

Routledge Handbook of Theoretical and Experimental Sign Language Research

Null arguments – experimental perspectives

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1. Introduction

Numerous studies experimentally investigate properties of null arguments in sign languages. In this chapter, such studies are divided into two sections: psycholinguistic studies with adults, and acquisition studies (with both children and adults). Before diving into these sections, a review of the nature of null arguments in sign languages is needed, and a summary of the research questions addressed by existing experimental studies is presented.

Chapter 13 (Cecchetto) presented basic facts and theoretical questions raised about the nature of null arguments in sign languages. Here, those aspects of null arguments that are relevant for understanding the experimental studies summarized below are presented. In fact, first a brief review of overt pronouns is given, as this will be important for several of the experimental studies.

In sign languages (all that we know of), pointing signs (also known as ‘index’ signs, sometimes glossed IX) assume the function of overt pronouns (see Cormier, 2012 for a recent overview). A signer directs a point at self for first-person reference; a point directed at addressee is interpreted as ‘you’, and a point directed at a non-addressed referent is interpreted as ‘she/he/it’.¹ For referents not in the immediate physical context, a location in space is designated as the location toward which the pointing sign should be directed, known as a locus or R-locus (for referential locus; Lillo-Martin and Klima, 1990). This designation may take place by initially placing the sign naming the referent in the spatial location, by gazing at the location, or by using verbal morphology employing that location, among others. This process is sometimes known as locus establishment.

Sign languages (all established Deaf community sign languages that we know of) also make use of the loci just described in the modification of a certain subset of verbs. This process is often described as verb agreement, though the precise analysis is a matter of some debate (see Chapters 5 and 6 of this volume; also Lillo-Martin and Meier, 2011; Mathur and Rathmann, 2012). Despite the potential that agreement is not the correct analysis of this phenomenon, the term will be used here. Verbs marked for agreement are spatially produced so that they move and/or are oriented with respect to loci. For transitive verbs prototypically having human

arguments (Meir, 2002), agreement usually involves moving the sign from the locus associated with the subject toward the locus associated with the object. Verbs may also be localized to indicate spatial information such as source and goal or location of an event; in this case they are frequently referred to as spatial verbs employing spatial or locative agreement. Verbs that are not spatially modified are commonly called plain verbs (Padden, 1983).

A description of verb agreement is important in the context of null arguments because it has been argued that (at least) some null arguments in American Sign Language (ASL) are syntactically licensed by agreement (see review in Chapter 13; Bahan et al., 2000; Lillo-Martin, 1991). In particular, it is descriptively clear that arguments of verbs marked with agreement may be null, and usually are. In such cases, the referent of the null argument (or its identification) is determined by the agreement. Null arguments are not only found in contexts of agreeing verbs. On one analysis, they are licensed by a (potentially null) discourse topic, similar to null arguments in languages without verb agreement such as Chinese and Japanese. As described by Checcetto (Ch. 13), an alternative analysis looks at all null arguments as instances of argument ellipsis (Koulidobrova, 2012, 2017a).

A number of studies have sought to characterize the properties of overt and null arguments in languages employing them. There seems to be some variability in the acceptability of an overt pronoun in contexts where a null argument might be employed. One approach to such questions is to calculate which kinds of nominal elements are used for reference tracking in different discourse contexts, including introduction of a new referent, maintenance of a previously-introduced referent, and re-introduction of a referent after a reference shift. Typically, introduction of a referent requires the use of an overt noun phrase, while languages use overt pronouns or, if available, null pronouns, for maintenance of an already-introduced referent. When a referent has been introduced but then not used in a clause, it needs to be re-introduced, and typically reintroduction would use a definite noun phrase or pronoun (e.g., Hickmann and Hendriks, 1999).

A few studies have examined these reference tracking preferences in sign languages. Perniss and Özyürek (2015) looked at this issue for (adult native) signers of German Sign Language (DGS) (in comparison to gestures produced by non-signers). Adult deaf native signers were asked to narrate a brief video vignette. As expected, they found that overt elements were much more frequent in re-introduction contexts (about 65% of re-introductions were overt) compared to maintenance contexts (not much more than 10%) in DGS. Frederiksen and Mayberry (2016) obtained different results in a study of native signers of ASL. In their study, deaf native signers told stories from short picture books and videos. Unsurprisingly, they found that signers used overt nouns nearly all the time for introductions. However, in both maintenance and re-introduction contexts about 70% of the time the authors found use of ‘zero anaphora’, which includes verbs marked with agreement and plain verbs. The difference between these contexts came with respect to the forms used instead of zero anaphora. In the maintenance context, classifiers were used; these can be considered to be similar to agreeing verbs in that they

are predicates that include information about their arguments (see Chapters 7 and 8 of this volume; Benedicto and Brentari, 2004; Zwitserlood, 2012). On the other hand, overt nouns were used in virtually all of the re-introduction contexts that did not have zero anaphora. It can be concluded, then, that both sign languages are similar to spoken languages that allow null arguments, in that they strongly prefer null arguments for contexts of maintenance.

As the chapter by Cecchetto summarized, a major theoretical issue in analyzing null arguments in sign languages has been their derivation: are they null pronominals, variables from movement of a null element, or the consequence of ellipsis? While these questions remain important for theoretical analyses, they have not been directly addressed in experimental studies. Instead, the experimental studies have focused on the following questions. First, do fluent native signers process null arguments online in a way similar to the processing of overt pronouns? If so, this may provide a hint as to the nature of the null arguments, though it does not definitively address their derivation. Second, studies of the acquisition of null arguments have asked how children come to know the grammatical requirements for their use, both in terms of sentence-level licensing and with respect to the discourse-level preference patterns observed in fluent signers. Existing studies have extended the latter class of questions beyond native signers to look at both child bimodal bilinguals and adult second-language learners.

2. Psycholinguistic Studies with Adults

A series of studies by Emmorey and colleagues has investigated the processing of sentences with overt pronouns or null arguments. These studies had as their foundation numerous works on processing English that indicated very quick, on-line access to the antecedent of a pronoun, known as antecedent or referent activation (see Fodor, 1993; Nicol and Swinney, 2002 for overviews). In general, when a listener hears a pronoun in an English sentence, the antecedent of that pronoun is mentally activated. On the other hand, other noun phrases that are not the antecedent of the pronoun (non-antecedents) are suppressed, or inhibited. Furthermore, the less ambiguous the pronoun is, the more quickly non-antecedent suppression is seen. Moreover, although the contexts in which English permits arguments to be null are limited, antecedent activation of null arguments has also been observed.

Emmorey's studies applied one of the methodologies used to examine referent activation in spoken languages to the case of ASL, with appropriate modifications for use with fully visual stimuli. The probe recognition task used in spoken languages employs either visually-presented written words or auditorily-presented speech, involving a sentence containing a pronoun. At some point, either the end of the sentence or some number of milliseconds after the pronoun, a probe word is presented. The participant's task is to decide whether the probe word appeared earlier in the sentence. Their response time to a probe following a coreferential pronoun is compared to response time in other sentences, where the probe word appeared but no pronoun

was used. An example is given in (1), from MacDonald (1986, cited by Emmorey, Norman and O'Grady, 1991). In (1a), the pronoun 'she' takes 'Meg' as its antecedent, and participants respond faster to the probe word 'Meg' after being presented with this sentence than they do with (1b), where there is no pronoun to activate the antecedent.

- (1) a. Meg worked puzzles with Burt on the porch, but she got tired very easily.
- b. Meg worked puzzles with Burt on the porch, but many of the pieces were missing.

In the study by Emmorey et al. (1991), sentences such as those in example (2a) were visually presented entirely in ASL to participants. A probe (signed) word was presented either immediately following the overt pronoun or after a 1000 ms delay; the probe was identified by the fact that the recorded signer used different colored clothing while producing the probe sign compared to the test sentence. Following the probe, the participants did not see the rest of the sentence. In the no-pronoun condition (2b), there is no pronoun in the sentence, so the probe was presented immediately or 1000 ms after the eleventh sign. In the notation used here, the subscript 'a' or 'b' indicates spatial locations used in the production of these signs; INDEX is the gloss used for the pronominal sign (see Appendix for general notation conventions).

- (2) a. ONE-YEAR-AGO HIGH S-F JUDGE_a DECIDE PUT-DOWN PRISON-AGENT_b
LIFE JAIL, SUDDENLY INDEX_b HEART ATTACK DIE.
'A year ago, a high court judge from San Francisco decided to sentence a prisoner to life in jail, but unexpectedly he(prisoner) had a heart attack and died.'
Probes: PRISON-AGENT (referent), JUDGE (non-referent)
- b. ONE-YEAR-AGO HIGH S-F JUDGE_a DECIDE PUT-DOWN PRISON-AGENT_b
LIFE JAIL, SUDDENLY LAW-AGENT FIND NEW EVIDENCE.
'A year ago, a high court judge from San Francisco decided to sentence a prisoner to life in jail, but unexpectedly a lawyer found some new evidence.'
Probes: PRISON-AGENT, JUDGE

The results of this study indicated that participants did indeed activate the antecedent of the pronouns, when the probe was presented at the 1000 ms delay, since their reaction time was faster to the antecedents than to the non-antecedents, and furthermore antecedents were responded to more quickly in the pronoun condition than in the no-pronoun condition. In sum, the study by Emmorey et al. (1991) indicated that a similar pronoun processing mechanism applies both for signers and for speakers, although there are differences that will be discussed below.

Emmorey and Lillo-Martin (1995) extended the results of Emmorey's study with overt pronouns to the case of null arguments, asking whether participants would show a similar

activation of antecedents in sentences with null arguments as they did in the earlier overt pronoun study. For this experiment, sentences containing overt pronouns were compared to sentences with null arguments of agreeing verbs; for a control (baseline) condition, no-anaphora sentences were used. Examples of each condition are given in (3).

(3) A. Overt Pronoun

_____ rh-q _____ t
 FUNNY, KNOW-THAT MY CAT INDEX_a SNOBBY[“reserved and snooty”],
 _____ t
 MY DOG INDEX_b BOIL. INDEX_b FED-U-P.
 ‘It’s funny – you know that my cat is reserved and snooty, and my dog is boiling mad.
 He(the dog) is fed-up.’
 Probes: DOG (referent), CAT (non-referent)

B. Null Pronoun

_____ rh-q _____ t
 FUNNY, KNOW-THAT MY CAT INDEX_a SNOBBY[“reserved and snooty”],
 _____ t
 MY DOG INDEX_b BOIL. _bHATE_a WOW.
 ‘It’s funny – you know that my cat is reserved and snooty, and my dog is boiling mad.
 (the dog) really hates (the cat), wow!’
 Probes: DOG (subject referent), CAT (object referent)

C. Control

_____ rh-q _____ t
 FUNNY, KNOW-THAT MY CAT INDEX_a SNOBBY[“reserved and snooty”],
 _____ t _____ t
 MY DOG INDEX_b BOIL. INDEX_{1st} STEP-OUT.
 ‘It’s funny – you know that my cat is reserved and snooty, and my dog is boiling mad.
 As for me, I want nothing to do with it.’
 Probes: DOG, CAT

The results of the study by Emmorey and Lillo-Martin (Experiment 2) can be interpreted as showing that overt and null pronouns similarly activate their antecedents. Reaction times to the antecedents in both the overt and null pronoun conditions were faster than reaction times to the same probe signs in the control, no-anaphora condition. This would indicate that when an overt pronoun or a null argument is presented, signers activate its antecedent. If null arguments of agreeing verbs are pronominal, as in the analysis offered by Lillo-Martin (1986), this parallel performance of overt and null arguments would be expected.

However, there is a way in which the results of the studies by both Emmorey et al. (1991) and Emmorey and Lillo-Martin (1995) differ from those typically observed with English. In a number of studies of the processing of English, non-referent suppression is found alongside of referent activation. That is, not only is the processing time for the antecedent faster, but accessing the non-antecedent is slower in the context of a pronoun picking out a different referent compared to the no-pronoun condition. In contrast, this inhibition effect was not found for the non-referent of overt pronouns by either Emmorey et al. (1991) or Emmorey and Lillo-Martin (1995) (note that the null argument condition does not bear on this issue, since the probes consisted of the referents of the null subject and the null object of the test clause, so there is no non-referent probe in these items).

To address this issue, Emmorey (1997) conducted another experiment looking at referent activation using a different type of comparison condition, one in which probes were presented either before or after an anaphoric element. For non-antecedent probes, response time was slower when the probe was presented after the anaphoric element than when the probe was presented before the anaphoric element – that is, the non-antecedents were inhibited after a pronoun was presented that should induce the participant to recall the actual antecedent. However, although non-antecedent suppression was found, the different baseline used in the study by Emmorey (1997) resulted in no evidence of antecedent activation, unlike the previously-reviewed studies. Emmorey suggests that this is due to the normal decline in activation that occurs when a noun phrase is encountered; in the before-pronoun condition, this decline has not depressed the activation level much, so even if the pronoun reactivates the antecedent, it only goes back to the same level of activation it had earlier in the sentence.

There is one more important theoretical issue addressed by these studies to be discussed. In Emmorey et al. (1991) a second experiment was conducted in which the spatial locus used by the probe either matched or did not match its original position within the introducing sentence. Participants were told to make their judgment on the basis of the lexical content, not the spatial locus, and in fact they seemed to be able to do that, as there was no interference effect for the mis-matching spatial location. Interestingly, another study, by Emmorey et al. (1995), did find interference for mis-matching spatial locations, but only for cases in which the spatial loci indicated topographical spatial information, not when they were purely referential. Sign languages frequently make use of the space in front of a signer to indicate physical spatial relationships between elements, which can be considered a topographical use of space (see also Chapter 19 on use of space). What on the surface appears to be very similar pointing to or indicating spatial locations thus has different functions and arguably different linguistic analyses. On the basis of the set of findings discussed so far, Emmorey (1997, 2002) concludes that the relationship between referential pronouns and their spatial loci is semantically light and is not kept in memory, while that between locative pronouns and locations is kept in memory. This is consistent with theoretical positions that differentiate these two types of elements (see also Chapters 6 and 7 on verb agreement).

Besides the probe-recognition technique, another methodology has been used to study null and overt pronouns experimentally: tracking eye-gaze during language production (also mentioned in Cecchetto's chapter). Thompson, Emmorey and Kluender (2006) used a head-mounted eye-tracking system to investigate signers' use of eye-gaze while they produced sentences containing verbs with overt or null arguments. This study tested the proposal by Neidle et al. (2000) that eyegaze marks object agreement and licenses null objects whether or not the manual verb shows agreement, in contrast to the proposal by Lillo-Martin (1986) that null objects of verbs without manual agreement require a topic for licensing.

What Thompson et al. found was that eyegaze to the object locus was used with verbs marked with manual agreement, but rarely did eyegaze indicate the object locus with plain verbs; rather, gaze was to addressee or other during the production of plain verbs. Their data furthermore contained no examples of null objects with plain verbs without an overt topic. Further discussion of the study by Thompson et al. can be found in Chapter 6 (Hosemann) where its implications to theories of verb agreement are discussed.

The experimental studies of null arguments discussed in this section contribute toward theoretical questions in the following ways. First, they indicate that null arguments used with agreeing verbs are processed similarly to overt pronouns, at least by the 1000 ms time point at which the differential activation of probes was found. However, this cannot be taken as definitive evidence that their linguistic status should be pronominal, as opposed to other possible analyses (e.g., the argument ellipsis analysis reviewed in Cecchetto's chapter) for several reasons. Importantly, various types of psycholinguistic experiments have indicated that antecedent reactivation is found for null elements of different types, but to differing degrees based on the method employed (see Fodor, 1993). On the basis of these findings, Fodor (1989, 1993) proposed that the probe recognition task taps a semantic level of representation rather than a syntactic one. If the study by Emmorey and Lillo-Martin (1995) similarly tapped a semantic level, it can be concluded that the signers did activate the antecedent of the null argument, but not that the null argument has a specifically pronominal representation in the syntax. Another relevant comparison comes from studies of null argument processing in languages like Japanese and Korean, where varying linguistic analyses have been proposed. Such studies have employed different methodologies from the one used in Emmorey's studies, so conclusions must be tentative. While some differences between processing of overt and null arguments have been found, it seems that in both cases referent activation can be detected (e.g., Kwon and Sturt, 2013). Therefore, caution is advised in drawing conclusions from the finding of referent activation for null arguments in ASL to their syntactic nature.

The experimental findings reviewed here also bear on questions regarding the nature of the spatial loci that overt pronouns and agreeing verbs are associated with. As summarized above, Emmorey et al. (1995) found interference in reference activation for mis-matching loci only for verbs indicating spatial information, not purely referential. In an interesting follow-up, Emmorey and Falgier (2004) compared activation for referent and location information in sentences where

the same locus is used for both. They found significant activation for the referent only, not for the location associated with the referent. They concluded that pronouns only activate their antecedent noun phrases, and in that way they are processed similarly to spoken language pronouns. Thus, despite the significant differences between signed and spoken pronouns due to the use of loci in signing space, the relevant aspect from the processor's point of view is simply the indication of a referent (see Cormier, Schembri, and Woll, 2013 for discussion about the similarities and differences between signed and spoken pronouns).

3. Acquisition Studies

The acquisition of null arguments in sign languages has been investigated in various ways, including studies of first-language learners, child bilinguals, and adult second-language learners. The studies have addressed several different research questions, which have focused more on acquisition issues than on the question of how null arguments are to be analyzed. These issues will be discussed in the context of each set of studies.

3.1. Acquisition of null arguments – Syntactic factors (Deaf native signers)

It is well-known that children acquiring a wide variety of languages tend to omit arguments early in their development. For example, monolingual English-acquiring children produce utterances such as those in (4) (from Hyams, 1986, citing Bloom, Lightbown and Hood, 1975).

- (4) Play it
Eating cereal
See window
No go in

A good deal of research has debated whether such utterances reflect a lack of the appropriate grammatical knowledge regarding the limitations on the use of null arguments in English (see Hyams, 2011, Valian, 2016 for reviews). It has become clear, however, that the types of missing arguments in early child language do bear some reflection on the grammatical options of the adult language; for example, while English-speaking children omit subjects, they do so less frequently than Italian-speaking children (Valian, 1991), and unlike Chinese-speaking children, they rarely omit objects (Wang et al., 1992).

In this context, the study of the acquisition of null arguments in ASL by Lillo-Martin (1991) can be seen as another indication that children's early null arguments reflect their broader knowledge of their target grammar, despite some numerical fluctuations.

Lillo-Martin studied the use of null arguments in elicited narratives produced by deaf native signing children between the ages of 1;07 (years;months)-8;11. She noted that there was a parallel development between the use of null arguments and the use of verb agreement, as follows.

In the earliest stage (one child age 1;07), a child in her study produced only very simple one- or two-sign utterances that would frequently omit arguments, such as those in (5). In these examples, the referent of the missing arguments could be understood from the broader linguistic context, but not from linguistic-internal mechanisms (such as verbal morphology or an overt topic).

- (5) (Monica, 1;07)
- a. BOY
 - b. BALLOON
 - c. CRY

At the next stage (starting with 2-year-olds), children produced sentences with overt or null arguments. Those with null arguments were similar to null-argument sentences observed in English-speaking children, in that they were not grammatically licensed; no verb agreement was observed. Examples are given in (6).

- (6) (Steve, 2;03)
- a. _aPRONOUN HAVE BALLOON.
'He has balloons.'
 - b. GIVE[uninflected] BALLOON.
'(He) gave (him) a balloon.'
 - c. HOLD, LET-GO.
'(He) held on (to it), then let go (of it).'

Near their third birthday, children started using verb agreement, though inconsistently. Sometimes the loci used with agreeing verbs were inconsistent; at other times the child signed with reference to locations in the book pictures, signing on the book itself. Null arguments were sometimes licensed, but their referent was not always made grammatically clear. See (7) for examples.

- (7) (Steve, 2;11)
- a. SEE_a WITH BALLOON.
'(He) sees (-him) with balloons.'

- b. GIVE(2h)_b BOY BALLOON [index to picture]
 ‘(He) gives the boy a balloon (he does).’

The next stage might be surprising. Around age 3;06, some children produced very few null arguments, instead repeating the overt arguments unnecessarily. They seemed to overuse overt nouns or pronouns, in contexts where native signing adults would prefer null arguments. Examples are given in **Error! Reference source not found.**

- (8) (Maureen, 3;08)
- a. BOY WALK.
 ‘A boy is walking.’
- b. BOY SEE[uninflected] BALLOON.
 BOY WANT BALLOON.
 ‘The boy saw a balloon. The boy wanted a balloon.’
- c. MAN GIVE[uninflected] A BOY BALLOON.
 ‘The man gives the boy a balloon.’
- d. BOY LET-GO BALLOON GO-AWAY.
 ‘The boy lets go and the balloon goes away.’

During this stage, children’s productions also generally lacked verbal morphology. Verbs were produced in ‘citation form’, without setting up referents in signing space. In other cases, even when verb agreement was used, arguments were still overtly repeated.

Finally, (ages 5-6), verbal morphology was used correctly and null arguments re-emerged, properly licensed with agreeing verbs, as illustrated in **Error! Reference source not found.**

- (9) Susan (6;02)
- _aPRONOUN BOY WANT PAINT. _aPAINT_b GIRL. THEN GIRL _bPAINT_a. THEN BOY _aPOUR_b SPILL-ON-HEAD. GIRL _bPOUR_a. THEN MOTHER _cSCOLD_{a,b}.
 ‘The boy wants to paint. (He-) paints the girl. Then the girl paints (-him). Then the boy pours on (-her), spilling on the head. The girl pours on (-him). The mother scolds (-them both).’

Lillo-Martin (1991) interpreted this pattern as evidence that as the children were developing in their ability to use verbal morphology, they were able to apply that ability to properly license null arguments. The stage at 3;06 was taken to indicate not a grammar that disallows null arguments, but rather one that recognizes the licensing requirement on them. Recognition of this requirement, and conservatism in production of unlicensed null arguments, was taken to indicate linguistic competence in advance of performance ability.

Lillo-Martin (1991) also considered the possibility that children's early use of null arguments might be related to their growing competence with using (null) topic licensing. She observed that overt topics were rarely used in the first few stages, and in fact the null arguments were often produced without any overt nominal indicating the referent. Only in the last stage did children correctly use discourse-topic licensing of null arguments.

Note that although Lillo-Martin's focus was on the syntactic licensing and identification of null arguments, since the data she examined came from mini-narratives, the discourse requirements for reference tracking (discussed in the introduction) would also be relevant. We discuss signing children's development in this domain as well as early syntactic factors of null arguments in bimodal bilingual acquisition of ASL and English in the next subsection.

3.2. Null and overt arguments in reference tracking (Deaf and hearing native signers)

Null arguments play multiple roles in languages, with specifics varying depending on licensing requirements. Since they typically are interpreted with respect to a particular linguistic context, researchers have frequently considered the use of null versus overt arguments in narratives, where reference tracking functions can be clearly seen. This is also an area for investigation of language development, since very young children often do not manage well with the requirements of cross-sentence cohesion and successive elaboration of the contents of a narrative.

Morgan (2006) investigated the use of overt and null arguments for reference tracking in the narratives of 12 native or near-native 4- to 13-year-old children signing British Sign Language (BSL). He considered reference forms according to their function in the discourse: introduction, for the first mention of a character in a story; maintenance, for continued reference to a character in discourse focus; and re-introduction, for a referent that has gone out of focus and returned.

Adult BSL signers differentiated these functions in the use of overt versus covert arguments. Introduction was virtually always accomplished by an overt noun phrase; maintenance almost never used an overt noun phrase; re-introduction used an overt noun phrase half of the time. Children also generally differentiated the functions but they did not reach the extreme levels of the adults. The youngest group (ages 4-6 years) used overt forms for introduction about 70% of the time – much less than did the adults. They used overt forms for maintenance 22% of the time – much more than did the adults. Finally, their use of overt forms for re-introduction was only somewhat higher than adults' (about 60%), making re-introduction not very different from introduction for the children. Older age groups showed increasing use of overt noun phrases for introduction, approaching the adult level, and lower levels of overt noun phrases for maintenance; however, rather than approach the adult level, they used higher percentages of overt forms for re-introduction.

Morgan (2006) interprets these findings as indicating that children are more concerned with making characters explicit at the sentence level, and less able to control reference forms across a discourse. Morgan compares these results to the characterization of stages of the organization of reference forms in (hearing) English-speaking children by Bamberg (1986).

An extension of this research to native signers acquiring ASL, including both Deaf children and bimodal bilinguals, was conducted by Reynolds (2016). Reynolds (2016) compared the use of null and overt forms in the narrative productions of 6 Deaf children (ages 5;05-7;10) of Deaf parents, in comparison to 6 bimodal bilingual children (ages 5;02-8;02) acquiring both ASL and English, each of whom was observed two times, 18 months apart. Three of the bimodal bilingual children are hearing children of Deaf parents (Kodas), and the other three are Deaf children of Deaf parents, using cochlear implants to access spoken language (DDCI). The first question to address is whether the Deaf children show expected patterns. Next, we discuss the patterns observed in the bimodal bilingual children, and what accounts for them.

The Deaf children in Reynolds' study produced overt forms for reference introduction over 90% of the time; they produced overt forms for maintenance 15% of the time; and they produced overt forms for reintroduction 50% of the time. This pattern is very similar to the pattern observed for adults in the study by Morgan (2006), and also the adult pattern found for DGS by Perniss and Özyürek (2015) described in the Introduction, though dissimilar to the pattern found for ASL signing adults by Frederiksen and Mayberry (2016), and unlike the pattern for any of the age groups of children in Morgan's study (even though the oldest group in the latter was several years older than the oldest participants in Reynolds' study). Overall, the Deaf participants showed good differentiation of noun phrase form associated with referential function.

It was predicted that the bimodal bilingual children might perform differently from the Deaf participants. Reynolds (2016) presents bimodal bilingual children as heritage learners, in the sense that their home (heritage) language is not the same as the dominant community language (see also Chen Pichler et al., in press). Heritage speakers frequently show differences from monolinguals in particular domains, including over-use of overt forms in contexts where null forms would be used (Montrul, 2004). Differences might also be expected due to increased influence of English at school and in other contexts, since it requires overt forms in more contexts than does ASL. In addition, it was expected that the degree of departure from ASL-like structures toward more English-like ones would increase over the two observation points 18 months apart.

As predicted, the bimodal bilingual children used a greater number of overt forms than the Deaf children did. They used almost twice as many overt forms in re-introduction contexts, and over twice as many overt forms in the maintenance contexts. Furthermore, the number of overt forms used increased from the first to the second observation of the bimodal bilingual children.

Looking at the types of overt forms used, the bimodal bilinguals produced overt pronouns much more frequently than did the Deaf participants, whose overt forms were almost always nominal. Reynolds suggests that this may be due to influence from English, since English would

almost always use overt pronouns in the contexts where ASL prefers null ones. This suggestion is supported by her observation that overt forms were used more frequently at the second observation than the first, when the bimodal bilinguals have had a sustained period of intense monolingual English exposure at school. Reynolds discusses this effect within the context of considering young bimodal bilinguals as heritage learners.

Further support for the proposal that bilingualism may affect the proportion of null vs. overt forms used by bimodal bilinguals comes from a study by Koulidobrova (2017b). Koulidobrova's main focus was on children's English, but she also looked at the use of ASL null arguments in spontaneous production of two younger children, one of whom was also observed by Reynolds at a later age. Koulidobrova observed that the two children overall used about 40% null subjects, lower than the overall rate of null subject usage by the older Deaf children in Reynolds' study. While unfortunately a quantitative comparison using similar spontaneous production data from younger Deaf signing children is not available, this rate of null subjects is also lower than that typically observed for children acquiring a null-subject spoken language.

Summing up, studies of the use of null arguments by signing children have looked at two major issues. First is the question of when native signers show evidence of understanding the licensing requirements on the occurrence of null arguments. The study by Lillo-Martin (1991) argued that at the earliest stages, null arguments are not used according to the grammatical requirements of ASL; rather, they are similar to null arguments used by English-speaking children and others. However, she argued that at the next stage, children's non-adult null argument usage could be explained by their developing verbal morphology; their use of overt arguments when verb agreement is unreliable is indicative of their knowledge of the licensing conditions; as they increase in accuracy of verbal morphology, they use appropriately sanctioned null arguments.

The second issue concerns children's developing ability to correctly select null vs. overt arguments as required by the discourse context, focusing on reference tracking in narratives. Morgan (2006) found that over time, children acquiring BSL became closer to adult-like in their distribution of overt forms in Introduction, Maintenance, and Reintroduction contexts, although even the 11-13-year-olds used overt forms in reintroduction much more than adults did. Reynolds (2016) found that 5- to 7-year-old native Deaf signers patterned very much like the adults in Morgan's study, though the ASL-signing adults in the study by Frederiksen and Mayberry (2016) showed a surprisingly higher proportion of overt forms in the reintroduction contexts. Reynolds also showed some bilingualism effects in bimodal bilinguals, who were more likely to use overt forms in maintenance and especially in re-introduction, displaying a pattern that appears to combine aspects of ASL and English.

If native signing bilingual children show bilingualism effects including higher usage of overt forms, how do adult second-language learners manage with null arguments when they learn a sign language? This is the question addressed by the two studies described in the following section.

3.3 Adult L2 learners

There are very few studies of adult learners of a sign language as a second language (L2) in any grammatical domain. When the learners' first language is a spoken language, the new language is also in a new modality (M2), potentially leading to acquisition patterns not seen in speakers learning a second spoken language (Chen Pichler and Koulidobrova, 2016). With this in mind, several studies have examined the use of null arguments in adult M2L2 learners of various sign languages.²

Bel, Ortells, and Morgan (2015) looked at M2L2 learners of Catalan Sign Language (LSC) whose first languages were Catalan and Spanish (hence technically these were L3 learners). These were advanced learners in their final year of interpreter training. L1 Deaf signers of LSC were also tested for comparison. Participants viewed a silent film and were asked to tell a story of a similar event in LSC.

As might be expected, Bel et al. found that for the native signers, overt elements (nominals and pronouns) were the preferred types used in referent introduction, and null pronouns were predominantly used for maintenance. All three types were used in reintroduction, with about 2/3 overt and 1/3 covert. The L2 signers followed the same pattern as the L1 signers for introduction, but they used more overt pronouns in maintenance and reintroduction contexts. This pattern is like that found for L2 learners of spoken languages. Note that the study by Bel et al. demonstrates for a sign language that overuse of overt forms by learners is not restricted to cases in which the L1 is a non-null-subject language. Catalan and Spanish, like LSC, permit null subjects. Since over-use of overt forms is also found in Spanish-Italian bilinguals (Sorace and Serratrice, 2009), it seems to be more a bilingualism phenomenon than one strictly connected to the properties of the L1.

Frederiksen and Mayberry (2015) studied M2L2 learners of ASL in the same story retelling task used in their (2016) study of native signers. The participants in this study were beginning to low-intermediate level whose L1 was English. They performed similarly to native signers in strongly preferring overt nouns for introduction and zero anaphora for maintenance contexts (with the L2 participants using fewer classifiers than the L1 participants did). The L2 signers used fewer zero anaphors in the reintroduction context, with greater use of classifiers here. This pattern is unlike that found by Bel et al. in that the learners did not display greater tendency for overtness in comparison to the native signers. However, Frederiksen and Mayberry point out that the L2 signers used reintroduction more frequently, and maintenance less frequently, than the native signers did. This was due in part to a technique used by the native signers by which a referent is held across a clause boundary (and therefore can be referred to using maintenance). They suggest that both over-use of overt forms and low use of cross-clause

holds by L2ers are indications of a focus on sentence-level planning by L2 learners in comparison to native signers or speakers.

This brief discussion of M2L2 learners' use of null arguments in sign languages indicates that there are similarities between sign languages and spoken languages in the over-use of overt forms (also observed in bimodal bilingual children). The modality-specific technique of holding a referent observed by Frederiksen and Mayberry (2015) is an indication that common underlying constraints may surface somewhat differentially across modalities, motivating further investigation of this understudied population.

4. Discussion and Conclusion

Experimental studies on sign language null arguments have increased our understanding of language processing and language acquisition. Overt and null arguments in sign languages involve mechanisms that on the surface appear quite different from those used in spoken languages: signers must mentally associate discourse referents with locations in signing space, communicate these associations, and maintain them through a discourse sequence (see Lillo-Martin and Klima, 1990; Steinbach and Onea, 2016 for some suggestions about formalizing this process). Despite these differences, the online processing of overt and null pronouns in ASL bears strong resemblances to what has been observed for spoken languages. The similarities and differences in processing studies begin to suggest answers to deeper questions about the mental activities revealed by these studies, which can be taken up again in the context of other studies of languages with null arguments (e.g., Sakamoto and Walenski, 1998).

Acquisition studies have contributed in several ways. The observation that syntactic structure acquisition is co-dependent with the acquisition of morphology bears on theories of acquisition or architecture that might attempt to separate the two. At the discourse level, similarities in the distribution of overt and null elements speak to theories of referent access that start at a stage that is independent of language specific properties. Bilingual studies (both 2L1 and L2) reveal again the potential for modality-specific properties to show up on the surface while common language characteristics and mental systems that permit language share deep properties below.

APPENDIX: Notation conventions

Signs are notated using upper-case English glosses that are potential translation equivalents, but properties of the signs should not be inferred from properties of the English words used to gloss them. Cited examples use the notation found in the original source. Common conventions follow.

INDEX_b Subscripts before and/or after a gloss indicate spatial locations, where co-indexing should be interpreted as signed in the same location, but the physical location itself is not identified in the subscript.

_____rh-q _____t
KNOW-THAT MY CAT

A line above glosses indicates co-occurring non-manual grammatical markers; ‘rh-q’ stands for rhetorical question; ‘t’ stands for topic

SNOBBY[“reserved and snooty”] Information in square brackets indicates the interpretation of grammatical modifications to the sign

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¹ Some authors have discussed ways in which pointing signs in sign languages may be gestural and/or have gestural components; see Cormier et al. (2013), Meier and Lillo-Martin (2010, 2013) for some discussion. One part of this discussion concerns whether there is any formal 2nd person/ 3rd person distinction in ASL and other sign languages, although these interpretations may be assigned. In addition,

Koulidobrova and Lillo-Martin (2016) argue that (non-first) points have the status of demonstrative rather than personal pronouns. As these issues are not addressed by the experimental studies reviewed here, they will be put aside for the current purposes.

² See also Matsuoka and Lillo-Martin (2017), who look at the interpretation of null and overt pronouns in M2L2 learners of Japanese Sign Language. The focus of their study is on the overt pronouns, with the null arguments as a comparison case, so it is not discussed in this chapter.