. Furthermore, the mean distance between singular verbs and their target indexers is significantly smaller than the mean distance between plural verbs and their target indexers. This suggests that singulars do indeed more precisely indicate their referents than plurals do.

We might expect that since the mean distance was smallest for singular verbs, the mean distance would increase according to the number of referents. However, this is not the case; Figure 5.15 showed a spike in the mean verb/indexer distance for two referents. One reason for this may be related to perception. Lillo-Martin (1997) notes that with regard to the use of space in signed languages, there is a tendency for maximal perceptual salience. Thus for two referents, the need to establish a clear contrast between two locations (to convey the information that there are two referents) may override the need for indexicality. The same is true to some extent for three referents, but with three referents even if the first and last verb path are contrasted far from each other, at least the middle verb path could still be somewhat indexic.
These data also confirm some patterns that we saw with the other verbs, i.e., that indexers held in place during the verb result in higher indexicality, and that when the indexer is not held in place, verbs beginning distally are more indexic than those ending distally due to perseveration of the indexer location.

4. AGAINST A COGNITIVE/MOTORIC EXPLANATION FOR LOSS OF INDEXICALITY

The findings from the verb GIVE (normal perspective) have important implications for the way that agreeing verbs use space. In particular, the significant singular vs. non-singular contrast is consistent with the conclusion that agreeing verbs can be marked for singular and plural (i.e., non-singular), because singular verbs more precisely approach the indexer location than non-singular verbs do.

However, there may be other possible explanations for this contrast. The distances for plurals could be smaller simply for cognitive reasons – i.e., perhaps it is just not possible to point to more than 3 or 4 distinct locations as precisely as it is to point to only 2 or 3 locations. Or perhaps the distances for many referents are larger due to motoric factors such as phonetic dampening, i.e., a shorter movement path with each successive cycle. In order to address these issues, I ran two additional analyses on the data from this study: one to determine indexicality on a larger scale (lateral indexicality), and one to determine if dampening is occurring with duals, trials, and plurals.
4.1. Lateral indexicality

The general consensus about how agreeing verbs use space in the literature is that with agreeing verbs the hand is ‘directed toward’ the location associated with its referent (Klima & Bellugi 1979, Liddell 2000, Lillo-Martin & Klima 1990, Lillo-Martin 1997, Neidle et al. 2000, Padden 1983, plus many others). This is somewhat less stringent than claiming that the hand actually achieves that location. So, perhaps indexicality as we have defined it so far (i.e., how closely a verb approaches its indexer in three-dimensional space) is not the only thing we should consider. Perhaps we should devise a way to look at how precisely verbs are ‘directed toward’ their referents. Whereas before I calculated the distance between indexers and verbs (a measure of what I will hereafter refer to as absolute indexicality), here I will simply determine if indexers and verbs are produced on the same side of the signer’s midline. Recall from Part I that I refer to this as lateral indexicality.

I first coded all the tokens of GIVE verbs (normal perspective) in my data for lateral verb location. Lateral verb location was ‘right’ or ‘left’ if all the coded verb locations for that token were on the right or left side (respectively) of the signer’s midline (I used the marker at the center of the chest to determine the signer’s midline). Lateral verb location was ‘scattered’ if the locations for that token were on both sides of the midline. I also coded lateral indexer location (‘right,’ ‘left,’ or ‘scattered’) in the same way. I then determined which verb/indexer pairs matched in lateral location, the results of which are shown in Figure 5.20. In this figure, the first column shows that 89% of the single referent
GIVE tokens matched in lateral location, while the last column shows that 69% of the many referent GIVE tokens matched in lateral location. There is a gradual decrease in lateral indexicality from one referent to many referents. While this is not exactly the same pattern as the absolute indexicality results shown above in Figure 5.15, these results are certainly consistent with those previous results. That is, Figure 5.20 suggests, as does Figure 5.15, that singulars are more precisely directed toward their referents than plurals are. More importantly, these results replicate the lateral indexicality findings from Part I, in which pronouns indicating many referents were less laterally indexic than pronouns indicating two or three referents. I will return to this in Chapter 6.

The results from both absolute and lateral indexicality for GIVE show that plurality affects indexicality. Specifically, we have seen that duals, trials, and
plurals are less ‘directed toward’ their referents than singulars are. This has implications for Liddell’s argument that indicating verbs are gestural; this will be discussed further in Chapter 6.

4.2. Tests for dampening

In Chapter 4, we saw an example of an exhaustive verb (shown in Figures 4.8, 4.9, and 4.10) that clearly had dampened movement – i.e., each successive path movement of the verb was shorter than the one before it. Figure 4.10 is repeated below as Figure 5.21. If dampening such as that shown in Figure 5.21 occurred with all of the dual, trial and plural forms, then one could posit that motoric factors are causing the loss of indexicality with these forms, i.e., that precision decreases as the number of referents increases simply due to dampening.

In order to test this hypothesis, I calculated the distance between the beginning and end of each path movement produced in order to determine the length of each verb path. I performed these calculations for tokens of GIVE indicating two, three, and many referents. For example, in Figure 5.21, I calculated the distance between the two squares (S), the distance between the two circles (C), the distance between the two triangles (T), and the distance between the two diamonds (D). I considered this verb to have dampened movement if D was less than T, T was less than C, and C was less than S (S>C>T>D). According to these criteria, this token did have dampened movement.
Interestingly, dampened movement did occur with other verbs, but it was by no means the norm. Some dual verbs had dampened movement, but dual verbs in which the second verb path was longer than (rather than shorter than) the first verb path also occurred, as shown in Figure 5.22. In this example, the distance between the two squares is less than the distance between the two circles (S<C). Since S is not greater than C, this verb does not have dampened movement.
Likewise, while some verb tokens had dampened movement similar to that shown in Figure 5.21, there were also several trial and plural verbs that did not have dampened movement. Some had successively longer verb paths just as with the dual verb in Figure 5.22; an example of such a plural verb appears in Figure 5.23. In this example, the distance between the two squares is less than the distance between the two circles, which is less than the distance between the two triangles (S<C<T). This is the opposite of a dampening movement pattern, since the verb path lengths are increasing rather than decreasing.
In addition, there were trial and plural forms in which some successive verb path were longer and some were shorter. Figure 5.24 shows an example of a plural verb with these highly varied path lengths. In this example, the verb path lengths neither steadily increase nor decrease throughout the articulation of the verb. The second verb path decreases in length compared to the first, but then the third path increases in length, and then the fourth path decreases. There doesn’t seem to be any clear pattern here, but what is clear is that the movement of this verb is not just successively dampened.
Thus, while dampening did occur in some verb forms, these examples show that other movement types also occurred in this data set. Therefore dampening cannot be the sole explanation for why duals, trials, and plurals are less precise at achieving their targets than singulars.

5. Summary and Discussion

These results have shown that some verb types are more indexic than others. In general, indexers that are held in space during the production of the verb provide an overt target, and verbpaths that begin distally maintain the location of the previous indexer. Changes in reference scale within a description
(i.e., small scale for indexers but large scale for verbs) as well as the use of the non-dominant hand seem to provide a few explanations for the high indexicality for some forms of PUT.

Some of these patterns may be due to motoric factors. The higher precision of verbpaths beginning distally as opposed to verbpaths ending distally can be explained motorically/phonetically, since if the indexer is produced immediately before the verb, perseveration of location is likely to occur such that any transition movement that there might have been between the indexer and verb would be lost.

Other trends may be largely cognitive in nature. For instance, the fact that verbs more precisely approach a target location overtly represented by the other hand is likely due to cognitive constraints. In a study of the accuracy of pointing gestures in hearing people, Berkinblit et al. (1995) found that pointing gestures were significantly less accurate with remembered targets (i.e., targets shown to the subject but then removed from the visual field) as compared to actual targets (i.e., targets visible while the subjects pointed to them). Berkinblit et al. note that the simplest explanation for this pattern may be poor memory of the target location. Yet, they note other studies (e.g., Soechting & Flanders 1989) which show that target location is stored in memory much more accurately than the target that can be achieved with pointing. Following these studies, Berkinblit et al. claim, “it is not the process of forgetting the target location, but rather, difficulties in the integration of visual and proprioceptive information that can explain pointing errors to remembered targets” (p. 329). Thus, Berkinblit et al.
suggest that the reason that reference to a remembered target is less accurate than reference to an actual target is indeed cognitive, but it is largely due more to the brain’s ability to match proprioceptive information (i.e., kinesthetic information about muscle position) with visual information than constraints due to memory. I propose the same cognitive explanation for the higher precision of verbs accurately achieving visible versus remembered targets.

The data from the verb GIVE in normal perspective further reveal a difference in indexicality, specifically a singular vs. non-singular contrast such that singular verbs are more indexic than non-singulars. On first glance, this could also be attributed to cognitive factors, since it may not be possible to indicate many referents as precisely as it is to indicate only one referent. This may indeed be the case, as the high amount of variation in successive path lengths is certainly consistent with lack of precision. At the very least, these results are inconsistent with the general assumption that the distributed plural form (exhaustive) has dampened movement; dampened movement is reflected in illustrations of the exhaustive inflection in Klima & Bellugi (1979) and Humphries, Padden & O’Rourke (1994). While that assumption may hold for some exhaustives such as the example in Figure 5.21, dampening did not occur for many of the verbs in this data set.

More compelling against the argument that plurals are less absolutely indexic due to cognitive/motoric constraints is the finding that plurals are also less laterally indexic than singulars. It should not require an immense amount of cognitive ability or motor control for a verb to at least be articulated on the same
lateral side as its matching indexer. The fact that this happens less with plurals is strong evidence against cognitive/motoric factors and for grammaticization.

Furthermore, the smaller (though not significantly smaller) mean distance for GIVE compared to the other verbs at the very least suggests that the distinction between agreeing verbs and spatial verbs in the literature in not quite as straightforward as it may seem. It seems that spatial verbs are no more indexic and thus no more precise than agreeing verbs. There may be much more overlap between these two verb classes than previously thought.

6. THE GRAMMATICAL STATUS OF NUMBER IN VERBS

These findings from GIVE also have implications for the grammatical status of number marking on verbs in ASL. The statistically significant singular/non-singular contrast suggests a clear distinction between singular and plural. Furthermore, recall that Figure 5.15 showed a much higher mean verb/indexer distance for two referents than for the other number values, possibly due to a need to establish a clear contrast between two locations. This higher mean distance (and thus, loss of indexicality) could be considered evidence for a distinct dual category for ASL agreeing verbs. Thus, I propose the following number values for ASL agreeing verbs: singular, dual, and plural. The plural category can be further broken down into distributive (exhaustive) and non-distributive (multiple).
Chapter 6. Conclusion

1. SUMMARY OF RESULTS

These studies have both shown that indexers and verbs referring to more than one referent are less indexic than indexers and verbs referring to only one referent. For whatever reason, the use of space when referring to several entities is less precise than when referring to only one.

1.1. Inclusive/exclusive study

The inclusive/exclusive study showed that exclusive marking requires displacement of lexical plurals to the ipsilateral or contralateral side. Thus, lexical plurals are regularly grammaticized (i.e., indexicality is lost) under exclusive marking, and even ostensive plurals show evidence of grammaticization in exclusive contexts. Lexical plurals can be displaced to index the location of a group (though not locations of individual referents) or for exclusive marking. If they are displaced and are not indexic of the group, they must be exclusive.

This study also sheds light on the issue of grammatical number marking in the ASL pronominal system. The results suggest that number-incorporated plurals are marked for cardinal plural (i.e., plural with cardinality specified) while the other lexical pronouns (WE, OUR, and ALL-OF-US) and the ostensive pronoun WE-COMP are simply plural (i.e., plural with cardinality not specified).

Furthermore, the exclusive forms in this study have implications for Meier’s (1990) two-person analysis of ASL. Since the exclusive forms can
exclude referents other than just the addressee, this is consistent with the notion that second person is not a distinct grammatical category in ASL.

1.2. Instrumental study

The instrumental study showed several significant effects. For all verbs, the verb more closely approached the target indexer location when the indexer was held in place. Verbs were also more precise when the verb path began distally rather than ended distally. Finally, the dominant hand was more precise in achieving the target indexer location than was the non-dominant hand. These effects can be explained cognitively or motorically. Indexers more closely approach targets that are visible than targets that are remembered. The greater precision of verbs beginning rather than ending at a distal location is likely due to motoric/phonetic factors, specifically the adjacency of indexers and verbs. The greater precision of the dominant hand is also likely motoric, since the dominant hand is better controlled.

Perhaps the most important finding is the significant effect of number of referents with GIVE. Results here show a clear and significant difference between singular and plural, more specifically between singular and non-singular (such that verbs indicating one referent are significantly more precise than verbs indicating many referents). This supports the general assumption that GIVE has grammatical plural marking on verbs.

This pattern of greater precision with singulars was seen in both absolute indexicality and lateral indexicality analyses. Singular forms of GIVE are more absolutely indexic because the hand more precisely reaches the target indexer
location in singulars than in non-singulars. Likewise, singular forms of GIVE are more laterally indexic because the hand more frequently achieves the side of the midline where the indexer is produced with singulars than non-singulars.

One trend that was not statistically significant but still important is the smaller mean verb/indexer distance for GIVE compared to the mean distances for PUT and HIDE. If anything, we would expect the mean distance for GIVE (an agreeing verb) to be higher than for PUT or HIDE (which in this study were both spatial verbs), since according to the literature, spatial verbs convey locative information more gradiently than agreeing verbs. The distinction between agreeing and spatial verbs made by Padden (1983) may not be as clear as her analysis would suggest. The results of this study support the claim that agreeing and spatial verbs use space in very similar ways, especially in their plural forms. These results also highlight the semantic similarity between these two verb types: i.e., the prominence of source and goal in both agreeing and spatial verbs.

1.3. Overall results

The evidence from lateral indexicality in both studies suggests that reference to many referents is less laterally indexic than reference to two or three referents. If stimuli designed to elicit one referent had also been included in the exclusive study, I predict that (following the results from the instrumental study) the lateral indexicality of forms referring to a single referent would have been highest.

Thus, both studies show more precision with singular forms than with non-singulars. Although it is possible that motoric or cognitive factors are
contributing to this pattern, the finding that plurals are less laterally indexic than
sINGULARs is evidence against this. The reasons for any verb (even a plural verb) to
not be articulated on the same lateral side as its matching indexer do not seem
related to cognitive ability or motor control. These results provide strong
evidence against cognitive/motoric explanations for the higher loss of indexicality
with plurals.

Furthermore, the results of these studies show a three-way number
distinction for both pronouns and agreeing verbs: singular, dual, and plural. This
claim has been made by other researchers as well, but these studies provide
empirical as well as distributional evidence to support that claim.

One overall conclusion of these studies is that there is often no sense in
which number can exist independently from spatial location in ASL. We know
that in most if not all spoken languages, the categories of number and person are
intimately linked (Forchheimer 1953). It seems that in signed languages (at least
in ASL), number and spatial location are similarly interrelated. Hence, because
the use of spatial location is gradient, plural marking is also to some degree
gradient. Therefore, plural marking is not simply the addition of arcing
movement to a singular form. Plural marking is also, I propose, a grammaticized
form of multiple location marking, often resulting in phonetic reduction (i.e., loss
of indexicality).

2. DISCUSSION

According to Liddell (2000), ASL signers use pronouns and indicating
verbs the same way that hearing gesturers use points in speech. His argument is
based primarily on the gradient use of space for these signs and for hearing pointing gestures. This seems appropriate for indicating a single referent, and we now have evidence that plural forms in ASL may not be gradient to the same degree as singular forms. When pointing is combined with speech, the hand is ‘directed toward’ the referents. It seems that the same would be true of pointing to multiple referents in speech, that the speaker would use either a static pointing gesture to indicate a group collectively or a pointing gesture with some circular/sideways movement. What would the results be for a study looking at pointing gestures accompanying speech? With gestures indicating more than one referent, we would probably predict a pattern similar to the results found with absolute indexicality in the instrumental study (i.e., loss of absolute precision). However, I would predict that lateral indexicality would be quite different for hearing gestures, such that pointing gestures used by hearing people to indicate multiple referents would be much more gradient than the results from these two studies.

These results have implications for the field of sign linguistics, in which the verb agreement and pronominal systems of signed languages are generally taken to be either fully indexic or fully grammaticized. It is very likely that today’s ASL derived from a system that was fully indexic, even gestural. The question remains: Does ASL have a significant gestural component even today? Goldin-Meadow & McNeill (1999) claim that gesture is well suited to being either a mimetic system or a discrete combinatorial one. Speech, they say, only supports a discrete combinatorial system. When language cannot be spoken but
only signed, how do both systems interact? Is there a gestural system (e.g., a more iconic and/or more indexic system) available concurrently with or in alternation with the discrete combinatorial ASL system? The results of these studies suggest that both systems are available and used within ASL, that singular pronouns and verbs use a more indexic system while plural forms use a more (although not fully) discrete system.

Furthermore, what we know about other signed languages suggests that other signed languages may be more or less indexic or grammaticized. For example, Engberg-Pedersen (1993) claims that Danish Sign Language has no non-indexic signs comparable to the ASL sign WE. Thus, plural marking in Danish Sign Language may be further toward the indexic side of the continuum than in ASL. Signed languages may differ in the extent to which they are indexic/grammaticized. The fact that the signed modality allows highly indexic reference does not necessarily prevent grammaticization from occurring.

3. DIRECTIONS FOR FUTURE RESEARCH

The findings from these studies have shed light on the nature of indexicality in ASL. However, it is also clear that there is room for more investigation into the nature of indexicality. One significance of the instrumental study in terms of methodology is that it provides an experimental model for research into how signed languages use space. This is the first study to use kinematic data for analysis of the use of space in signed language; my hope is that it will provide a useful model for future researchers.

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There are ways in which the current studies could be improved. For example, recall that the inclusive/exclusive study looked at reference to two, three and many referents. It would be helpful to include one referent as well, to see if the lateral indexicality of all four sets (one, two, three, and many referents) matches the results found with the verb GIVE in Chapter 5.

The instrumental study described in Part II was based on indexers that largely consisted of classifiers. Another possible improvement would be to instrumentally determine the absolute indexicality of pronouns specifically. This would provide instrumental data on the indexicality of singular versus plural pronouns that may support the findings from the inclusive/exclusive study.

There are also directions for new research based on the results of these studies. Recall Liddell’s (1990, 2000) claim that different indicating verbs are directed towards different body parts. One interesting follow-up study would be to determine how these different targets are phonetically realized. How much variation is possible? If these targets are psychologically real, we would expect a significant difference between the locations used by, for example, GIVE (target: chest) versus ASK (target: chin) versus HAVE-SAME-IDEA-SAME-TIME (target: forehead).

Liddell (2000) claims that signers use pronouns and indicating verbs to point to referents the same way that hearing people use pointing gestures. Another interesting follow-up study would be to determine instrumentally how precisely hearing people use pointing gestures. If signers use pronouns and indicating verbs the same way that hearing people point to multiple referents, then
the results of an instrumental study of pointing gestures by hearing people should
yield results similar to the results from this study. As noted above, even if
absolute indexicality is the same for pointing gestures, I would not expect lateral
indexicality to vary according to the number of referents in the same way it does
for indexers and agreeing verbs. Therefore, this study would need to include a
measure of lateral indexicality for hearing pointing gestures as well.

Such a study would help clarify claims about gestures used with speech,
such as iconic gestures as identified by McNeill (1992), that depict aspects of the
same situation that the accompanying speech depicts. McNeill claims that these
iconic gestures may not convey the totality of the meaning intended—rather, that
“gesture and speech jointly comprise an integrated expression of meaning” (p. 79).
Examining this type of gesture would help determine how precisely these
gestures convey their intended meaning.

The results from these studies give us some insight into indexicality in
ASL. There are of course many other signed languages which should be
researched as well. For instance, it has been argued that all signed languages that
have been studied to date have a class of agreeing verbs, and that all have
classifier and pronominal systems similar to those of ASL (Bos 1990, Engberg-
2000, Smith 1990). If the findings from this instrumental study could be
replicated for other signed languages, this would support the idea that different
signed languages use space in very similar ways.
More specifically, a typological look at pronouns across different signed languages (both singular and plural) would give us a better understanding of what signed languages are capable of in their pronominal systems. One very interesting first step would be to compare the first person plural pronoun WE across different signed languages. Since this pronoun is formationally idiosyncratic compared to other ASL pronouns, we might expect other signed languages to exhibit an idiosyncratic form for this pronoun as well (although certainly not the same form) due to crosslinguistic variation. A study on inclusive/exclusive marking in other signed languages would also prove very useful, as this could help determine whether the distribution of exclusive marking among signed languages is widespread (and thus a product of the visual/gestural modality) or spotty (and thus subject to crosslinguistic variation).

Finally, a crossmodal study between the number systems of spoken languages and signed languages like ASL would also be beneficial. Particularly relevant would be a comparison of the number systems of Native American languages and signed languages. Like ASL, Native American languages are well known for their complex verbal morphological systems, particularly in their marking of verbal number. An investigation of the similarities and differences between the verbal number systems of Native American languages versus signed languages would help shed light on morphological features that are unique to the sign modality and those that are common to both signed and spoken languages.
Appendix

1. Notation

As is conventional in ASL literature, English glosses for ASL signs are
given in all caps. The subscripts \( s, a, i, j, k \), etc... that are attached to the glosses
represent distinct locations in space; \( s \) and \( a \) represent the signer and addressee
respectively, and \( i, j, k \), etc... represent third person locations. Verbs are
translated in present tense for clarity. ASL does mark aspect and can mark tense,
but often tense is not marked if it is understood in context. Also, different
genders are used here to distinguish between different locations, although ASL
does not grammatically distinguish gender.

Table A.1. Description of notation used.

<table>
<thead>
<tr>
<th>NOTATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>_xPT</td>
<td>A pointing sign (pronoun) referring to target location ( x )</td>
</tr>
<tr>
<td>SIGN-SIGN</td>
<td>A single ASL sign requiring more than one English word for translation</td>
</tr>
<tr>
<td>(pronoun)-COMP</td>
<td>A composite form of a pronoun</td>
</tr>
<tr>
<td>CL</td>
<td>An ASL classifier</td>
</tr>
<tr>
<td>SIGN[( x )]</td>
<td>A sign marked with inflection ( x )</td>
</tr>
<tr>
<td>#SIGN</td>
<td>A fingerspelled loan sign</td>
</tr>
<tr>
<td>( xSIGN_y )</td>
<td>A verb beginning at location ( x ) and ending at location ( y ) (or, a verb whose palm is facing toward location ( y ) but away from location ( x ))</td>
</tr>
<tr>
<td>SIGN-cf</td>
<td>A sign in citation form</td>
</tr>
<tr>
<td>SIGN-nd</td>
<td>A variant of a sign that uses the non-dominant hand</td>
</tr>
<tr>
<td>(verb)-comp</td>
<td>A completive form of a verb</td>
</tr>
</tbody>
</table>
2. NONMANUAL SIGNALS USED WITH EXCLUSIVE PRONOUNS

The participants of the inclusive/exclusive study used the following nonmanual signals with exclusive pronouns in ASL.

2.1. Cheek-to-shoulder (CS)

The signer brings one shoulder close to his/her cheek. This indicates nearness in proximity, either in time or space (Liddell 1980). This NMS is adverbial in nature, so that the sign CAR-CRASH with CS would indicate that the car crash just happened. Likewise, CS can be used with the sign FUTURE in FUTURE WEDNESDAY (lit. ‘next Wednesday’) to indicate ‘this coming Wednesday’, a construction that is awkward in English. CS can also be used to express nearness in terms of physical location, so that the sign BEHIND with CS would mean something like “right behind”.

Interestingly, the signers in this study used CS more often in exclusive contexts than in inclusive contexts. One possible reason for this use of CS may be to accentuate the cohesiveness of those included and also to create opposition between those included and the one or ones who are excluded. Thus, CS used with exclusives may have the same effect as the English word “just”, as in “just the three of us”.

2.2. Body lean

The signer leans to one side, without necessarily rotating the torso. This can be used for a variety of purposes, e.g., verb agreement (Bahan 1996) or contrast. In this study, body leans served a purpose similar to CS. That is, the signer would often lean to one side when using an exclusive pronoun. In
particular, when the signer leaned to one side, it was always the same side on which the pronoun was produced.

Wilbur & Patschke (1998) claim that forward and backward leans (rather than leans to the side) indicate inclusion and exclusion, respectively. However, my data showed no systematic use of forward or backward leans.

2.3. Body shift

The signer's torso rotates so that the shoulders noticeably change orientation. Body shift can be used for several purposes, but it is primarily used as a grammatical marker of role shift, where the signer assumes a role of another discourse participant. This shift is used extensively with direct discourse (Engberg-Pedersen 1995).

In this study, body shift was most often used in exclusive contexts. However, the direction of the body shift (left or right) did not always match the location of the pronoun, so it is not clear if the body shift is further marking of inclusive or exclusive.

2.4. Eyegaze

Eyegaze is the direction or object towards which the signer’s eyes are directed. Eyegaze in general is difficult to determine because it can change so often and so quickly. Eyegaze in this study varied greatly, and was further problematic due to the method of data collection. The participants were instructed to sign to the camera as if the camera was the addressee, but the participants more often gazed at the questionnaire or the props. A more in-depth study on eyegaze
as a marker of inclusive/exclusive would therefore be very helpful; I leave this for future research.

Signers might not use CS or body shift or body lean, but eyegaze is always a factor in sighted signers. Therefore, this NMS may need to be considered separately.

3. FOLLOWUP ANALYSIS: EFFECT OF Z-AXIS IN INSTRUMENTAL STUDY

Recall from Chapter 4 that the notional locus of an indexer with stamping movement could be a bit higher than the trough of the movement where these indexers were actually coded. To ensure that this stamping movement did not affect the overall indexicality patterns noted above, I also measured the distances between indexers and verbs within only two axes: the X-axis (front-to-back) and Y-axis (side-to-side). This would eliminate any effect that the Z-axis (vertical) might have had in the previous three-dimensional analyses.

Figure A.1 shows the mean indexer/verb distance in three dimensions (gray column) versus the mean distance in two dimensions (white column), for the data set containing all verbs at distal locations. The two-dimensional distances are all consistently smaller than the three-dimensional distances. The differences range from 12mm to 26mm. The fact that the two-dimensional distances follow the same overall pattern as the three-dimensional distances suggests that the way in which the stamping movement in the Z-axis was coded did not substantially affect the analyses using the three-dimensional distances.
Figure A.1.  Indexer/verb distances (all verbs, normal perspective, distal locations): Three-dimensional distance vs. two-dimensional distance
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**Vita**

Kearsy Annette Cormier was born in Beaumont, Texas on August 9, 1973, the daughter of Donna Donalson Cormier and Dr. Lucius Cormier, Jr. After completing her work at Monsignor Kelly High School, Beaumont, Texas, in 1991, she entered the University of Texas at Austin. During the spring and summer of 1994 she attended Reading University in Reading, England. She received the degree of Bachelor of Arts from the University of Texas in December, 1994. In September, 1995, she entered The Graduate School at the University of Texas. She received the degree of Master of Arts from the University of Texas in August, 1998. Her publications include *Modality and Structure in Signed and Spoken Languages* (2002), which she co-edited with Richard P. Meier and David Quinto-Pozos (Cambridge University Press), as well as Locus Agreement in American Sign Language (1999) in *Lexical and Constructional Aspects of Linguistic Explanation*, which she co-authored with Stephen Wechsler and Richard P. Meier (CSLI Publications).

Permanent address: 6910 Hart Lane #307, Austin, Texas 78731

This dissertation was typed by the author.