

## CHAPTER 16

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**MODALITY EFFECTS AND MODULARITY  
IN LANGUAGE ACQUISITION:  
THE ACQUISITION OF AMERICAN  
SIGN LANGUAGE**

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### I. INTRODUCTION AND BACKGROUND

There have been two main themes in studies on the acquisition of American Sign Language (ASL) over the past 20 years. One is exemplified in the following quotation:

The purpose of this paper is to argue for the inherent interest to linguistic theory of the acquisition of sign language by deaf children. (Gee & Goodhart, 1985, p. 291)

The second theme is related to the first, although in some instantiations the two could be considered contradictory. Two relevant quotes follow:

One might have every reason to believe that such surface differences between signed and spoken languages might influence the course of language acquisition. . . . the change in transmission system (from the ear to the eye, from the vocal apparatus to the hand) might in itself be expected to influence the course of acquisition. (Bellugi & Klima, 1982, p. 3)

[T]he modality in which the language is conveyed plays a significant role in language learning. (Reilly, McIntire, & Bellugi, 1991, p. 22)

It might be thought that the modality difference between signed and spoken languages makes signed languages *uninteresting* to linguistic theory. What responsi-

bility should linguistic theory have to a communication system that does not even use speech, a feature that many have considered a fundamental property of language? Yet, if modality effects do play a pervasive role in the acquisition of signed languages, then linguistic theory should be interested. Numerous recent studies of the structure of ASL have shown convincingly that ASL has the characteristics of natural language and should be accounted for within a general theory of language (see, e.g., Klima & Bellugi, 1979; Wilbur, 1987). Thus, if the acquisition of ASL is significantly different from the acquisition of spoken languages, linguistic theory should well wonder why. However, if modality is, in the end, merely a surface effect—if in fundamental ways signed languages and spoken languages are structured and acquired similarly—then this too should be interesting for linguistic theory, as it broadens the database on which to build the theory, testing it, sharpening it, supporting whichever theory can incorporate the similarities *and* the differences between speech and sign.

First, some common misconceptions about sign language need to be cleared up. ASL is the visual-manual language used by most Deaf<sup>1</sup> people in the United States and Canada. It is not a universal language, nor is it a representation of English. The rules of ASL syntax, morphology, phonology, and so on have been studied in numerous articles (though there is need for many more); some of this research will be summarized as needed for the presentation of the acquisition research that follows.<sup>2</sup>

Only 5 to 10% of deaf children at most are in a position to learn ASL as a native language from Deaf, signing parents; 90 to 95% of deaf children have hearing parents (Schein & Delk, 1974). However, a large percentage of deaf adults consider some form of sign as their primary mode of communication. Most of them learned to sign at school; in some cases, they learned from other Deaf students who were from Deaf families, from Deaf staff members at their school, or from hearing teachers fluent in ASL. In many other cases, they learned sign from hearing teachers using a manual form of English or a mixture of a signed English system with aspects of ASL (see Reilly & McIntire, 1980), or from other Deaf students who learned from such models. In these cases, *sign* might not equal *ASL*. Many factors can potentially influence the acquisition of ASL by Deaf children without Deaf parents, especially regarding the amount and type of input presented. For this reason, the bulk of research on the acquisition of ASL has been conducted with Deaf children of Deaf parents (often abbreviated DCDP), and this chapter will only be concerned with this group. The subjects in the studies reported here are Deaf (or hearing) children with Deaf parents, who are learning ASL as a native language.<sup>3</sup>

<sup>1</sup>It has become relatively common practice to capitalize the word *Deaf* when referring to the cultural group who have, among other characteristics, impaired hearing and who use American Sign Language with each other. People with similar degrees of hearing loss who are not part of this linguistic minority would be referred to as *deaf*. See Padden and Humphries (1988) citing Woodward (1972).

<sup>2</sup>In this literature, it has become common practice to transcribe ASL using English glosses to approximate the meaning of each sign; this gloss is written in all caps. It is important to bear in mind, however, that these are merely glosses; they stand for a sign that has its own particular hand configuration, location, and movement and is used in sentences according to the syntactic rules of ASL.

Linguistic research on the structure of ASL began about 30 years ago, with the publication of *Sign Language Structure* by William C. Stokoe (Stokoe, 1960). Studies of the acquisition of ASL begin perhaps 10 years later. In 1985, an excellent review article of studies on the acquisition of ASL to that date was published by Elissa Newport and Richard Meier (Newport and Meier, 1985).<sup>4</sup> Because this article is rather comprehensive and easily obtainable, this chapter will not, for the most part, duplicate it. Instead, the focus here will be on research published since the Newport and Meier paper was written and not referred to there. For readers unfamiliar with this background, Section II presents a short summary of some of the research presented in Newport and Meier, especially when it concerns topics that have continued to be investigated since their chapter was written.

Some research has been conducted on the structure and acquisition of sign languages other than ASL, though ASL remains the most widely studied. Unfortunately, such studies will not be included in this review, except in cases that directly compare the acquisition of ASL with the acquisition of another sign language. Clearly, for the claims in this chapter to be maintained—especially those claims about modality effects and the nature of the language apparatus—support will have to be found in studies of the acquisition of other sign languages. Such studies are eagerly anticipated.

## II. THE FIRST DECADE OF RESEARCH ON THE ACQUISITION OF AMERICAN SIGN LANGUAGE

In summarizing their earliest chapter, Newport & Meier (1990, p. 3) stated:

[A] synoptic perspective on acquisition in the two language modalities reveals that children acquire sign and speech in much the same fashion and on much the same schedule. (Newport & Meier, 1985)

<sup>3</sup>Many interesting issues arise from consideration of language acquisition in deaf children without Deaf parents. In the most severe cases, essentially no usable linguistic input is available for the first several years of the child's life. In such cases, the children often develop home sign systems—relatively patterned use of gestures that are idiosyncratic to each family (though often related to “natural” gestures, or iconic in various ways). See Goldin-Meadow and Mylander (1990) for a recent review of studies in this area. Many other deaf children of hearing parents receive sign language input and learn ASL but beginning at a later point in development. Some studies have been conducted with such children, concentrating on the differences between their course of development and that of DCDP. See Gee and Goodhart (1985) for a discussion of the issues related to this subject group. See also, among others, Mounty (1986), Newport and Supalla (1987), Galvan (1988), and Mayberry and Eichen (1991). For an interesting study of the effects that such late learners have (and do not have) on the acquisition of ASL by their children, see Singleton (1989).

<sup>4</sup>Other helpful summaries have been presented by Hoffmeister and Wilbur (1980), Hoffmeister (1982), Deuchar (1984), Kyle and Woll (1985), Wilbur (1987), Bellugi (1988), Bellugi and colleagues (1988), and Meier (1991).

Indeed, the milestones that children pass by in first language acquisition are remarkably similar for signed and spoken languages. This said, it is important to point out two caveats: (a) there may be an important difference between modalities in the earliest stages (to be discussed more immediately and in Section III) and (b) at the time of Newport and Meier's review, it was appropriate for them to say "virtually no work has been done to date on the acquisition of ASL syntax" (p. 927) (cf. Section IV). This summary with these caveats tell us that more work is needed in the investigation of the acquisition of ASL and that such effort is likely to pay off.

### A. First Signs

The first major issue which Newport and Meier addressed concerns the timing of the first signs. A number of studies had found that young children's first signs seemed to occur significantly earlier than the average age reported for first spoken words. According to some reports, this advantage for signs amounted to as much as six to seven months difference, quite significant during the first year of life. If this difference in the timing of first signs held up in continued studies, it would certainly require explanation. In fact, the earliest studies not only claimed an advantage for the production of the first signs, they also claimed that the first 10- and sometimes 50-sign vocabularies were advanced, and similarly the first 2-sign combinations occurred before the first 2-word combinations. This much of a difference for the acquisition of sign versus speech would need further exploration. However, by the time of the Newport and Meier chapter, the strength of this claim was already under some scrutiny. Because additional work was published later, which helps to clarify the issue, if not to settle it, this will be discussed in more detail in Section III.B.

### B. Early Pronouns

One of the first signs to appear in the Deaf child's productions is an indexical point. Pointing occurs in the early gestures of both children learning ASL and children learning to speak, and it serves as a linguistic unit—a pronoun—in ASL, so it is an especially interesting phenomenon to study for the light it can shed on possible reorganizations between prelinguistic and linguistic forms of communication. Laura Petitto thus studied the acquisition of personal pronouns in Deaf children learning ASL. The first stages of her work are summarized by Newport and Meier; see also Petitto (1983, 1987, 1988, 1990) for more recent discussion. Because the later references expand on (rather than alter) the conclusions summarized by Newport and Meier, I will review the more recent work along with the discussion by Newport and Meier here.

Pronouns for *me* and *you* are produced in ASL by pointing to the intended ref-

erent—the same gesture as the nonlinguistic point that often accompanies speech. Because this gesture is highly iconic, it might be expected that the acquisition of first- and second-person pronouns in ASL would be relatively effortless. In comparison, hearing children learning spoken languages often go through a stage of confusing the reference of the words *me* or *you*. This is most likely because the meanings of these words shift in discourse, but children apparently initially treat them as names.

Petitto found that Deaf children also initially treat the signs for *me* and *you* as names, despite their iconicity. She found that at the age of 6 to 12 months, Deaf and hearing children point to themselves and others as a way to investigate and explore their surroundings. However, although points to objects continue, from ages 12 to 18 months the two Deaf children whom Petitto studied ceased pointing to people. Following this, at 21 to 23 months, the Deaf children went through a phase of using the sign YOU for ME (one child consistently, the other child inconsistently), just like the pronoun reversal errors often found in hearing children. They also made other errors with personal and possessive pronouns. Petitto argued that at this time, the indexical pointing had changed from a prelinguistic gesture to a linguistic unit, and like other linguistic units being acquired at that time, the children were treating this unit as a name with consistent reference rather than shifting reference. When hearing and Deaf children go through this phase of pronoun reversal errors, they often avoid using first- or second-person pronouns and produce names instead. Finally, by 25 to 27 months, Petitto's subjects correctly produced personal pronouns.

Two other more recent studies have also supported Petitto's conclusions. Pizuto (1990) studied one Deaf child and found that deictic personal pronouns were not produced until 20 months. Furthermore, the first pronouns of this child also displayed a few ME for YOU substitution errors, at the beginning of use of deictic pronouns. Unlike pronouns, points for demonstratives and locatives occurred at 15 and 18 months, respectively. Jackson (1984, 1989) studied a hearing child of Deaf parents, learning ASL and spoken English simultaneously. She found *you* = *me* substitution errors in both speech and sign at 28 months, although they were not systematic. She found additional errors in the development of possessive pronouns, not limited to pronoun reversals. In ASL, possessive pronouns use the same locations as personal pronouns, but a different handshape. One interesting error Jackson's subject displayed in possessives concerned the direction of the agreement. Instead of moving the possessive pronoun toward the location of the possessor, she directed it to the possessed object. Because possessor agreement is found in some languages, Jackson concluded, "Thus, Cari's errors concerning what deixis to code in her ASL possessive constructions are not linguistically unusual forms, but are types of constructions allowed across languages. They do not happen to be the options exercised by the languages she was learning" (Jackson, 1984, p. 42).

There are two reasons for theoretical interest in Petitto's result. First, it shows that the high iconicity of some ASL signs seems not to affect the time-course of language acquisition. As Pizzuto (1990) pointed out, the acquisition of these forms does not "seem to be significantly influenced by the modality in which communication and language take place" (p. 152). This point will be repeated later. Second, Petitto used her result to argue against proposals that early gestures form a sort of continuum into first words. For example, Bates, Benigni, Bretherton, Camaioni, & Volterra (1979) argued that the young child's pointing and other gestures are generated by the same cognitive mechanism that underlies naming. In this view, the apparent break between prelinguistic gestures and linguistic naming is an artifact of modality. Alternatively, in sign languages, where gestures and words take place in one and the same modality, this position would not expect a drastic break between prelinguistic and linguistic forms. According to Petitto's results, however, there is a clear break between prelinguistic and linguistic forms. This casts doubts on the proposal that a single cognitive mechanism underlies both prelinguistic gesturing and linguistic naming.

### C. Early Lexical Development

Other signs that children acquire in the early stages of sign language acquisition, like the first words of speech in many languages, take the form of uninflected common nouns and verbs referring to things and actions common in the child's daily life. The child learning ASL has yet to acquire the rich verbal morphology and use it appropriately in syntax. Instead, first signs in ASL are typically *citation* forms, that is, uninflected roots or unanalyzed amalgams if they appear inflected. Semantically, they capture the range of concepts common to young children in their home environments (Newport & Meier cited Newport & Ashbrook, 1977; see also Bonvillian & Folven, 1993; Petitto & Charron, 1987).

### D. The Acquisition of ASL Verbal Morphology and "Spatial Syntax"

The verbal morphology of ASL includes markers for agreement with subject and object, aspect marking, and classifiers used in verbs of motion and location. The acquisition of these morphological forms has been studied and reviewed in Newport and Meier's chapter. Here, I will discuss the former and latter. Both topics have also received attention since Newport and Meier was written, so the discussion will be continued in Section IV.

#### **Verb Agreement and Anaphoric Reference**

A digression should be made here to describe the system of agreement morphology and anaphoric pronouns used in ASL (see Padden, 1983, 1990, among other sources). A verb root is specified lexically for its hand configuration and general location and movement, but for verbs that can be inflected to agree with sub-

jects and objects,<sup>5</sup> specific verb location and movement are supplied by agreement. An example will help to illustrate. The verb for *give* is produced by moving a hand that is closed as if holding a piece of paper or other thin object, in the neutral space in front of the signer. If the verb is used in a sentence meaning “I give (something) to you,” then the hand moves from a position near the location of the signer (I) to a position near the location of the addressee (you). If it means “you give (something) to me,” the movement goes in the opposite direction: from *you* to *me*. In general, verbs that inflect for subject and object agreement thus move from a location designating the subject to a location designating the object.<sup>6</sup> The location designating a referent will be a location near that referent, if he or she is present; in this case, I will discuss agreement with present referents. If the referent is not present, an arbitrary location in the signing space will be chosen to designate that referent, and that arbitrary location will be used for verb agreement and pronouns. These arbitrary locations are usually on the right and left side of the signer, chosen to maximize perceptual saliency; however, in some cases the locations are representative of real spatial locations. The association of referents with these locations can be done in a number of ways, including naming the referent and then pointing to the location, eye gaze in the direction of the location, or verb agreement using this location with an overtly named referent.

The sign for *give* was used as an example of verb agreement, because the resulting form is rather iconic: the sign as inflected for “I give to you” takes almost the same form as I would take in handing something to you; likewise, although “you give to me” is not signed in the same way as it would be pantomimed, nevertheless the reference is quite clear once one knows the system. Even the forms for nonpresent referents are rather transparent, especially for a verb like *give*. In other verbs, the iconicity or transparency is diminished; for example, the verb *hate* takes the form of the thumb contacting the middle finger while the other fingers are extended; the middle finger is released from the thumb while the hand moves in the direction of the location designating the object.

Once a location has been marked to designate a particular referent, that location can then be used for anaphoric pronouns as well as verb agreement. Thus, if Sally is associated with a location on the signer’s right, then subsequent uses of this location in the verb agreement will indicate whether Sally is the subject or object of the inflected verb. In addition, an indexic point can be directed at that location to serve as the pronoun *she*.<sup>7</sup> To use such pronouns and verb agreement appropri-

<sup>5</sup>Not all verbs participate in the agreement system. Verbs that cannot be inflected for subject and object agreement generally can still be marked for aspect; Padden called these “plain” verbs.

<sup>6</sup>A small class of verbs is sometimes referred to as backwards verbs. These verbs move from the location of the object to the location of the subject.

<sup>7</sup>Unlike the English pronoun, the ASL pronoun does not indicate gender. However, it does more than the English third-person pronoun in that it picks out a particular referent (in this case, Sally) rather than a class of referents (e.g., third-person singular female). For more on this particular characteristic of ASL pronouns, see Lillo-Martin and Klima (1990) and Meier (1990).

ately, Deaf children need to learn (a) to associate a referent with a location, (b) to use different locations for different referents (except when a group of referents is being referred to or, in some cases, for possession), (c) to use verb agreement or pronouns with nonpresent referents, and (d) to remember the association of referents with locations over a stretch of discourse. This complex system of locations and the verb agreement and pronouns directed to these locations is called "spatial syntax" by some researchers.

A number of studies have examined the acquisition of this system of verb agreement and pronominal reference, as summarized by Newport and Meier. One in-depth study of verb agreement with present referents was undertaken by Richard Meier (Meier, 1982, 1987), who asked in particular whether the iconic or transparent nature of some verb forms would make them easier to acquire than others. He used studies of spontaneous productions in 3 Deaf children aged 1;6 to 3;9, and elicited imitation in 10 Deaf children aged 3;1 to 7;0. He found that the iconic and transparent verb forms were not acquired any earlier than the more abstract forms, and that the whole ASL system was not acquired earlier than comparable agreement systems in spoken languages. At the earliest ages (less than 2 years), Deaf children use mostly verbs that do not participate in the agreement system. As they begin using verbs that can be modified (age 2;0 to 2;6), they produce only uninflected verb forms, with a short movement in neutral space not picking out any particular referents. The verb agreement system is not acquired until around the age of 3;0 to 3;6. This is similar to the age at which children acquire verb agreement in nonagglutinative spoken languages, but in fact later than the acquisition of verb agreement in other languages (such as Turkish). Note that Meier studied the acquisition of verb agreement for present referents only—that is, situations in which the verb agrees with a subject or object physically present in the discourse. In Section IV.B I will discuss more recent studies of the acquisition of this verb agreement system.

The use of verb agreement with nonpresent referents comes substantially later than verb agreement with present referents. In Ruth Loew's longitudinal study of one Deaf child's use of verb agreement with nonpresent referents, she found that consistent and correct use of this system does not occur until the age of 4;9 (Loew, 1984). Similar results were found by Robert Hoffmeister (Hoffmeister, 1978, 1987) in his longitudinal study. Newport and Meier consider this a result of the additional abstraction and association of nonpresent referents with locations in the signing space, rather than a failure to identify agreement in the two situations. This point will also be discussed further in Section IV.B, together with more recent studies.

Loew's and Hoffmeister's studies found that once children begin using verb agreement with nonpresent referents and associating referents with locations, they initially make some interesting errors. For example, from 3;6 to 3;11 the child used some forms marked with agreement; however, all the referents of a story might be associated with one location in space. Further uses of verb agreement or anaphoric pronouns picking out this location fail to distinguish between the various refer-



ents. Later errors include the use of different, but inconsistent locations within one story. Loew called this use of spatial loci contrastive, as opposed to the adult use, which distinctly identifies referents. By 4;0 to 4;4, these subjects used what Hoffmeister called “semi-real world forms”; that is, an object in the discourse situation would serve as a substitute for the nonpresent referent, and the location of the present referent would be used for agreement and pronouns. Occasionally abstract locations would be associated with referents, or verb agreement would be used with multiple locations, but many errors would remain. It was not until 4;6 to 4;9 that these subjects were able to use this system accurately in their discourse and storytelling.

Newport and Meier suggested that this acquisition pattern “suggest[s] that the errors arise from difficulties inherent in establishing and maintaining abstract spatial loci” (p. 905), rather than separate acquisition of verb agreement with present versus nonpresent referents. In Section IV.B, I will present data that bears on this point and discuss it more fully.

### Verbs of Motion and Location

ASL has a rich system of classifiers that are used in verbs of motion and location. The term *classifier* refers to the hand configuration used to represent a semantic class of referents, such as upright beings or land and water vehicles. Hand configuration is not usually morphemic; only in these classifier constructions and some other morphological processes in ASL (such as number incorporation) does the hand configuration by itself convey meaning. These classifier handshapes are combined with movement roots to produce verbs of motion and location. In many cases, the resulting form appears *mimetic* or analog; however, Supalla (1982, 1986) has convincingly argued that they consist of complex combinations of a limited number of morphemes.

Ted Supalla, in addition to his study of the structure of verbs of motion and location, examined their acquisition by three Deaf children from 2;4 to 5;11. Other studies of this construction reviewed by Newport and Meier include Ellenberger and Steyaert (1978), Kantor (1980), and Newport (1981). These studies find that children acquire the structures of verbs of motion and location piece by piece, morphemically rather than holistically. The youngest children use limited movement roots, and frequently use the incorrect classifier handshape and omit morphemes for manner of movement or secondary objects. At around 3, children use some correct combinations of handshapes and movements, but combinations of movement roots or movement plus manner are absent. Interestingly, a few months later children sometimes produce two roots in sequence, rather than simultaneously; for example, one child produced linear and arc movements sequentially, meaning “to move (straight) downward followed by a jump,” rather than the target simultaneous combination of these morphemes, which would mean “to jump downward.” By the age of 5;6, most complex verbs of motion and location are pro-

duced correctly, although errors do remain. In sum, Newport and Meier stated, "All of these patterns suggest that young children are not acquiring ASL verbs of motion in an analog or holistic fashion, but rather are acquiring them morpheme by morpheme, just as in the acquisition of morphologically complex spoken languages" (p. 901).

Most of the issues that were reviewed by Newport and Meier have continued to be of interest to researchers in the acquisition of ASL. Further work in each of the areas just discussed will be brought up in the sections that follow. For more details on the earlier studies, the reader is referred to Newport and Meier's very helpful summary and the original sources.

### III. CURRENT ISSUES: THE FIRST STAGES

#### A. Manual Babbling

The acquisition of ASL received national attention in 1991 when Laura Petitto and Paula Marentette published a cover story in *Science* (Petitto & Marentette, 1991). The paper made the claim that Deaf children, exposed to a natural sign language from birth, "babble" manually in much the same way that hearing children babble orally, at around the same age, 10 months. This claim led to front-page newspaper headlines such as "Deaf Babies Use Their Hands to Babble, Researcher Finds" (*New York Times*, 3/22/91). Why was there so much attention paid to this research (when, sadly, most language acquisition research is ignored or garbled by the popular press)? Apparently, this work brought home the message that similarities in the development of signed and spoken languages reveal the falsity of the idea that language = speech and reinforce the plausibility of some biological foundations for language, present at birth in all humans.

Petitto and Marentette were not the first to claim that children learning ASL babble manually. Newport and Meier cited two works making this claim, one as early as 1979. However, they stated, "there are no detailed studies of this behavior, so the precise phonological status of this babbling (e.g., is it phonologically restricted to those forms which are permissible in gestural languages generally, or in ASL in particular?) is unknown" (1985, p. 888). Petitto and Marentette are able to answer this question in part. Their detailed study found that Deaf children exposed to sign language, but not hearing children exposed only to spoken language, manually babble systematically using syllables that are possible phonetic units in signed languages. Furthermore, they state (in a footnote) that Deaf children exposed to *Langue des Signes Québécoise* (LSQ)<sup>8</sup> babble using the same syllabic

<sup>8</sup>LSQ is the sign language used by French Deaf people in parts of Quebec and in some other parts of Canada. It is apparently distinct from ASL and LSF, the sign language used in France.

units as children exposed to ASL: thus, “[j]ust as hearing infants do not babble in specific languages, deaf infants do not babble in ASL or any other sign language” (p. 1496).

Besides the point that Deaf children do babble manually, one of the most interesting claims that Petitto and Marentette made is that hearing children, in general, do not. They show that using the same criteria to classify manual babbling in both the hearing and Deaf children, the hearing children produce manual babbles in at most 15% of manual activities; in contrast, the Deaf children produce manual babbles in 32 to 71% of their manual activities. Petitto and Marentette have claimed that the Deaf children’s vocal babbling is similar to the hearing children’s manual babbling: with little variation in form and a reduced set of phonetic units. They state, “[t]hat infants produce occasional babbling forms in the modality that does not carry linguistic input appears to be the vestige of their potential to have produced language in either modality” (p. 1496).

This study makes it clear why developmental psycholinguists should be interested in the acquisition of ASL—for the same reason that readers of the *New York Times* should be—and it sets the stage for future studies of the earliest stages of language acquisition. Future work should include studies of more, younger children (Petitto and Marentette studied two Deaf children at the ages of 10, 12, and 14 months), and it should provide additional detailed information regarding the questions concerning the phonology of sign babbling and the characteristics of the prelinguistic gestures of young hearing children.<sup>9</sup> With more extensive studies Petitto and Marentette’s strong claims about the equipotentiality of language in either modality can be defended.

## B. First Signs

For hearing children, vocal babbling develops into first words. Although estimates vary, first words tend to appear at 10 to 12 months; the first 10-word vocabulary is achieved at an average age of 15 months (Nelson, 1973). Given the overall summary that the development of spoken languages and the development of sign languages follow remarkably similar courses, it is surprising to find that numerous studies have claimed an advantage for the acquisition of the first signs compared to first words. In some studies, it has been claimed that the first signs are produced as early as 5 months (Schlesinger & Meadow, 1972).

The strongest, most consistent claims for earlier first signs compared to first spoken words comes from a series of studies done by John Bonvillian, Michael Orlandy, and their colleagues (Bonvillian & Folven, 1990, 1993; Bonvillian, Or-

<sup>9</sup>In an unpublished poster presentation, Willerman and Meier (1992) reported on such a study in progress. Their study includes several younger children, both Deaf and hearing. They found that hearing children do produce a large amount of manual babbling, including some of the complex manual babbling forms that Petitto and Marentette found only for Deaf babies.

lansky, & Folven, 1990; Bonvillian, Orlansky, Novack, Folven, & Holley-Wilcox, 1985; Orlansky & Bonvillian, 1985). Bonvillian and colleagues reported on two studies of children learning ASL from Deaf, signing parents. In the first project, 9 children were studied (8 of them had normal hearing, one was Deaf); in the second, 13 children were studied (12 hearing, 1 Deaf).<sup>10</sup> Using parents' reports plus monthly videotape sessions, these studies found that the first signs were produced at an average age of 8.5 months; the first 10-sign vocabularies were obtained by an average age of 13.3 months (Bonvillian & Folven, 1993). An additional study that also claims early first signs is Siple and Akamatsu (1991); interestingly, Siple and Akamatsu studied a pair of twins (one hearing, one Deaf), and still found precocious first signs, despite the fact that twins are often found to be slightly language delayed (Siple & Akamatsu cited, among others, Day, 1932).

Newport and Meier reviewed the earliest studies on the appearance of first signs in their 1985 chapter, and concluded that

young children, whether deaf or hearing, may be capable of first language use at somewhat earlier ages than has previously been supposed, if they have access to a modality which favors their earliest attempts. . . . From this perspective, it is spoken language onset which is slightly delayed (rather than signed language onset which is slightly advanced), relative to when the child is cognitively and linguistically capable of controlling the first lexical usages. (p. 889).

Later, Newport, & Meier expanded on this possibility in a review including additional studies of the timing of first signs and words (Newport & Meier, 1990). They summarized their review by saying, "We have defended the claim that there are indeed differences across the two language modalities in the emergence of language milestones" (p. 18). However, they acknowledged that there is still controversy regarding the accuracy of this claim. The controversy mainly concerns whether the studies claiming early sign use might be overattributing *word* status to early gestures akin to the early nonlinguistic communicative gestures used by hearing children with no sign language input. Although they make very different claims with regard to the development of first signs, Petitto (1988) and Volterra and Caselli (1985) both argued that more stringent criteria need to be applied when determining when a gesture *counts* as a sign (word).<sup>11</sup>

Petitto (1988; Petitto & Charron, 1987) has claimed from the study of Deaf chil-

<sup>10</sup>Bonvillian and his colleagues included hearing children as well as Deaf children, as long as at least one parent was Deaf and ASL was considered the most dominant language used at home. Although they do not report extensively on the hearing children's development of spoken English, they do say that the precocious appearance of signs compared to spoken words was present even for those hearing children with one hearing parent. The difference between sign and speech usually disappeared by age 2, they reported.

<sup>11</sup>Other researchers who do not find earlier signs than words include Ackerman, Kyle, Woll, and Ezra (1990), who studied Deaf and hearing children learning British Sign Language and English, and Gaustad (1988), who, like Siple and Akamatsu, studied twins, one Deaf and one hearing.

dren learning ASL and LSQ, and hearing children learning English and French, that when rigorous criteria are adopted, no differences appear in the emergence of first spoken words versus signs. In particular, Petitto was concerned with the linguistic status of early communicative gestures and argued that both Deaf and hearing children produce such gestures as pointing, "natural" gestures (reaching, raising the hands, etc.), instrumental gestures with and without objects, and iconic gestures (e.g., twisting the hands as if opening a jar); but Petitto argued that none of these communicative gestures are linguistic. To determine whether a gesture has the characteristics of naming, Petitto argued that the form of a gesture must be distinct from the object or action to which it refers; the scope of the referring relations must include a single, consistent form to designate a class or kind; and the function of the name is to assign an object to a category (this summary is necessarily very sketchy; see Petitto, 1988 for more detail). In her study, Petitto used these criteria for both Deaf and hearing children's gestures and vocalizations; she found that only the Deaf children used gestures linguistically, and that both the Deaf children's first signs and the hearing children's first words occurred at the same time, around 12 months. It should be pointed out that Petitto used once-monthly videotape sessions with particular elicitation protocols. Although this is much more exacting than Bonvillian's use of parental reports (with videotaped visits), it is likely to underestimate children's proficiency (cf. Newport & Meier, 1990, citing Nelson, 1973).

Bonvillian and colleagues, aware of the necessity for caution in over attributing linguistic status to early gestures, excluded waving, pointing, and other gestures common to Deaf and hearing children in their second study. Still they found almost the same average age at onset of signing across the two studies (8.2 months in the first study, 8.6 months in the second). However, they note that "initial sign production occurred within a nonreferential context—the signs emitted typically were either imitations of others' productions or requests for action. Not until these children were, on the average, 12.6 months old . . . did they begin to use signs referentially" (Bonvillian & Folven, 1993, p. 240). Thus, it seems that Bonvillian and colleagues are not in disagreement with Petitto regarding the age at first referential sign use. The disagreement concerns earlier gestures—whether they indicate an earlier onset for sign language compared to spoken language. Noting this, Meier and Newport stated, "For our own purposes, a modality difference even in non-symbolic early usages would be interesting" (p. 7).

If there is not a difference between signed and spoken language development for *referential* sign/word use, what implications does this have for theories of language acquisition? As mentioned earlier, Newport & Meier found the possibility that sign languages are begun earlier than spoken languages a potential source of information regarding the mechanism(s) by which linguistic milestones are achieved. They suggested that the linguistic and cognitive underpinnings for the first lexical items are in place at the same time, regardless of whether a manual or

vocal language will be acquired. However, the development of peripheral factors such as articulatory and perceptual mechanisms for sign and speech may differ. In particular, although children may be ready to begin using language by an age of 8 to 10 months, perhaps control over the vocal apparatus (or perceptual apparatus)—at least sufficient control to produce recognizable words—simply takes longer to attain than similar control over the large muscles of the hands and arms. The fact that both Bonvillian's study and Petitto's study found similar ages for referential sign use supports this conclusion. Apparently, the mechanism underlying the deepest linguistic abilities does develop in step, regardless of modality.

### C. Lexical Development

It is a misconception to think that ASL signs are pictures in the air, but it should be recognized that some signs are iconic, or have an iconic base. This includes some common nouns, such as TREE (in which the forearm is extended vertically, with the fingers of the open hand extended; this calls to mind the trunk and branches of a deciduous tree); as well as verbs such as DRINK (a cupped hand moves up at the mouth); and adjectives such as BIG (the two hands, fingers outstretched and palms facing, move away from each other in the neutral space in front of the signer's body). Despite the presence of some iconic signs, naive adults could only guess the meaning of 10% of 90 common ASL signs in one study; in another, their multiple-choice guesses for the meanings of signs were no better than chance (Klima & Bellugi, 1979). Would perhaps the iconicity of some ASL signs make these signs the earliest or easiest to acquire?

A number of researchers have asked whether the iconicity of ASL signs affects their acquisition. Perhaps children learning sign languages will acquire iconic signs more quickly than noniconic signs. In fact, it has been suggested that this might underlie the apparently earlier acquisition of first signs compared to first words. However, every researcher who has examined this has concluded, with Pizuto (1985), that

the child does not exploit to her advantage the iconic-indexical features that observers have found in the ASL . . . lexicon. Thus it would appear that the iconic-indexical features inherent in a formal linguistic system are irrelevant to language learning processes. (p. 53)

Bonvillian and colleagues found that only one-third of the first signs that the children they studied produced were iconic (Bonvillian & Folven, 1993). Petitto (1988) even found that young children do not comprehend the iconic gestures which they themselves produce. Thus, it seems that iconicity is irrelevant to the acquisition of the first words. As we have seen in Section II, and will see in Section IV, it also is ignored in the acquisition of other aspects of ASL grammar.

Unlike the claims for the first signs and the first 10-sign vocabularies, it appears

that the first 50-sign vocabulary is not acquired drastically earlier than the first 50 spoken words. Bonvillian and colleagues found the 50th sign in the 18th month on average; similar findings with children learning a spoken language place 50 words in the 19th month (Nelson, 1973). Thus, the sign advantage (if there is one) diminishes as acquisition proceeds. Given this difference, it is not surprising that the course of the acquisition of the first 50 words or signs differs, according to Bonvillian and colleagues. For children learning a spoken language, there is a later start, and a large increase in the number of words acquired during the month in which the 50th word is achieved. For children learning sign, since the start is earlier, the increase in vocabulary during the month marking the 50th word is much less dramatic—only about half as many new signs are added in this month compared to spoken language acquisition (Bonvillian & Folven, 1993). At about the same time as this milestone, children learning both signed and spoken languages put together two words into early sentences, and syntax begins.

#### D. Phonological Development

The term *phonology* when applied to studies of sign language applies not to the patterns of sounds (*phones*), but to the patterns of sublexical, meaningless units. Although recent studies of the phonological structure of ASL have become rather advanced (see, e.g., Coulter, 1993), relatively few studies of the development of ASL phonology have been made. Those that have been published have concentrated on examining when children show command of the basic units of individual ASL signs: handshapes, locations, and movements.

The earliest work in phonological development concentrated on accuracy in hand configuration (see review in Newport & Meier, 1985; also Boyes-Braem, 1990; McIntire, 1977). According to these earlier models, children are expected to develop ASL handshapes in part by their anatomical and cognitive complexity. In support of this model, young children were found to use first the subset of ASL hand configurations that are formationally simplest. These hand configurations are also unmarked phonologically in the language; for example, they are the allowable hand configurations for the base (nonactive) hand in two-handed signs in which each hand uses a different hand configuration (Battison, 1974).

More recent work has looked beyond hand configurations used by the youngest signers. Siedlecki and Bonvillian (1993a, 1993b) examined several aspects of children's acquisition of sign phonology. They found that location was the first aspect of signs to be acquired; even the first signs produced by children learning ASL (less than 14 months of age) had accurate locations 84% of the time. Movements were accurate less often—only 61% of the time on average for children from 5 to 18 months of age. Handshapes were accurate the least often—only 43% of the youngest children's handshapes were accurate; even at 16 to 18 months, only 58% of handshapes were accurate. In their analysis of patterns of hand deletion, Siedlec-

ki and Bonvillian (1993b) again found a prominent role for location. They found that one hand of a two-handed sign was deleted more frequently if the deletion left information about the location of the sign intact; for example, a two-handed sign modeled with both hands using the same configuration on the face might be produced by a Deaf child with only one hand. In this example, location information (as well as information about the configuration of the missing hand) is recoverable from the hand that remains.

Schick (1990b) took a different approach. She looked at older (4;5 to 9;0) children's accuracy in handshape productions during a classifier production task (see also Section IV.A). The predictions made by Boyes-Braem and McIntire would be that as these children produce morphologically complex forms, they may revert to less marked handshapes—that is, hand configurations acquired at the earliest stages. However, contrary to this prediction, Schick found that substitutions came from hand configurations classified as equally complex or even more complex than the target handshape according to Boyes-Braem's model. Schick interpreted these findings as showing that "handshape simplification did not support notions of anatomical complexity" (p. 37). Rather, Schick focused on the morphosyntactic complexity of the utterances leading to the handshape errors. Because the children were able to produce the handshapes under investigation in morphosyntactically simpler forms, this leads to a consideration of these errors within the context of the acquisition of classifier morphology, so they will be discussed more later. Note also that (as she pointed out) the children Schick studied were considerably older than those that Boyes-Braem and McIntire studied; perhaps their anatomical models are still appropriate for the youngest children.

#### **IV. THE ACQUISITION OF MORPHOLOGY AND SYNTAX**

##### **A. Verbs of Motion and Location (Classifiers)**

As discussed in Section II, Supalla conducted a major study of the acquisition of ASL verbs of motion and location, which was reviewed by Newport and Meier. Since their review, three additional studies have been reported that bear on the development of this complex morphological system.

Brenda Schick studied the development of verbs of motion and location in Deaf children aged 4;5 to 9;0 (Schick, 1987, 1990c). She used a classifier elicitation task, in which the children had to describe the scene on a picture accurately enough for her to choose a matching card. These pictures were most felicitously described using classifiers to indicate spatial relationships; in addition, the experimenter produced classifier constructions in turn with the children, encouraging their use of this structure. Using this method, Schick collected a large number of classifier predicates from each of 24 children; these predicates differed in the category of classifier used, the particular hand configuration needed, and the morphosyntactic



complexity of the utterance. (See Schick, 1990a, for the morphosyntactic analysis used here.)

Schick found that accurate classifier handshapes were produced most often for what she has called CLASS predicates. These are the classifiers that represent semantic classes, such as people or four-legged animals. She attributed the relative ease of acquisition of CLASS handshapes to their morphological simplicity: the handshape represents one semantic class and has no handshape-internal morphemes. When combined with a movement root (as in the forms elicited), a CLASS predicate represents a subject with an intransitive verb (e.g., CL:G-MOVE-FORWARD “a person went forward”).

The second-most accurate classifier predicates were produced with SASS handshapes. SASS (for size-and-shape-specifier) handshapes represent aspects of the physical dimensions of the referent; they are more complex than CLASS handshapes morphologically, in that a single handshape might represent both shape (e.g., circle) and depth (e.g., a long cylinder). A SASS handshape with a movement root produces an inanimate predicate adjective (e.g., 2hCL:C-SPREAD-APART “be a long, deep cylinder”).

The most difficult classifiers for the children in Schick’s study were HANDLE classifiers, which represent the size or shape of a referent by indicating how it is held by a human hand. These have multimorphemic handshapes, like SASS classifiers, and combine with movement roots to produce transitive, agentive predicates (e.g., 2hCL:S-MOVE-UPWARD “lift a long, shallow cylinder”).

The progression of difficulty for handshapes shows that the different classifier morphemes are acquired differentially and that both semantic and syntactic factors play a role in determining sequence of acquisition. Furthermore, the sequence of acquisition for location morphemes did not parallel the sequence for handshape morphemes, again supporting the hypothesis that these forms are acquired morphologically rather than holistically (cf. Section II). Location morphemes were produced most accurately in HANDLE classifiers. Schick attributed this to a proposed linguistic difference between HANDLE versus CLASS and SASS predicates: whereas the CLASS and SASS predicates use space to represent space, Schick analyzed the HANDLE predicates as transitive verbs with regular verbal inflection.<sup>12</sup> According to this analysis, the acquisition of the use of space in one domain of ASL syntax does not cross over automatically into other domains; rather, the morphologically relevant spatial locations used in verb agreement are acquired differently from those same locations when used with predicates representing space directly.

If correct, this analysis may bear on a current debate in the literature on ASL

<sup>12</sup>This analysis is inconsistent with that of Padden (1983), who analyzed the inflections on verbs of movement and location (her “spatial” verbs) as different from verb agreement with other “agreement” verbs. Whereas Schick maintained a distinction between abstract and location agreement, Padden argued that verbs like GIVE-BY-HAND (which incorporates a HANDLE classifier) are spatial verbs—that is, verbs that agree with locations rather than arguments.

structure. Although most researchers have made a distinction between spatial, *mapping* uses of linguistic space, and arbitrary *referential* uses of space, Liddell (1990, 1992) argued that in most cases the two are manifestations of the same linguistic use of space; in particular, Liddell argued that essentially all linguistic uses of space are mapping. In contrast, Poizner, Klima, and Bellugi (1987) have argued for the distinction between these uses of space, and they have shown that they break down differentially in signers with right or left hemisphere brain damage. If Schick's conclusion that the two types of space are acquired differentially is correct, it provides psycholinguistic evidence along with that of Poizner and colleagues for a distinction.

Another study which examined Deaf children's fluency with verbs of motion and location was conducted by Hamilton and Lillo-Martin (1986). One concern of this study was to compare DCDP with DCHP (ages 7 to 10) in their ability to imitate short sentences containing verbs of motion and location. It was found that the DCDP made many fewer errors than DCHP, and the few errors that the DCDP made led Hamilton and Lillo-Martin to conclude, "The errors made by the [DCDP], as opposed to those made by the [DCHP], indicate that the [DCDP] are making a structural analysis and are mastering the system" (p. 47), as opposed to acquiring the system holistically or analogically. In this way, these results corroborate those of Supalla's earlier study.

A third study that bears on the development of the classifier system examined children's acquisition of ASL word formation devices. Lillo-Martin (1988) presented Deaf children with two tests of their ability to create new words. The results showed that very different results were found when different methods were used.

The first word formation test was the People and Machines test. Twenty-four Deaf children ages 3 to 10 were asked, "What do you call a person who X's," or "What do you call a machine that X's," where "X" might be feeds babies, tears paper, laughs, and so on. Given this type of presentation, the children used mainly word-based word formation devices, such as compounding (e.g., LAUGH^MACHINE), affixation (e.g., FEED-ER), and derivation (e.g., READ[D:noun]). The youngest children, perhaps following a principle of formal simplicity (cf. Clark & Berman, 1984), mostly used derivation, as the derived forms require the least change to the input (furthermore, it should be noted that their derivations did not necessarily use the correct movement patterns found in the adult grammar).

Rather different results were found in the Invented Objects test, in which 34 Deaf children ages 2 to 10 were shown pictures of made-up objects or people using these objects. They were asked, "What is this thing?" or "What is he or she doing?" Compounds and extensions of existing signs were used, but now compositional responses making use of the ASL classifiers were also frequently used. SASS and HANDLE classifiers (in Schick's terms) can be used in descriptions or neologisms that clearly refer to the strange objects or activities used in this experiment. Even 2- and 3-year-old subjects produced innovative forms using SASS and

HANDLE classifiers. Thus, although development was found in the precision and frequency of these forms, it is clear that they are available as word-formation devices even to young children.

In sum, it is clear that children acquire the complex morphology of verbs of motion and location morphologically, not holistically. Various factors affect the course of acquisition, including the sequence encountered and the errors made. These factors are mainly linguistic in nature—factors such as morphological and syntactic complexity—and they show that the child's approach to these constructions is analytic, not analogic.

## B. Spatial Syntax

As discussed in Section II, several studies have examined the acquisition of verb agreement and pronominal anaphora in ASL. However, these studies have been conducted with relatively few subjects, and they have left open some questions. Several studies have since been conducted to address some of these questions, although much interesting work remains to be done.

### The Comprehension of Referent Association and Verb Agreement

One of the first questions to be addressed concerns the apparent difference between children's use of verb agreement with present referents, and its use with nonpresent referents. Recall that Newport and Meier attributed this difference to the difficulty of establishing and maintaining abstract loci for nonpresent referents. This step, necessary for the felicitous use of verb agreement with nonpresent referents, certainly seems more cognitively demanding than using the locations of present referents. It is doubtless reasonable to ask whether young children even understand the association of referents with abstract locations. Tests of the comprehension of this association and of verb agreement were presented in Lillo-Martin, Bellugi, Struxness, and O'Grady (1985) and in Bellugi, vanHoek, Lillo-Martin, and O'Grady (1988).

The first test looked simply at how well young Deaf children understand the abstract association between a referent and a location in signing space. The tester signed a sequence such as "BOY HERE<sub>a</sub>, GIRL HERE<sub>b</sub>"; in some cases three objects were used. (The different subscripts indicate that different locations are used.) A sequence of a noun followed by an index point to a location in space is one way to designate a location for a referent—the most explicit way possible. Following this simple sequence, the child was asked, "WHERE BOY?" or "WHAT HERE<sub>a</sub>?" The results showed that the youngest subjects, less than 3 years old, did not understand the abstract association. They would look for a real boy when asked the test question. However, even 3-year olds were able to understand the association: they answered WHERE questions with about 80% accuracy. Their errors seemed to reflect memory shortcomings rather than an lack of understanding of

the issue, because they made more errors on the tasks that required the most memory—that is, they performed better on the items with two objects than with three, and they performed better on the WHERE questions (which require only a point as a response) than on the WHAT questions (which require a referent).

Thus, the results of this test indicate that it is not simply a matter of not comprehending the association of referents with locations that prohibits young Deaf children (at least by age 3) from producing verb agreement with nonpresent referents. What, then, of their comprehension of such verb agreement? A series of tests presented in Lillo-Martin and colleagues (1985) and Bellugi and colleagues (1988) looked at children's comprehension of verb agreement. In these studies, it was found that a total of 43 Deaf children ages 3 to 10 did not show a high level of comprehension of verb agreement with nonpresent referents until the age of 5, when they obtained about 80% accuracy (at ceiling for these tests, which included picture choice and act-out tests). Thus, despite an understanding of the basics of the spatial syntax system—including associating referents with locations and use of agreement with present referents—the Deaf children in these studies failed to comprehend the agreement with nonpresent referents until age 5.

Like Newport and Meier, however, I believe the problems that the children are encountering have to do with performance, and with the memory burden that agreement with nonpresent referents poses, rather than with competence in the rules followed by this system. Newport and Meier pointed out that the acquisition of verb agreement with nonpresent referents does not “recapitulat[e] the acquisition of real-world verb agreement” (1985, p. 905), in its pattern of development. Rather, once abstract loci “are correctly established and maintained, verb agreement with these loci is immediately correct” (p. 906). Further evidence for this position comes from the fact that by the age of around 3;0 to 3;6, when the verb agreement system has been acquired with present referents, the children's productions even with nonpresent referents show that they respect certain conditions on the use of null arguments associated with agreement. This will be discussed in more depth later in this section.

### **The “Paint” and “Balloon” Stories: Studies of Production**

An additional large body of data has been examined for the acquisition of verb agreement, pronouns, and other aspects of the spatial syntax. These data were generated by asking young Deaf children to tell stories. In many of the studies to be discussed, children were shown two separate picture books with no words, each displaying a short story. The children were first asked to describe each picture individually, then, after seeing the whole book, they were asked to retell the story from memory. The two stories are described here briefly. One, the balloon story, was adopted from Karmiloff-Smith (1985). This story shows a boy walking down a neighborhood street. He encounters a balloon man, who gives him a balloon. After walking happily with the balloon, the boy lets go, and the balloon flies away.

Finally, the boy continues walking, crying. The second story is the paint story. In this story, two children are sitting at a kitchen table, painting. The boy paints on the girl's face, and then the girl paints on the boy's face. Next, the boy pours a container (of paint or water) on the girl's face, and the girl pours on the boy's face. Finally, the mother, who has been blithely washing dishes in the background all this time, turns around, sees the children, and scolds them. These two stories have proved to be excellent elicitation aids. They encourage the children to use ASL spatial syntax. Some additional tasks were also used in the following studies, as described next.

One study using data from these stories looked at children's development of verb agreement, pronouns, and cross-sentential cohesion. Ursula Bellugi and colleagues (Bellugi, Lillo-Martin, O'Grady, & vanHoek, 1990) described four stages in children's storytelling based on these elicited narratives.

In Period One, at around 2 years of age, children use short, isolated sentences without any of the trappings of the spatial syntax. This is the stage at which children use only uninflected forms, even with present referents; word order is used to convey grammatical relations.

In Period Two,  $2\frac{1}{2}$ - to  $3\frac{1}{2}$ -year-old children use verb agreement with present referents only. This result was demonstrated in the earlier studies as well. Here, it is replicated with additional subjects; furthermore, it is reinforced by the finding that in storytelling, children will sometimes use the pictures in the book as *present referents*. By producing a verb such as PAINT as if it agrees with a present subject and object—that is, the pictures of the boy and girl on the page—the children show that they have command of the rules for the verb agreement system, but need a crutch for nonpresent referents. Furthermore, at this stage children's stories don't cohere—there is no clear continuity from one utterance to the next.

In Period Three, ages  $3\frac{1}{2}$  to 5, the children's stories do have the coherence missing from the earlier stage. However, the sentences, in general, do not use the spatial syntactic marking. Because not all verbs mark agreement in ASL, it is possible to use word order to convey grammatical relations in a sentence devoid of spatial manipulation. However, these children were doing so even with verbs that do mark agreement, and thus should be inflected. Later in this period, children begin to use the verb agreement with nonpresent referents, but, like the subject Loew studied, they may stack or use inconsistent locations for each referent. This makes individual sentences grammatical, but across the narrative each location should be associated with a consistent referent (unless the referent has been changed explicitly).

Only by Period Four, age 5 to 6, is the cross-sentential use of verb agreement and anaphoric pronouns accurate in these children's productions. Of course, some may go on to be fluent and entertaining storytellers, whereas others may not achieve such refinement; but by this time, the basics of the system are used.

Overall, then, Bellugi and colleagues found support for the results of Meier, Loew, and others, with a much larger group of children. Further investigation of

paint and balloon stories revealed still more interesting phenomena in children's development of spatial syntax.

Karen vanHoek and colleagues (vanHoek, O'Grady, Bellugi, & Norman, 1987) found that eight children between the ages of 3;0 and 5;6 produced novel morphological forms when telling the paint story. These forms used space, but not in the grammaticized ways allowed in adult ASL. For example, some of the children used the right versus the left side of the face to distinguish referents. Thus, they signed PAINT on the right side of the face to mean "he paints on her face," and PAINT on the left side of the face meant "she paints on his face." Although it is possible to sign PAINT on one's own face to mean "paint on someone's face," it is not possible to distinguish two referents on different sides of the face. vanHoek and colleagues said, "[t]he children are thus taking a basic organizational principle of ASL's spatial morphology and giving it a novel instantiation."

When PAINT is signed on one's own face to mean "paint on someone's face," an additional layer of ASL's spatial syntax is invoked. This layer, often called referential shift, uses a change in body or head position, eye gaze, or other nonmanual marking to indicate a change in the association between locations and referents (hence, referential shift). The 3- to 5-year-old children in the study summarized above should have used this referential shift with their PAINT-FACE sign, which they did not. By invoking the referential shift, PAINT on one's own face does not mean "painted *me* on the face"—it just means "painted on the face." Furthermore, it becomes intransitive; to express an object, the location-incorporated verb must be used in a serial verb construction, with a regular transitive verb (without body location) preceding it. Referential shift is used in perspective shift, direct quotation, serial verbs, and other constructions. How do children learn to use referential shift?

This was explored by vanHoek and colleagues in another study (vanHoek, O'Grady, Bellugi, & Norman, 1989), which used the paint stories and an additional elicitation procedure. As seen previously, up until age 5 Deaf children incorporate the body location (body classifier) in sentences without the required shift, and they use the incorporated verb as a transitive, rather than intransitive, form. Five- and six-year olds cease making this error. Instead, they simply omit the body location or use a separate nominal to indicate where the painting took place. Seven- to ten-year olds finally use the serial verb construction, but they too fail to include the shift. Only 10-year olds used the serial verb construction with the shift.

On the other hand, the referential shift was used by children in discourse, to indicate perspective shift or direct quotation, much earlier than it was used in serial verbs. This looks similar to the problem in verb agreement: a morphosyntactically complex construction is acquired and used in one context, but not extended to another applicable context.

Why should these differences occur? In a third study, vanHoek and colleagues (vanHoek, O'Grady, Bellugi, & Norman, 1990) analyzed the children's paint sto-

ries again, attempting to discover why the spatial syntax is so relatively late in development, compared with other aspects of syntactic acquisition. They hypothesized that intra-sentential reference might be in place before cross-sentential reference, and they tested this hypothesis by comparing the development of nonspatial and spatial aspects of reference at the sentential and narrative levels.

This hypothesis was supported. The children's narratives were categorized by levels, according to the consistency of nonspatial reference (e.g., naming) and spatial reference. It was found that the two developed in parallel. As one example, they studied a 4-year old for whom they had longitudinal data in depth and concluded,

We thus find a striking similarity between Maxine's use of referential loci and her signaling of reference and reference switches. At the sentential level, reference is clear and spatial indexing is used appropriately. It is at the level of the overall narrative, what we might call the discourse level of structure, that she still has not acquired full fluency with either system.

Five months later, this subject had consistency for both reference and space at the discourse level.

### **Parameter Setting: The Use of Null Arguments in ASL**

Given the rich morphological agreement found in ASL, it might be expected that null arguments (subject or object not overtly expressed using a separate lexical item) would be allowed. This turns out to be the case, although it is somewhat complicated due to the splitting of the verb lexicon into verbs that can and cannot be marked for agreement (for the analysis to be presented here, see Lillo-Martin, 1986; also Kegl, 1986; but cf. Aarons, Bahan, Kegl, & Neidle, 1992).

For verbs that are marked with subject and object agreement, these arguments can be null. Furthermore, the behavior of these null arguments, especially in extraction, shows them to behave like null pronominals, or *pro* (cf. Jaeggli & Safir, 1989; McCloskey & Hale, 1984; Rizzi, 1986). It should be noted that *pro* is licensed and identified by verb agreement, so even a verb that can be inflected does not allow pronominal null arguments if it is not inflected (subject agreement is optional).

However, it is not the case that null arguments are never found with verbs that are not marked for agreement. Rather, these verbs seem to allow null arguments of the type found in Chinese and other "discourse-oriented" languages (Huang, 1984). The null arguments refer to a discourse topic, and do not display pronominal characteristics. Like Chinese, ASL has been called "discourse oriented," and the typological characteristics of such a language are found in ASL (most noticeably, topic prominence).

Given the abundance of null arguments found in ASL, how does the Deaf child sort them out? This question was studied by Lillo-Martin (1991). The paint and balloon stories of 23 Deaf children ages 1;7 to 8;11 were examined, as well as an

elicited imitation test with 18 children ages 2;11 to 10;8. It was found that the Deaf children's appropriate use of null arguments was intimately tied with their development of verb agreement, as noted in the preceding discussion.

Children in the earliest stages, using no verb agreement or spatial syntax, used null arguments freely. In this way, they are like children learning a language such as English. Although English does not allow null arguments, young children frequently omit the subject (and much less frequently, the object) in their early sentences. Because English does not have a rich enough verb agreement system, and does not pattern as a discourse-oriented language, it seems that early null subjects are unidentified (Hyams, 1986; but cf. Hyams, 1991).

However, an interesting change takes place at around 3 years of age. From the earlier studies cited, it is known that Deaf children acquire and use the verb agreement system with present referents at around 3;0 to 3;6. At the same age, verb agreement is not used with nonpresent referents. In their stories, which involve nonpresent referents, they turn at this age to using almost all overt arguments. If they used many null arguments with verbs not marked for agreement, they would violate the requirement that null arguments be identified. Because they do not use these null arguments, it seems that this requirement is respected at this age. Perhaps this is related to the development of verb agreement with present referents: it seems that children at this age do use null arguments with present referents, when they use verb agreement and their null arguments are thus identified. Hence, their stories show that by age 3, Deaf children understand both that null arguments are allowed in ASL, and that they must be identified. Because the stories with nonpresent referents do not show verb agreement, they also do not show null arguments.

To be more precise, it should be pointed out that children's stories at this age are not completely devoid of null arguments. They do occasionally use null arguments identified by a discourse topic. However, they do not make up for the lack of null arguments with agreement-marked verbs. The children's utterances give the impression of an overuse of overt arguments, especially repeated names.

Once the children learn to use verb agreement with nonpresent referents, they correctly use null arguments in these sentences. There is a short period marked by errors in both agreement and null arguments, as the children learn to associate referents with locations differentially. However, it is clear that appropriate use of null arguments comes in step with appropriate use of verb agreement.

If one looked exclusively at the development of adultlike use of null arguments, one might be tempted to say that the Deaf children go back and forth between a parameter setting that allows null arguments and one that does not. Such a pattern would not be consistent with the idea of parameter setting as throwing a switch in one direction or another. However, I have argued that it is important to consider the use of null arguments together with the development of the verb agreement system. In so doing, it becomes clear that the Deaf children in fact do not go back and forth in parameter setting, but they do experience a delay in their correct verb



agreement use with nonpresent referents. This analysis places the locus of children's delayed acquisition within the morphology and the lexicon, rather than in syntactic parameter setting, which is expected to occur relatively rapidly and effortlessly.<sup>13</sup>

### C. Nonmanual Grammatical Markers

As noted earlier, in 1985 Newport and Meier stated that essentially no work had been done on aspects of the acquisition of ASL syntax. Now, some years later, a few studies have been published, though more are desperately needed. A very interesting set of studies was undertaken by Judy Reilly, Marina McIntire, and Ursula Bellugi. These studies focus on the acquisition of the nonmanual facial behaviors that mark certain kinds of structures in ASL.

As Reilly and colleagues pointed out, facial behaviors serve several purposes in signing. As with the facial gestures made by hearing people while they are talking, a number of affective facial gestures accompany ASL signs. Reilly, McIntire, and Bellugi assumed that these uses of affect as a "complement to language" would develop much as they do in hearing children. Indeed, they found that 1-year olds use facial expressions to report their own present state; as they mature, affective facial expressions take on increasing complexity and decontextualization. No radical reanalysis is shown in the gradual development of affective facial expressions (Reilly, McIntire, & Bellugi, 1990b).

In contrast, grammaticized facial expressions take a different route. There are specific facial expressions that accompany signs for affective states. From 1;6 to 2;3, Deaf children use these signs with these facial expressions—as amalgams, unanalyzed units of face + hands. Around the age of 2;5, a reanalysis occurs. Now, the facial expression may be missing from such a sign, or even a different facial expression might be used (such as smiling while signing SAD). By age 4, the facial expressions are used correctly again, and the timing of the onset and offset of the facial gesture marks it as linguistic rather than affective. There is a sharp break in the development of these facial behaviors. The first linguistic behaviors have been led into by the previously existing nonlinguistic units; Reilly and colleagues claimed, "children use their pre-linguistically productive affective knowledge of facial expression as a bridge into its linguistic use" (Reilly, McIntire, & Bellugi, 1990a, p. 374). Once into linguistic use, however, the forms need to be analyzed and applied by rule to the appropriate signs.

<sup>13</sup>An interesting report on the use of null arguments by Deaf children learning Sign Language of the Netherlands was presented by Coerts and Mills (1992). They found use of both null subjects and null objects in the two children they studied. Like the results of Lillo-Martin (1991) and Wang, Lillo-Martin, Best, and Levitt (1992), this indicates that young children exposed to a language that allows null objects will use them from an early age (as opposed to their infrequent use, compared with null subjects, by children learning a language that does not allow them, like English).

As a third type of acquisition, Reilly and colleagues consider the acquisition of facial gestures which mark syntactic units (Reilly et al., 1990a; Reilly et al., 1991). For example, conditionals are marked by a specific facial gesture, including raised eyebrows, which co-occurs with the antecedent, and an eye-blink and head thrust during the pause between the antecedent and the consequent. Conditionals may be marked by the facial behavior alone; alternatively, a manual sign for IF or SUPPOSE may be used to mark the antecedent.

Fourteen Deaf children ages 3;3 to 8;4 were studied in a set of comprehension and production tasks. It was found that manual marking preceded facial gestures in both comprehension and production. For 3-year olds, conditional sentences were comprehended one-third of the time when a manual marker was present; but none of the sentences with conditionals marked only on the face were comprehended. Similarly, in the one-third of the trials in which the 3-year olds produced conditionals, every case had a manual marker, and no nonmanual markers were used. By age 5, both manual and nonmanual conditionals were comprehended and produced; although the facial expression was not always completely accurate.

Reilly and McIntire (1991) found similar results in a study of the acquisition of the facial expressions used in questions. Wh-words were used by the children in questions as early as 1;6, but the wh<sub>q</sub> facial expression was not used until 3;6. This does not seem to be due to the children's inability to produce these facial expressions. At the same time (1;3), Deaf children can use the yes/no question facial expression appropriately (although the yes/no facial expression uses raised brows, whereas the wh-question facial expression uses furrowed brows). Unlike wh-questions, yes/no questions have no manual marker. And of course, the Deaf children have long since used facial expressions for affect and to accompany affective signs.

What makes the manual markers used first in wh-questions, whereas the facial expression is used for yes/no questions? Reilly and colleagues (1991) cited Slobin's operating principle of unfunctionality: "if a single form signals two similar but distinct meanings, the child will initially seek distinctive means to mark the two notions" (p. 19). Reilly and colleagues suggested that children apply this principle to use the face only for marking yes/no questions. Because wh-questions have a distinctive marker, it will be used to distinguish them from yes/no questions.

This application of Slobin's principle to the acquisition of facial versus manual marking led Reilly and colleagues to the quote cited at the beginning of this chapter, repeated here:

[T]he modality in which the language is conveyed plays a significant role in language learning. (Reilly et al., 1991, p. 22)

How much does the modality affect language learning—or the organization of language grammar, its localization and processing by the brain, its other fundamen-

tal properties? This question is intricately related to the modularity hypothesis, for only certain (limited) modality effects are expected under a modular view of language. Although the topic is too vast to consider all of its implications here, we turn now to a discussion of the effects of modality—and modularity—in language acquisition.

## V. MODALITY AND MODULARITY EFFECTS IN LANGUAGE ACQUISITION

The modularity hypothesis, as made well known by Fodor (1983) contends that language is a cognitive system distinct from other cognitive systems. Although the same base of horizontal faculties (memory, attention, etc.) may be tapped by language and other cognitive functions, Fodor argued that language is processed independently of these other systems. In Fodor's terms, language is an *input system*, like vision, audition, touch, and so on, and specialized processors deal with input in any of these systems rapidly, automatically, and without influence from higher-level systems. Once this specialized processor is done with the input, it gets sent to higher levels, where it can be used in decision making, contemplating, and manipulating, or any of numerous other cognitive functions.

The Chomskian version of modularity (see, e.g., Chomsky, 1981) differed some from Fodor's. For the present purposes, let us consider Chomsky's proposals regarding the modularity of the internal structure of the language processor. According to Chomsky, the various subcomponents of the language mechanism are also modular, feeding from phonological processing to syntactic processing to semantic processing. Like the modularity of the language processor as a whole, this means that the various levels work independently, using their own particular rules and mechanisms. Furthermore, the higher levels do not affect the processing of the lower levels.

Given the properties of signed languages discussed earlier—their essential similarities in function and form to spoken languages—I believe that most versions of modularity would have the following expectations regarding modality. Certainly, at the higher levels of organization, such as syntax and semantics, modality should not affect language structure or processing. Why should this be so? If one and the same language mechanism underlies both signed and spoken languages—which seems plausible, given their similarities in structure, acquisition, and, as we have not discussed here, brain organization and processing (see, e.g., Emmorey, 1993; Poizner et al., 1987)—then this mechanism—let us call it Universal Grammar—would not make a distinction between modalities once the input has entered the system.

What about the lower levels—phonology and phonetics? Clearly, at some point

the modality must play a role, because the input comes from either the eyes or the ears. How soon can this input be translated into an amodal form that can be processed by Universal Grammar? Apparently, this takes place very soon. The phonological structures of signed and spoken languages have been found to be remarkably similar. Although some authors would not agree, many sign phonologists have found that using the tools and models for representation of spoken languages has been very effective for the analysis of signed languages (see, for examples, papers in Coulter, 1993; bear in mind however, that it would be incorrect to claim that there is consensus in this view). Thus, under the view developed here, even the phonological component of universal grammar is stated abstractly enough for both signed and spoken languages to be included.

Sandler (1993) drew an alternative conclusion. Because the input forms are distinct between signed and spoken languages, and the labels and specific hierarchy needed for sign language phonology are different from those needed for spoken language phonology, Sandler concluded that a Fodorian module “cannot contain sign language, and that, since sign languages are languages, there can be no language module of this sort” (p. 331). An alternative view of modularity, which Sandler dubbed the grammatical form module, would claim that “The principal requirement of the language module . . . is that grammatical forms, constraints, and rules . . . be unique to the module” (p. 345). Although she granted that such a module might accurately explain both signed and spoken languages, Sandler worried that with this view of modularity as a research paradigm, “important and potentially revealing questions go unasked” (p. 347).

Sandler posed many important and potentially revealing questions—a challenge, indeed—for the view of modularity advocated here. However, I believe that it is not necessary to depart from a Fodorian modularity hypothesis in order to accommodate the facts about signed languages. In fact, I believe the modularity hypothesis is supported by the facts about signed languages. For the present chapter, I will focus on the facts about language acquisition.<sup>14</sup>

How many modality effects were found in the present review of the literature on the acquisition of sign languages? Note that many anticipated modality effects were not found. One possible modality effect that was studied by many researchers involved iconicity. Because aspects of the ASL lexical and morphological system are iconic, it is possible that they would be acquired more easily than noniconic equivalents in spoken languages, or nonequivalent counterparts in ASL. However, some individual lexical items, deictic pronouns, and verb agreement, all of which display some degree of iconicity, were found *not* to be acquired more easily because of iconicity. Rather, these aspects of ASL were consistently found to be acquired in parallel to spoken languages.

What about the aspects that led Reilly and colleagues (1991) to claim that

<sup>14</sup>A more in-depth consideration of sign language and the modularity hypothesis is in preparation.

modality does affect language acquisition? Recall that their claim concerned the acquisition of grammaticized facial expressions. They found that Deaf children use manual markers for conditionals and wh-questions before they acquire the facial markers, even though the facial marker is obligatory while the manual marker is optional. They applied Slobin's operating principle of unfunctionality to explain why the children appropriately used facial gestures for yes/no questions while failing to use them for wh-questions. Then, they asked, why does the child use the manual markers before the facial markers, instead of the other way around? Clearly, because the facial markers are used for yes/no questions (as well as affective signs and to show the child's own affective states), it is not because the child has not yet acquired control over facial gestures. Rather, they hypothesized, "it appears that their *first* hypothesis may be that hands are for language and faces are for affect" (Reilly et al., 1991, p. 20). Once language acquisition is under way, they propose that children learning ASL must invoke a new operating principle, applicable only for the acquisition of signed languages: "Pay attention to faces for linguistically significant information" (p. 22).

If the acquisition of signed languages requires new operating principles (or principles of UG) not needed for spoken languages, then it would seem that, as Reilly and colleagues claim, the modality plays a significant role in language learning. However, I would like to propose that the significance of the role of modality is limited to phonetics. The difference between hands and faces that Reilly and colleagues found for wh-questions versus yes/no questions can be accounted for using the same principle of unfunctionality they cited. Rather than use the face for multiple functions (yes/no questions, wh-questions, and conditionals), different means are used to mark each function: the face for yes/no questions and independent lexical items for wh-questions and conditionals. Because there are no independent lexical items for signaling yes/no questions, it is this construction that is marked by the face. Reilly and colleagues also noted that young Deaf children use the topic-marker facial expression before using the same raised eyebrows in conditionals. Here again, it is topics which are marked with the face, because there is no lexical sign to mark topics; unfunctionality leads the children to choose a manual marker for conditionals rather than use the same raised eyebrows.

The operating principle proposed by Reilly and colleagues, pay attention to faces, can still be applied in the acquisition of sign language, but now its role is phonetic. Perhaps this view is not really far off from that intended by Reilly and colleagues. After all, they also said,

Taken together, the accumulated studies suggest that deaf children use strategies in acquiring ASL that are strikingly similar to those found in the acquisition of spoken languages, despite the radical differences between signed and spoken language. In addition, our study demonstrates the remarkable breadth of the language learning mechanism in its ability to process these unusual behaviors as grammatical units. (1991, p. 20)

At the phonetic level, that is, the level indicating the modality of linguistic input, modality necessarily plays a role.<sup>15</sup> Because of this role, a true modality effect in language acquisition is possible: the effect (if real) of earlier first signs than first spoken words. As Meier and Newport argued, this effect is plausibly due not to a difference in the maturation of the linguistic component, or of the cognitive requirements for language, but to a difference in the maturation of the articulatory or perceptual mechanisms used for signed versus spoken languages.

There is still room for real modality effects in the structure and acquisition of ASL syntax. Liddell (1992) claimed that in the so-called spatial syntax, as well as verbs of motion and location, although movements can be morphologically analyzed (as claimed by Supalla, 1982), locations cannot. His claim is that the locations which were described earlier as "associated with" referents, are analogically representative of real locations, and thus, not analyzable. If correct, this would seem to be a modality effect on the structure of ASL, as by the time input reached the syntactic level, modality should be irrelevant, according to the preceding discussion. As such, it might also have an affect on language acquisition.

In this regard, it is instructive to recall the studies discussed earlier regarding the acquisition of ASL spatial syntax and verbs of motion and location. In every case discussed, the conclusion was drawn that these structures of ASL are acquired morphologically. The time course of acquisition, as well as the types of errors encountered, led the researchers to claim that morphology, not iconicity (or an analog representation of real space) guided language acquisition. However, it is clear that more work needs to be done to address this question specifically. As Schick (1990c) put it, "These data suggest that the key to characterizing and assessing ASL acquisition lies in the nature of the use of syntactic space" (p. 370).

## VI. CONCLUSION AND IMPLICATIONS

It is hoped that the goal of making the acquisition of sign language by Deaf children of interest to linguistic theory has been met. It is clear that much work remains to be done, in the collection of much more data on the acquisition of sign languages and in its application to linguistic theory. New theories, new methodologies, new subject groups, and even replications of existing studies are sorely needed. Current work is in progress in the areas of early stages, phonological de-

<sup>15</sup>Despite this modality effect, there may even be similarities between signed and spoken languages in the specialized nature of the phonetic processor for language. Liberman and Mattingly (1985), among others, have argued that the phonetic processor for spoken language is specialized and pre-emptive; thus, speech is perceived differently from other nonlinguistic sounds. Whether there is a parallel special processor for signed languages is of considerable interest. (See discussion in Mattingly & Studdert-Kennedy, 1991.)

velopment, and syntactic development (at least), and the results of these studies will help in the construction of theories of language acquisition.

The question of modality effects in language acquisition has not, of course, been settled. Such effects are immensely interesting, for they help to sharpen the distinctions between language, communication, and other cognitive systems. In current studies of the acquisition of spoken languages, it has been found that in-depth studies of one language can be a substantial source of data; but comparisons across languages are also vital. The same must be true for signed languages as well: it will be essentially impossible to distinguish modality effects from typology effects until a number of sign languages other than ASL have also been studied. It is gratifying to know that many such studies are currently underway.

The conclusion drawn by other summaries of the acquisition of ASL can be repeated here: Signed languages are acquired in much the same way as spoken languages. The same sequences of steps are found at roughly the same ages; the same types of errors are found and not found. This lends credence to further studies of sign language development, further comparisons with the development of particular spoken languages, and further use of sign language data to sharpen theories of language. Only by including signed languages in the empirical database that a theory must explain will the goal of constructing a theory of language be met.

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