

VI. Psycholinguistics and neurolinguistics

28. Acquisition

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Abstract

This chapter provides a selective overview of the literature on sign language acquisition by children. It focuses primarily on phonological, lexical, morphological, and syntactic development, with a brief discussion of discourse development, and draws on research conducted on a number of natural sign languages. The impact of iconicity on sign language acquisition is also addressed. The chapter ends with brief discussion of acquisition in other, less typically researched contexts, including late L1 acquisition, bilingual sign-speech acquisition, and adult acquisition of sign as a second language.

1. Introduction

This chapter is an overview of the acquisition of phonological, lexical, morphological, syntactic and discourse properties of sign languages. Only a few decades ago, the task of reading everything written about sign language acquisition was still reasonably manageable. Today, with the establishment of new sign research programs all around the globe, the list of published articles on sign acquisition (not to mention unpublished theses and dissertations) has far outstripped the abilities of even the most assiduous reader. This chapter does not attempt to summarize them all. Rather it aims to lay out the major directions in which sign language research has progressed over the last few decades, sketching a general outline of what we know so far about this fascinating aspect of human development.

A major theme of early sign acquisition research was to draw parallels between L1 acquisition of natural sign languages by native-signing deaf children and more traditional L1 acquisition of spoken languages by hearing children. In emphasizing the underlying similarities in acquisition regardless of modality, this research contributed crucially to the argument that sign languages are fully complex natural languages, autonomous from and equal in linguistic status to the spoken languages that surround

them (Marschark/Schick/Spencer 2006). With the linguistic status of sign languages now firmly established (in academic circles, if not yet in the broader context), focus is now turning to the identification of modality effects: aspects of acquisition that are unique to languages in one or the other modality. Chief among the investigated sources for modality effects is the enormous potential in sign languages for iconic representation (see chapter 18, Iconicity and Metaphor). Sign languages are well suited to expressing visual information, offering transparent representations for shapes of objects, the posture of human hands manipulating those objects, spatial configurations of multiple entities and direction of movement through space. Iconic elements can be identified at all levels of sign language organization, in contrast to their comparative rarity in spoken language. If it turns out that children are sensitive to iconicity, then the acquisition processes for the iconic elements of sign language and their non-iconic counterparts in spoken language may be expected to diverge noticeably.

For reasons of space, this chapter focuses on early L1 development of sign languages, aiming at the period from birth to about four years (for information on later L1 development, readers are referred to Newport/Meier 1985; Emmorey 2002; Schick/Marschark/Spencer 2006). Section 2 discusses research on manual babbling and the theoretical implications of these findings for language acquisition in general. Section 3 focuses on sign phonology, summarizing developmental patterns for the three major formational parameters, and section 4 discusses first signs and the development of a sign lexicon. Section 5 presents overviews for a selection of syntactic and morphological aspects of sign languages, including word order, spatial syntax, *wh*-questions, topics and focus, classifiers, and non-manuals; section 6 summarizes the acquisition of referential shift, a discourse phenomenon that recruits a number of syntactic devices discussed in section 5. The chapter closes with a very brief mention of other types of sign acquisition (late-exposed L1, bimodal bilingualism, and second language acquisition) in section 7 and a look towards future studies in section 8.

2. Babbling

Until fairly recently, babbling was thought to be a phenomenon exclusive to speech, tied to the development of the parts of the body used for speaking (van der Stelt/Koopmans-van Bienum 1986). At around 4–6 months after birth, physiological changes allow the infant to produce true vocalizations, rather than just the cooing and other vegetative sounds typical of earlier stages. Babbling is non-referential (i.e. it does not have any associated meaning) and uses a subset of the phonetic units available to spoken language (not necessarily specific to the target language). Investigations of vocal babbling have revealed two stages of development: syllabic or canonical babbling at around 7–10 months, characterized by multi-cyclic repetition of simple consonant-vowel (CV) syllables, and variegated or jargon babbling from about 12–14 months, characterized by strings of different CV syllables, often produced with prosodic patterns appropriate to the target language (Oller/Eilers 1988). Interestingly, infants display individual preferences for certain phonemes and syllable types in their babbling, and these preferences carry over into their first words (Vihman et al. 1985). This last observation has led some researchers to consider babbling as the first stage of language

production development, one that is uniquely shaped by and suited for the speech modality (Liberman/Mattingly 1985, 1989).

Petitto and Marentette (1991) first challenged the concept that babbling is exclusively tied to speech development, presenting evidence for babbling in the gestural modality. They studied the manual activity of two deaf and three hearing infants and reported that both sets of babies produced non-referential hand activity with the general characteristics reported for vocal babbling. This “manual babbling” shared the phonetic and syllabic (movement) structure of natural sign languages and exhibited the repetitive, rhythmic patterns typical of vocal babbling. Manual babbling by the deaf subjects, who had been exposed to American Sign Language (ASL) from birth, followed a time course similar to that reported for vocal babbling in hearing children, including syllabic babbling at 10 months and more complex, variegated babbling at 12 months. Deaf babies’ manual babbling was deliberate and communicative, and deaf mothers responded by signing back to their infants. Most crucially, individual preferences for hand configurations, locations, and/or movement types in deaf infants’ manual babbling continued into their first ASL signs (see also Cheek et al. 2001). None of these patterns were observed in the manual activity of hearing infants, who exhibited a limited inventory of hand configurations and movement types and did not progress to more complex forms over time. A similar disparity has been noted by Masataka (2000) for Japanese deaf and hearing infants. In subsequent discussion, Petitto (2000) classified manual activity by the hearing babies as excitatory motor hand behavior rather than true manual babbling.

Petitto (2000) and Petitto and Marentette (1991) interpreted their findings as support for an amodal language capacity equally suited for speech or sign. Under this view, babbling is not triggered by motor developments of the speech articulatory system, but rather by infants’ innate predisposition towards structures with the phonetic and syllabic patterns characteristic of human language, spoken or signed. This predisposition leads to either vocal or manual babbling, depending on the input the child receives. As further support for an amodal language capacity, Petitto (2000) cites the observation that deaf babies occasionally produce limited vocal babbling (Oller/Eilers 1988) just as hearing, non-signing babies occasionally produce limited manual babbling. If the tongue and hands are truly “equipotential language articulators” at birth, Petitto predicts that “we will see language-like articulations spill out into the ‘unused’ modality, albeit in unsystematic ways” (2000, 8).

Meier and Willerman (1995) pursued an alternative, motor-driven explanation for the structural and timing similarities between manual babbling and signing. They examined the gestural production of two hearing and three ASL-exposed deaf children from 8 to 15 months of age. In their patterns of handshape, movement and place of articulation, deaf and hearing subjects looked very similar, in contrast to the reports by Petitto and her colleagues. Both groups also tended to produce communicative gestures with a single cycle, but non-referential gestures with multiple cycles. The only difference observed was that deaf subjects tended to produce their non-referential gestures with more cycles than did hearing subjects.

Like Petitto and Marentette (1991), Meier and Willerman (1995) also interpreted their results as support for the language capacity’s equal potential to develop as speech or as sign. However, they argued that there is no reason to assume, as Petitto and Marentette did, that input is crucial for triggering babbling in one modality or the

other. Babbling may emerge due to motor factors that apply equally to speech and gesture. For example, all babbling is characterized by repetitive movement; in manual babbling this repetition occurs at the hands, whereas in vocal babbling, it occurs at the mandible (MacNeilage/Davis 1990). Meier and Willerman proposed that these repeated movements may both be rhythmical motor stereotypies of the type described by Thelen (1981) as occurring at the transition between “uncoordinated activity and complex, coordinated voluntary motor control” (1981, 239). Under this view, the fact that both manual and vocal babbling (uncoordinated activity) occur when the infant is ready to transition to language (complex, coordinated activity) accounts for their similar onset times.

As for why hearing children with no exposure to any sign language should exhibit robust manual babbling, Meier and Willerman speculate that since adult speech and sign are both rhythmically organized, simply hearing adult speech might be enough to trigger rhythmic behavior in both the gestural and vocal modalities. Hearing infants may persist in babbling manually because they receive visual feedback of their own gestures (such feedback is not available for deaf infants with regard to their vocalizations, perhaps leading to the late onset of their vocal babbling (Oller/Eilers 1988)). Still, Meier and Willerman did not discount the effect of the input language entirely: the tendency of deaf infants to produce more multi-cyclicity in their babbling gestures than their hearing counterparts could well be an effect of growing up in a sign environment, where multi-cyclicity is an extremely salient feature of the target language.

3. Phonological development

When sign-exposed children begin to produce lexical items in their target sign language, their production is characterized by phonological simplifications and substitutions affecting the formational parameters of sign languages (hand configuration, location, movement, and orientation). Like their speech-exposed counterparts, sign-exposed children must gradually develop a system of phonetic contrasts, adding to their phonetic inventory and learning the phonotactic constraints that apply for their target language. In the meantime, production by both groups of children is subject to certain universal factors such as markedness, which presumably apply regardless of language modality. However, despite striking parallels in the L1 development of speech and sign, modality effects nevertheless exist. Most obviously, sign and speech implicate very different sets of articulators that may be subject to different motoric limitations and develop at disparate rates. Broad typological differences between sign and speech may also mean that signing and speaking children choose different strategies to compensate for their immature phonological systems. As mentioned in the introduction, the prevalence of iconicity in sign languages is one such typological feature, and a thorough account of language acquisition must consider how this feature might affect the early phonological forms produced by signing children.

3.1. Effects of iconicity on early phonology

Unlike their peers acquiring spoken languages, sign-exposed children are regularly presented with highly iconic forms in their input. If iconicity enhances the transparency

of new signs, it could potentially be very attractive to children as something that facilitates the mapping from form to meaning. Sign-exposed children might initially assume that lexical items should be as faithfully iconic as possible and seek to enhance the iconicity of target signs in their own production, resulting in phonological forms that do not match target forms. Research in this area, however, indicates that iconicity does not play this role in most of children's phonological errors. In a study of the early ASL of two deaf girls, Launer (1982) found that roughly 15 % of their production displayed enhanced iconicity, while 20 % was counter-iconic, or less iconic than the target form of the sign. More recently, Meier et al. (2008) found that signing adults rated the vast majority (59.4 %) of the ASL signs produced by four 8–17 month old babies as neither more nor less iconic than their target forms. Of the remaining child tokens, significantly more were judged as less iconic than the target (36.2 %) than more iconic (4.3 %). Of the 33 signs judged as more iconic than the target, Meier et al. (2008) noted that one-third of them featured additions of mimetic facial movements rather than any modification of the manual component. They cited as an example one child's articulation of EAT with a cookie in hand, and mouth movements mimicking chewing (although the child did not actually bite the cookie). This pattern calls to mind claims that young signers assume lexical meaning to be encoded by the hands, while affect is encoded by the face (Reilly 2000; see discussion in section 5.5).

The fact that so few of the signs in the Launer (1982) and Meier et al. (2008) data showed enhanced iconicity might be puzzling in light of well-known studies on home-sign systems (Goldin-Meadow 2003; see chapter 26 for discussion). Iconicity is the hallmark of the communicative gestures invented by home-signers, deaf children raised without exposure to any conventional sign language. For these children, a high degree of transparency is necessary to ensure that their invented gestures will be understood by others, and this constraint alone may pressure the child to favor highly iconic forms. Meier et al. (2008) proposed that as the inventors of their own gesture systems, home-signers are free to choose iconic forms that match their articulatory capacities. This is in contrast to ASL-exposed children, who have no control over the articulatory complexity of the conventionalized forms presented to them.

In summary, both Meier et al. (2008) and Launer (1982) concluded that iconicity does not exert a major effect on the phonological production of ASL-exposed children. Errors in early ASL are better explained by appealing to motoric factors, as I will discuss in the next sub-section.

3.2. Effects of motoric factors

Observations of infant motor development offer many potential insights into the acquisition of manually-expressed languages such as sign languages. Recent studies of phonological development in sign-exposed children have focused on three motoric factors in particular, proximalization of movement, tendency towards multi-cyclicity, and sympathy. Proximalization refers to the fact that infant motor control generally progresses from proximal articulators (close to the torso) to distal articulators (far from the torso). Multi-cyclicity is related to the prevalence of repeated movement patterns across many domains of early motor development. Finally, sympathy refers to infants' initial diffi-

culty in inhibiting movement of one of their hands, resulting in a tendency to move both hands in tandem. In the following sub-sections, I will detail how each of these features of early motor development affects early articulation of signs by sign-exposed children, as well as address relative rates of error for the three major sign formational parameters of hand configuration, location, and movement.

3.2.1. Proximalization of movement

Signing activates a series of joints along the arm and hand from the shoulder and elbow (the joints most proximal to the torso) to the wrist and first (K1) and second (K2) sets of knuckles (the joints most distal to the torso) (Mirus/Rathmann/Meier 2001). Detailed investigation of child signing has revealed that their patterns of joint activation do not always match those of adult signers. Children often shift movements at distal joints to more proximal ones, resulting in bigger movement patterns. Proximalization in child signing has been noted in studies of sign languages other than ASL (Takkinen (2003) for Finnish Sign Language (FinSL); Lavoie/Villeneuve (1999) for Quebec Sign Language (LSQ)), but the most detailed study to date is Meier et al. (2008). In a careful examination of 518 ASL signs spontaneously produced by four deaf children between 8 to 17 months, these researchers found that only 32 % were correct in their joint activation pattern. The rest exhibited errors due to omission of one or more joints and/or substitution of an alternative joint for the target.

Meier et al. (2008) established three predictions with respect to proximalization. The first was that when children made a joint substitution, they would be more likely to substitute a proximal articulator than a distal one. This prediction was borne out by the data: the majority of all the children's substitutions were proximal to the target joint. Substitution of a more proximal joint was especially pronounced when the sign called for movement at the elbow, wrist, and K1. Figure 28.1 shows an example of a proximalization error is the sign HORSE signed with bending at the wrist rather than at K1.

Next, Meier et al. (2008) predicted that distal joints would be more likely to be omitted than proximal joints. This prediction was also confirmed by the data: out of 55 errors of joint omission, all but two involved omission of the more distal joint. Conversely, Meier et al. (2008) reasoned that children's signs might sometimes activate



Fig. 28.1: Adult form of ASL HORSE (© 2006, www.Lifeprint.com; used by permission), followed by a child's proximalized form.

additional joints not specified in the adult form, and that in these cases, the additional joint would be proximal to those specified in the adult form. On first analysis, this final prediction was not supported by the data: out of 78 errors of this type, the majority involved an additional distal joint. Closer examination of these cases revealed that in almost all of them, children added K2 to signs that targeted K1. This was the only context in which K2 was added. Once these cases were excluded from analysis, addition of proximal joints greatly exceeded that of distal joints, strengthening the generalization that children manipulate and control proximal joints earlier than distal ones.

Interestingly, the tendency to proximalize movement is not limited to infants, but has also been observed in child-directed signing (Holzrichter/Meier 2000) and in the signing of adult second language learners of sign language (Mirus/Rathmann/Meier 2001). The former observation raises the importance of considering input factors as a possible influence on children's proximalization, in addition to motoric constraints. The latter observation indicates that proximalization is not limited to immature motor systems. Indeed, even fluent Deaf signers were observed by Mirus, Rathmann, and Meier to occasionally proximalize when asked to repeat signs from a sign language that they do not know.

3.2.2. Multi-cyclicity

The propensity for repetitive movement noted earlier for manual babbling has also been observed in infants' first signs in British Sign Language (BSL, Clibbens/Harris 1993; Morgan/Barrett-Jones/Stoneham 2007). Clibbens and Harris (1993) proposed that repeating a sign multiple times gives children the chance to improve the accuracy of their articulation. However, Morgan, Barrett-Jones, and Stoneham (2007) found that although their BSL-exposed subject produced additional cycles in 47 % of her signs, the extra repetitions led to improved articulation in only 10 % of those cases.

Meier et al. (2008) found that across 625 early signs produced by four deaf, ASL-exposed children (the same mentioned in the proximalization study in the previous subsection), signs were produced with anywhere from one to 37 cycles, with a median of three cycles per sign. Using elicited production from a Deaf, native ASL signer as a standard, the researchers counted 151 instances in which the children produced a different number of cycles than the adult standard. The children were slightly more likely to err for monocyclic targets than for multi-cyclic targets. However, multi-cyclicity is a robust feature of ASL, so most of the time children's tendency towards multi-cyclicity did not result in any error. The target forms of 70 % of the signs attempted by the children call for repeated movement; for these signs, the children's multi-cyclic productions were counted as target-like (cf. Juncos et al. (1997) for a similar report of child accuracy on multi-cyclic target signs in Spanish Sign Language (LSE)).

Meier et al. (2008) concluded that while their subjects demonstrated a preference for multi-cyclic forms, they were already learning to inhibit this preference for monocyclic signs. This was despite the fact that, like proximalization of movement, addition of cycles to target signs is a feature of child-directed signing (Maestas y Moores 1980; Masataka 2000 for Japanese Sign Language (NS)).

3.2.3. Sympathy

Infants in their first year of life have difficulty with actions requiring separate control of the two hands, including some one-handed activities that require inhibiting the action of the second hand (Fagard 1994). As a result, some children may mirror one-handed movements, such as reaching for an object, with the second hand (Trauner et al. 2000). Meier (2006) referred to this type of mirroring as sympathetic movement. In the realm of sign production by sign-exposed children, sympathetic movement is sometimes observed for one-handed signs, as in the ASL example of HORSE in Figure 28.1 above. Although the child correctly raises only the dominant hand to the target location, his non-dominant hand mirrors the movement of the dominant hand, repeatedly bending at the wrist. Generally, however, sign-exposed children have little difficulty inhibiting the non-dominant hand when producing one-handed target signs (Cheek et al. 2001; Meier 2006).



Fig. 28.2: The ASL target form of COOKIE

Sympathy is much more likely to cause problems for two-handed target signs that require distinct hand configurations, such as the ASL sign COOKIE (Figure 28.2) where the dominant hand acts upon a static base hand. This category of signs is referred to as two-handed dominance arrangements by Cheek et al. (2001). These researchers reported that such signs were attempted in less than 10 % of the total spontaneous production of their four deaf subjects, and were produced with correct arrangement of the hands only 40 % of the time. The remaining cases were counted as errors; these were articulated as either one-handed signs in which the non-dominant base hand was dropped, or as two-handed symmetrical signs in which the base hand was assimilated to the same movement (and sometimes handshape) of the dominant hand (also noted by Siedlecki/Bonvillian (1997) and Marentette/Mayberry (2000) for ASL; Takkinen (2003) for FinSL).

As for two-handed dominance signs, Cheek et al. (2001) also reported errors for this category (29 %), all but one of them articulated as one-hand signs. This type of error cannot be caused by sympathy, and indeed may appear unexpected in light of the mirrored reaching movements reported by non-linguistic infant studies. Indeed, such modification may not be an error at all; Cheek et al. noted that omission of the non-dominant hand in two-handed symmetrical signs (with non-alternating movement) is frequently attested in adult signing, where it is known as “Weak Drop” (Padden/Perlmutter 1987).

If signs with a two-handed dominance arrangement are cognitively more demanding than either two-handed symmetrical or one-handed signs, young sign-exposed children may avoid two-handed dominance arrangements in their production. Cheek et al. (2001) noted that two-handed dominance signs are extremely common in adult signing (although admittedly not necessarily as common in child-directed signing), making up 25 % of the adult ASL lexicon (Klima/Bellugi 1979, calculated on the basis of the *Dictionary of American Sign Language* by Stokoe/Casterline/Croneberg 1965). At less than 10 %, this class of signs is strikingly underrepresented in the children's ASL. Takkinen (2003), Karnopp (2002), and Pizzuto (2002) have also commented on lower-than-expected rates of signs with two-handed dominance arrangements in children's FinSL, Brazilian Sign Language (LSB), and Italian Sign Language (LIS), respectively. In contrast, Morgan, Barrett-Jones, and Stoneham (2007) reported that nearly 20 % of their BSL-exposed subject's signs involved a non-dominant base hand, with only 24 % errors. At least part of this observed difference from the ASL findings may be due to the fact that the BSL data were observed between 19 and 24 months, a bit older than the age range studied by Cheek et al. (2001) (5–16 months).

3.3. Developmental patterns for the three major formational parameters

In addition to the effects of motoric tendencies detailed in the previous subsection, studies on early sign phonology have observed a recurring pattern for the order of acquisition of the three major formational parameters. In general, location is acquired earliest, produced accurately in even the earliest signs. Movement is controlled less well than location; the motoric factors discussed above all affect the movement parameter, and we have seen that these effects persist well beyond the first year of life.

Tab. 28.1: Early handshape, location, and movement accuracy from selected reports

Study	# of subjects	Age span	Handshape	Location	Path	Hand-internal mvt
Marentette & Mayberry (2000) (ASL)	1 Deaf	1;0–2;0	dominant: (27 %) non-dom: (26 %)	horizontal: (89 %) vertical: (74 %)	(57 %)	(48 %)
Conlin et al. (2000) (ASL)	3 Deaf	0;07–1;05	93/372 (25 %)	303/372 (81 %)	201/372 (54 %)	(48 %)
Cheek et al. (2001) (ASL)	4 Deaf	0;05–1;04	195/528 (37 %)	499/623 (80 %)	354/630 (56 %)	77/162 (48 %)
Morgan et al. (2007) (BSL)	1 Deaf	1;07–2;0	602/1018 (59 %)	763/1018 (75 %)	462/910 (51 %)	106/198 (54 %)
Mann et al. (2010) (BSL)*	91 Deaf	3–5 yrs 6–8 yrs 9–11 yrs	54 % 64 % 76 %	not measured	72 % 86 % 91 %	55 % 64 % 77 %

* The results of Mann et al. are based on a nonsense sign repetition task, whereas the remaining studies in this table are based on natural production data.

Finally, handshape is mastered the latest of the major parameters, exhibiting both a low degree of accuracy and a high degree of variability. Table 28.1 summarizes the percentage accuracy for handshape, location, and movement reported by selected studies on ASL and BSL.

The finding that location is acquired early and handshape late, with movement falling somewhere in between, is cross-linguistically very robust, having been reported for LSE (Juncos et al. 1997), FinSL (Takkinen 2003), LSB (Karnopp 2008), BSL (Clibbens/Harris 1993; Morgan/Barrett-Jones/Stoneham 2007; Mann et al. 2010), and a number of studies on ASL (Bonvillian/Siedlecki 1996; Conlin et al. 2000; and Marentette/Mayberry 2000, among others). Furthermore, children's accuracy is affected by phonetic complexity; for instance, target signs with a complex or marked handshape are more likely to be produced with errors than those with an unmarked handshape (Boyes Braem 1973, 1990), as well as more likely to lead to errors in movement (Mann et al. 2010).

3.3.1. Location

In the case of location, the basic pattern of motor control discussed earlier (control of proximal joints before distal joints) works in favor of early acquisition, as production of location tends to implicate the most proximal articulators, the shoulder and elbow (Cheek et al. 2001). Errors in sign location must thus be attributed to sources other than difficulty controlling articulators. Morgan, Barrett-Jones, and Stoneham (2007) proposed that the best predictor of location errors is size of the target location. Twenty-five percent of their BSL-exposed subject's total signs contained location errors (a somewhat higher rate than reported by studies of ASL), and of these 71 % involved movement to a larger nearby location (e.g. from the temple to the cheek, or from the neck to the chest).

Marentette and Mayberry (2000) attributed similar errors in their ASL data to location saliency rather than size. These authors reported that 91 % of all location errors committed by their ASL-exposed subject involved substitution of a neighboring location with higher saliency, such as signing TELEPHONE at the ear rather than at the cheek. They argued that low saliency locations such as the cheek and temple are not yet well represented in the child's developing body schema, and as such may be unavailable as locations for signing. A similar conclusion was reached by Conlin et al. (2000), also for ASL.

Most studies agree that locations in neutral space and on or around the head are among the earliest and most accurate locations to emerge in early signing (Marentette/Mayberry 2000; Bonvillian/Siedlecki 1996; Conlin et al. 2000; Cheek et al. 2001). A notable exception is Morgan, Barrett-Jones, and Stoneham (2007), who reported that BSL signs targeting the face and head were consistently more prone to error than signs targeting the trunk, non-dominant hand, or neutral space. There is also some disagreement as to whether children's patterns of location substitution indicate preferred default values. Marentette and Mayberry (2000) reported that three location values – the trunk, head, and mouth – appeared in the majority of their subject's location substitutions, while other researchers found no favored substitute location in their data (Cheek et al. 2001).

3.3.2. Movement

Sign production by young sign-exposed children is marked by movement errors caused by proximalization, sympathy, and multi-cyclicity (Meier et al. 2008), as discussed earlier. In this subsection, I will focus on patterns of error and relative order of acquisition for specific movement values, for which there is considerable variation across the existing literature. Nevertheless, some interesting generalizations are beginning to emerge.

Most studies consider path or directional movement separately from hand-internal movement; as illustrated in Table 28.1 above, hand-internal movement is consistently reported as being less accurate in child signing than path movement. Cheek et al. (2001) reported a 56 % accuracy rate for path in their subjects' signing, very close to the accuracy rates reported by other studies in Table 28.1. The most common path movement according to these authors was "no path", or signs in which no articulation occurs at either the shoulder or elbow, although wrist extension or flexion (e.g. HORSE), rotation of the forearm (e.g. BOOK) or hand-internal movement might occur. Similarly, Morgan, Barrett-Jones, and Stoneham (2007) found the path type "hold" to be the most accurate of movement types produced by their BSL-exposed subject, although it was also the least frequently attested. At the other end of the acquisition spectrum, circular path movements were attested only once in the Cheek et al. (2001) data, and were also found by Morgan, Barrett-Jones, and Stoneham (2007) to be the least accurate (although not the least frequent) in their subject's production.

As for path movement substitutions, Marentette and Mayberry (2000) and Karnopp (2008) found no pattern or preferences in early errors of ASL and LSB, respectively. In contrast, Cheek et al. (2001) identified up-down movement, the second most common movement type in their data, as the most common substitution during movement errors (e.g. COLD with an up-down rather than a side-to-side movement).

Hand-internal movement is universally reported to be difficult for young sign-exposed children. Cheek et al. (2001) reported a 48 % accuracy rate for this category of signs, again similar to that found by Marentette and Mayberry. The former researchers listed open/close movement as the most frequent and most accurate in their data, in contrast to reports by the latter researchers that bending of K1 and rotation of the forearm were the most frequent in their data. The status of open/close as the most preferred substitution in errors of hand-internal movement was also reported for early BSL by Morgan, Barrett-Jones, and Stoneham (2007), although it was exceeded in accuracy rate by wrist-bend in their data. Both research groups commented on the difficulty posed by finger wiggling, which was either omitted or replaced with the open/close movement in the Cheek et al. (2001) data. In contrast, Morgan, Barrett-Jones, and Stoneham (2007) reported that all errors, including those involving finger wiggling, were due to substitution, never to omission.

Morgan, Barrett-Jones, and Stoneham (2007) noted a very interesting error type specific to target signs requiring a combination of path and hand-internal movement. In 85 % of such signs, their subject produced the two components sequentially rather than simultaneously. For example, she signed the BSL sign HOW-MANY, normally articulated with a repeated side-to-side movement with simultaneous finger wiggle, as a side-to-side movement followed by finger wiggle. In other cases, she deleted one element of the combination, or inserted extra holds between segments of the target sign.

Several researchers noted that their subjects often replaced path movement with hand-internal movement, or vice versa (Marentette and Mayberry (2000) for ASL;

Karnopp (2008) for LSB), suggesting that children may not yet fully distinguish these as separate classes of movement types. Also, early studies such as Siedlecki (1991) and Siedlecki and Bonvillian (1993) reported that children sometimes produced two-handed signs in which each hand executed a different movement, violating the Symmetry and Dominance conditions of Battison (1978). However, I have found no further extension of this claim in the literature.

3.3.3. Handshape

Contrasts in hand configurations are encoded in relatively small changes of finger and/or thumb position, rendering some contrasts difficult to articulate and perceive. Conlin et al. (2000) found that their subjects produced not only a high number of handshape errors but also a high degree of variability in their handshape substitutions. Similar observations have recently been reported for BSL by Morgan, Barrett-Jones, and Stoneham (2007).

Given that handshape poses such significant challenges to young signers, this formational parameter has been the subject of relatively intense study from early on, beginning with Boyes Braem (1973, 1990). She developed a system of eight features predicting hand configuration markedness in sign languages, based largely on anatomical characteristics of the human hand and observations of early infant reaching, grasping, and pointing behavior. On the basis of these features, Boyes Braem predicted the four stages of development (plus A as the maximally unmarked configuration, the posture of the infant hand at rest) listed in the table below.

Tab. 28.2: Boyes Braem (1973, 1990) hierarchy of hand configuration markedness

Max. unmarked configuration	A	Closest to the posture of the hand at rest
Stage I	S, L, bO, G/1, 5, C	involves manipulation of hand as a whole OR thumb and/or index only
Stage II	B, F, O	only the highly independent digits are able to move separately (thumb and index)
Stage III	(I, Y) (D, P, 3, V, H) W	requires differentiation of individual fingers, to inhibit or activate specific groups of fingers
Stage IV	(8, 7), X, R, (T, M, N)	requires activation and inhibition of ulnar fingers independently; applies additional features <i>cross</i> and <i>insertion</i>

The Boyes Braem markedness hierarchy has been tested by various investigators of early sign development, beginning with Boyes Braem herself. She found heavy reliance on Stage I configurations in the signing of one deaf, ASL-signing girl at 2;7 for both overall production (49 %) and substitutions for more marked handshapes (76 %). Accuracy for the Stage I configurations was generally high. Similar dependence on unmarked (Stage I and II) handshapes for early signs and substitutions has been reported by numerous other researchers of ASL (McIntire 1977; Siedlecki/Bonvillian

1997; Conlin et al. 2000, among others) and other sign languages (e.g. Clibbens/Harris (1993) for BSL; von Tetzchner (1984) for Norwegian Sign Language (NSL)).

Of course, researchers have also reported many patterns that are not consistent with the predictions described above. Some can be accounted for by secondary factors influencing hand configuration accuracy noted by Boyes Braem (1973, 1990). For instance, children are more accurate when they have visual feedback on their production of hand configurations; the same configuration may be executed accurately at visible locations, but inaccurately when the hand is placed out of view. Also, children may err on unmarked hand configurations if they occur in combination with movements or other features that increase formational complexity of the target sign (Boyes Braem 1990; McIntire 1977). Kantor (1980) suggested that the use of a hand configuration in a classifier construction may represent one such increase in complexity, causing errors in configurations that the child already controls for lexical signs. Conversely, many children learn to form all the letters of the manual alphabet, but are unable to control some of those same configurations in the context of lexical signs (e.g. Siedlecki/Bonvillian 1997). All of these examples indicate that the determination of markedness (or indeed, developmental stages) on the basis of whole hand configurations is too simplistic an approach to acquisition. More recent studies (such as Karnopp 2002 for LSB) are returning to discussion of markedness and acquisitional stages in terms of individual features, similar to those that Boyes Braem originally used to generate her stages of acquisition (cf. Johnson/Liddell 2010).

4. Lexical development

Somewhere around the first year, sign-exposed children begin to produce recognizable signs. There has been considerable debate over whether or not signing children experience accelerated progress through the early stages of lexical development (the so-called 'sign advantage'), as I discuss below.

4.1. Vocabulary content and trajectory

As sign-exposed children begin to develop their lexicon, the high potential for transparent mapping between form and meaning raises the possibility that iconicity might facilitate lexical acquisition in sign languages. If this is so, children may preferentially learn highly iconic signs earlier than arbitrary signs, resulting in a disproportional bias towards iconic signs in their early production. However, Orlansky and Bonvillian (1984) found that this was not the case; iconic signs were not particularly well represented in the earliest vocabularies of the nine ASL-exposed children they studied, accounting for only a third of their earliest signs. This finding aligns with the reports, summarized in section 3.1, that iconicity is not a major factor in children's phonological realizations of their earliest signs (Meier et al. 2008).

Rather than being determined by iconicity, early vocabulary content for sign-exposed children appears to be organized around semantic categories that are typical for infants learning English and other languages (Fenson et al. 1994). This is the conclusion

reached by Anderson and Reilly (2002) for ASL and Woolfe et al. (2010) for BSL, based on ASL and BSL adaptations of the MacArthur Communicative Development Inventory, a parental report originally developed for American English by Fenson et al. (1994). The ASL data, collected from 69 ASL-exposed children, indicated that children's first signs were predominantly nouns and revolved around terms for food (e.g. MILK, COOKIE), family members (e.g. MOMMY, DADDY, BABY), animal names (e.g. DOG, CAT), clothing items (e.g. SHOE, HAT), and greetings (e.g. BYE). Acquisition of *wh*-signs, negative signs, emotion signs, verbs of cognition, and the onset of two-sign combinations were also similar to the norms reported for American English in both sequence and time course (Fenson et al. 1994).

The many similarities across early spoken and sign vocabulary development notwithstanding, the ASL and BSL studies also described some notable differences. Whereas hearing English learners reportedly experience a "vocabulary burst" at some point in their first three years (Bloom 1973) during which they rapidly increase their rate of new word production, the ASL signers studied by Anderson and Reilly (2002) showed no evidence for such a burst. Instead, they appeared to follow a steady, linear course of vocabulary development. This is not necessarily a universal feature of sign development, however, because Woolfe et al. (2010) reported that their BSL subjects did exhibit a general vocabulary spurt, parallel to that described for spoken language development. They surmised that Anderson and Reilly may not have sampled their subjects frequently enough to detect a vocabulary burst. Interestingly, Anderson and Reilly did report a sort of 'verb burst' at around 200 signs, when ASL children's proportion of predicates increased dramatically, such that by 400+ signs, it was twice that observed for English learners. A verb bias has been reported for other sign languages, as well. Hoiting (2006) reported an even more dramatic difference between percentages of predicates in early English and Sign Language of the Netherlands (NGT), with her NGT-learning subjects producing predicates five times more frequently than their English-learning counterparts. Woll (2010) observed that the first 50 English words of young English/BSL bilingual children included no action words; yet these concepts were all expressed by the children in their BSL. These findings may reflect important typological differences by which predicates are more salient in ASL, BSL, and NGT than in English (Slobin et al. 2003; Hoiting 2006, 2009).

4.2. The "sign advantage" in early lexical development

Early studies of sign language development (Schlesinger/Meadow 1972; Prinz/Prinz 1979; Bonvillian/Orlansky/Novack 1983, among others) reported sign-exposed children producing their first signs 1.5–4.5 months earlier than the onset of the first word for speech-exposed children (de Villiers/de Villiers 1978). This difference led to speculation about a so-called "sign advantage", beginning with the assumption that the articulators for sign languages (i.e. the hands) develop earlier than those used for spoken languages, allowing sign-exposed children to produce lexical items earlier, which in turn might lead to accelerated progression through the early stages of linguistic development. Indeed, Bonvillian, Orlansky, and Folven (1990) reported that ASL-exposed children consistently achieved the milestones of first word/sign, first ten words/signs and first word/sign combination earlier than their English-exposed counterparts. Find-

ings like these quickly catapulted interest in a possible “sign advantage” into the realm of popular parenting, where a massive “baby sign” industry developed to encourage preverbal hearing children to use signs and gestures to communicate with their hearing parents (Garcia 1999; Acredolo/Goodwyn/Abrams 2002).

Meier and Newport (1990) reviewed studies of morphological and syntactic development in ASL and spoken language, concluding that the data do not support a sign advantage for these areas. In contrast, they agreed with previous claims for a sign advantage for the onset of lexical development, concluding that the age of signing onset is the age at which all children are ready to begin lexical development, but that speech-exposed children are delayed due to restrictions of motor development (a “speech disadvantage”). This position has been contested by Volterra and her colleagues (Volterra/Iverson 1995; Capirci et al. 2002), who argue that studies of early lexical development have conflated early signs with early communicative gestures for sign-exposed subjects, while counting only early words for speech-exposed subjects. Once communicative gestures are properly distinguished from signs and are coded for both sign- and speech-exposed children, both groups show comparable ages of onset for communicative gestures and first word/sign.

However, recent work by Meier et al. (2008) on motoric factors in early signing reiterates the claim for a sign advantage in early lexical development. As discussed in section 3.3, early control of two proximal oscillators (the shoulder and elbows) facilitates early and accurate articulation of one out of three major formational parameters of sign (location), allows the signing child to signal a comparatively large number of lexical contrasts in their early output. This may render signing children’s “early clumsy attempts [...] more recognizable to parents and experimenters than [...] the garbled first words of speaking children” (Meier et al. 2008, 341).

5. Morphological and syntactic development

Around the second year, sign-exposed children begin the process of morphological and syntactic development. Much of the research attention in this area has revolved around the child’s use of word order and phenomena that alter word order for morphological (e.g. verb agreement) or pragmatic purposes (e.g. wh-questions, topics, or focus). Interest has also been high for morphological and syntactic constructions unique to sign languages (e.g. spatial syntax, classifier predicates, and non-manual signals). Many of these morphological and syntactic phenomena are also relevant to the development of discourse, which will be mentioned briefly at the end of this chapter.

5.1. Basic word order

Studies of early word order are available for several sign languages, including NGT (Coerts/Mills 1994; Coerts 2000), ASL (Hoffmeister 1978; Schick 2002; Chen Pichler 2001), LSB (Pizzio 2006), and NS (Torigoe/Takei 2001). All of these sign languages allow variation in word order, in which the subject and/or object appear in non-canonical positions. Faced with variable word order in their input, sign-exposed children could

conceivably react in several different ways. They might ignore the variability, insisting on a single order (perhaps the basic or canonical order of their target language) in their early production. Alternatively, they might copy the variability they see, but in a random fashion. Finally, they might demonstrate early acquisition of the syntactic and pragmatic nuances distinguishing one order from another, leading to target-like word order variation.

One of the earliest English-language publications on the acquisition of sign word order was Coerts and Mills (1994), a study of the first subject and verb combinations of deaf twins acquiring NGT from their deaf mother. Subjects in NGT are canonically ordered before verbs (SV order), so Coerts and Mills set out to determine the age at which this ordering rule became productive in the child data. They found such high variability in the children's subject placement (i.e. both SV and VS orders) between 1;06 and 2;06 that they were forced to conclude that these children had still not acquired basic SV word order. It was not until later, when Bos (1995) documented sentence-final subjects as a grammatically licensed word order in NGT, that the true reason for the Dutch children's word order variability became clear. Coerts (2000) reanalyzed the data from Coerts and Mills (1994) and confirmed that the SVS and VS orders coded as errors in the earlier study were actually well-formed instances of sentence-final subjects. She concluded that NGT-exposed children control word order (at least with respect to subjects and verbs) from around the age of 2;01, in line with cross-linguistic reports.

The importance of taking into account the possibility that children use adult-like variation early is demonstrated again in the ASL literature on early word order. Hoffmeister (1978) reported a strong preference for canonical SVO order (i.e. preverbal subjects and/or post-verbal objects) in the early sign combinations of his three deaf subjects, reflecting a fixed word order strategy in contrast to the variable word order variation of adult ASL (Newport/Meier 1985). Schick and Gale (1996) and Schick (2002) subsequently reported the opposite trend, finding high word order variability in the sign combinations of 12 American deaf children at their second birthday. Of the total multi-sign utterances including a verb and overt theme argument (the authors referred to agents and themes to avoid making any claims that the syntactic notions of subject and object had been acquired by this age), only 57 % to 68 % appeared in canonical verb-theme order, and canonical agent-verb order hovered around 66 % across most of the children. Schick concluded from these figures that there was no evidence for a canonical word order strategy in her data, contrary to what had been previously reported by Hoffmeister (1978).

Chen Pichler (2001, 2008) reanalyzed the word order frequency rates provided by Hoffmeister (1978) and concluded that although his subjects' use of canonical orders increased with time, they produced a significant percentage of their earliest utterances with non-canonical orders: 17–33 % of all utterances containing a subject and verb were VS, while 38–42 % of all utterances containing a verb and an object were OV. These rates are comparable to those reported by Schick and Gale (1996) and Schick (2002). Interestingly, although Hoffmeister (1978) did not provide a list of the actual utterances produced by the children, he noted that OV utterances tended to occur with verbs that "allow modulation" (most likely referring to agreement for person and number, but possibly also including location or classifier information) although most of the forms actually produced by the children in the early stages were uninflected.

Chen Pichler (2001, 2008) hypothesized that, similar to the cases described by Coerts and Mills (1994), the non-canonical orders reported in the Hoffmeister and Schick studies might reflect early and target-like use of order-modifying operations.

The study conducted by Chen Pichler (2001) investigated the placement of both subjects and objects with respect to the verb for all multi-sign utterances produced by four deaf children between 20 and 30 months of age. All multi-sign utterances containing a verb and overt object were coded as either canonical VO or non-canonical OV. Index points (ix) clearly directed towards an identifiable referent (i.e. pronouns) were counted as overt subjects and objects, a practice that appears to have also been adopted by both Hoffmeister (1978) and Schick (2002). Additionally, Chen Pichler (2001) coded non-canonical utterances for evidence of order-modifying operations available in adult ASL. Following Padden (1988), post-verbal subjects were coded as instances of subject-pronoun copy, as long as the post-verbal copy of the subject appeared in pronoun form. Preverbal objects were coded as target-like whenever they occurred with an aspectual verb, a spatial verb, or a handling verb (where the hand configuration corresponded to either an instrument or a theme of the verb), following Fischer and Janis (1992) and other proposals for morphosyntactically-motivated object shift or (rightward) verb raising in ASL (Matsuoka 1997; Braze 2004). Examples of target-like instances of VS and OV order are shown in (1) and (2), respectively.

- (1) PUT-ON-SHIRT CAN IX(mother)
'You can dress yourself.'
[ASL, 26 months]
- (2) HAT BRING-HERE
'I'll bring the hat here.'
[ASL, 26 months]

Results indicated that the four children's use of canonical preverbal subjects ranged between 54 % and 72 % over the age span investigated, while their use of postverbal objects ranged from 32 % to 52 %. Taken together, these figures do not support an early fixed word order strategy. Once post-verbal subjects and pre-verbal objects meeting the criteria for order-modifying operations were taken into consideration, the children's rate of target-like word order rose to between 96 % and 97 % for subjects and verbs, and between 76 % and 86 % for verbs and objects (for all but one child, who made little use of order-modifying operations; see discussion of this child's OV production in section 5.2.3). Chen Pichler (2001) concluded that canonical word order rules are acquired early in ASL, by 30 months of age, but that their effects are obscured by very productive application of subject-pronoun copy and developing competence with certain morpho-syntactic operations triggering non-canonical OV order. Pizzio (2006), in a study of early LSB, came to a similar conclusion, although she attributed more of her subject's non-canonical object placement to topic and focus (discussed in the next section) than to the order-modifying verb types studied by Chen Pichler (2001).

5.2. Wh-questions, focus, and topics

The few existing studies that explore wh-questions, focus, and topics are limited to ASL and LSB. These three topics are presented together here because of their common

potential for movement in generative approaches, the theoretical perspective adopted by much of the early work on sign language linguistics. According to generative theories, movement of a *wh*-element, focused element, or topic may result in either a new word order (e.g. raising of a sentence-final *wh*-object to sentence-initial position) or leave word order unchanged (e.g. raising of a subject, already in sentence-initial position, to a topic position further to the left). Word order changes are used in many languages to signal changes in information structure, an important component of discourse/pragmatic organization that has long been assumed to emerge late in child language, although recent reports have indicated that some aspects of information structure are acquired early (e.g. de Cat (2003) for spoken French).

5.2.1. *Wh*-questions

The position of *wh*-elements in sign languages displays more variation than is typical of spoken languages, due to the fact that *wh*-signs can either remain in-situ (i.e. in their original, base-generated positions) or move to various positions in the sentence. A sample of the variety of possible configurations is illustrated by the ASL *wh*-questions below, drawn from Lillo-Martin and de Quadros (2006) and Petronio and Lillo-Martin (1997). (Note that these questions are marked by the *wh*-non-manual marker; acquisition of the non-manual component of *wh*-questions is covered in section 5.5.)

- | | | | |
|-----|------------------------|--|-------|
| | | <u>wh</u> | |
| (3) | a. <i>wh</i> -initial: | WHAT JOHN BUY | [ASL] |
| | | ‘What did John buy?’ | |
| | | (generally unacceptable according to Neidle et al. 2000) | |
| | | <u>wh</u> | |
| | b. <i>wh</i> -final: | JOHN BUY (YESTERDAY) WHAT | |
| | | ‘What did John buy (yesterday)?’ | |
| | | <u>wh</u> | |
| | c. <i>wh</i> -doubled: | WHAT JOHN BUY WHAT | |
| | | ‘WHAT did John buy?’ | |

There is currently much debate over the structure of *wh*-questions in sign language, fuelled in large part by the variability illustrated in (3a–c). There are two main positions in this debate, hinging on the direction in which basic *wh*-movement to the specifier of CP proceeds. Petronio and Lillo-Martin (1997) claimed that *wh*-elements move leftward to the specifier of CP, resulting in sentence-initial *wh*-questions like (3a). In contrast, Neidle et al. (2000) reported that *wh*-initial questions such as (3a) are generally unacceptable, at least for *wh*-objects. They proposed that *wh*-movement to the specifier of CP proceeds rightward, resulting in sentence-final *wh*-questions like (3b). Under both positions, *wh*-doubled constructions such as (3c) involve additional operations (see chapter 14, Sentence Types, for details).

From an acquisition perspective, both the leftward- and rightward-movement accounts predict that *wh*-in-situ questions should be among the earliest to appear in child signing, as these do not require any movement. Under both accounts, then, one would expect to see sentence-initial *wh*-subjects, as well as *wh*-objects surfacing just after the

Lillo-Martin and de Quadros (2006) used acquisition data to test these competing predictions. Their longitudinal data from two ASL-exposed and two LSB-exposed deaf children (falling within the age range of 1;01 to 3;0) indicated that all four children produced in-situ and sentence-initial wh-questions from the very earliest observations. Crucially, sentence-initial wh-questions occurred for both subjects and objects. Doubled wh-questions appeared subsequently in the ASL data, but did not occur in the LSB data. Neither group of children produced any unambiguously wh-final structures during the period of observation. This acquisition pattern is expected if wh-movement is leftward in ASL and LSB, but unexpected if wh-movement is rightward, especially if object wh-initial questions are unacceptable in ASL, as Neidle et al. (2000) reported. Further support for leftward wh-movement comes from experimental data from older ASL signers (4–6 years), in which the youngest children showed a strong preference for wh-initial structures for subject, object, and adjunct wh-elements (Lillo-Martin 2000).

Like the studies of *wh*-questions summarized in the previous subsection, the existing literature on acquisition of focus in sign language is motivated by theoretical debate over syntactic structure. According to a proposal advanced by Lillo-Martin and de Quadros (2008), ASL and LSB distinguish between (non-contrastive) information focus (I-focus) (4) and two related variants of emphatic focus (E-focus): focus doubling constructions (5a) and focus final constructions (5b). Examples of these focus types are shown below (these examples are drawn from Lillo-Martin and de Quadros (2005) and are grammatical in both ASL and LSB).

- Under the Lillo-Martin and de Quadros (2008) proposal, focus double and focus final constructions are structurally related, while they are unrelated under competing analyses (Neidle et al. 2000). Lillo-Martin and de Quadros (2005) reported that acquisition

data from two ASL-exposed and two LSB-exposed children revealed early use of I-focus (as early as 1;01 for the Brazilian subjects, and 1;07 for the American subjects). Focus doubling and focus final constructions emerged at very similar ages (between 1;09 and 2;02), both significantly later than I-focus. Pizzio (2006) reported a similar gap in ages of acquisition between I-focus and E-focus in her subject (one of the LSB subjects examined by Lillo-Martin and de Quadros (2005)), and added that a third type of focus, contrastive focus, appeared at 2;01. These data support the proposal by Lillo-Martin and de Quadros (2008) linking focus doubles and focus finals, and indicate that sign-exposed children use at least some aspects of information structuring early in development, echoing recent reports from spoken languages research (e.g. de Cat 2003).

5.2.3. Topics

In their investigation of grammatical non-manual markers in early signing, Reilly, McIntire, and Bellugi (1991) reported that the ASL topic non-manual (raised brows over the topicalized element) did not emerge until 3;0 in their data. The authors noted that children might potentially produce topics prior to that age, but that only the non-manual marker constitutes “inescapable evidence” that the child has developed competence in this domain (Reilly/McIntire/Bellugi 1991, 15). This view is consistent with the prevailing assumption that brow raise is the most salient and critical component of the ASL topic non-manual.

In contrast, Nespor and Sandler (1999) and Rosenstein (2001) reported that while brow raise sometimes marks topics in Israeli Sign Language (Israeli SL), the true topic marker is not limited to that or any other single non-manual feature. Rather, it involves the simultaneous change of a combination of features (that could include widened eyes, raised brows, head nods, eye blinks, and holds) between the topic and the remainder of the sentence (the comment). Chen Pichler (2001, 2010), examined utterances from one ASL-exposed child with preverbal objects but no evidence of the order-modifying features discussed in section 5.1. She found very simple prosodic breaks of the type described for Israeli SL, beginning at 24.5 months. These were typically characterized by repetition or holding of the topic sign, followed by a change in head position or slight nodding of the head for the remainder of the sentence. Using similar evidence, Pizzio (2006) attributed her LSB-exposed subject with early use of topics, marked with various non-manual features (brow raise, head movement, or eye gaze direction). These two studies, although very preliminary, suggest that competence in topicalization may begin nearly a year earlier than estimated by Reilly, McIntire, and Bellugi (1991).

5.3. Spatial syntax

Perhaps the most prolifically studied phenomenon in sign acquisition is spatial syntax, or the use of space to establish reference for pronouns and what has traditionally been referred to as verb agreement (see chapters 7 and 11 for discussion). Lillo-Martin summarized four crucial things that a sign-exposed child must learn in order to control spatial syntax: “(a) to associate a referent with a location, (b) to use different locations

for different referents [...], (c) to use verb agreement or pronouns with non-present referents, and (d) to remember the association of referents with locations over a stretch of discourse" (Lillo-Martin 1999, 538–539). Newport and Meier (1985) provided an excellent summary of the extensive research on the acquisition of ASL pronouns and verb agreement conducted through the mid-eighties. The general consensus of that early literature was that the heavily iconic properties of spatial syntax did not facilitate its acquisition by sign-exposed children. The studies of Meier (1982) and Petitto (1987) presented this position particularly clearly, for verb agreement and pronouns, respectively.

Petitto (1987) documented the development of pointing behaviors for two ASL-exposed deaf girls between 0;06 and 2;03. Both girls engaged in pointing at people, objects, locations, and events at 10 months, the same age at which hearing children (not exposed to sign language) begin to point gesturally. Between 12 and 18 months, the girls replaced pointing at people, including themselves, with lexical signs (mostly kinship terms like MOTHER); other types of pointing continued unchanged. Pointing at people resumed between 21 and 23 months for both children, but they committed reversal errors in both production and comprehension in which they signed/understood YOU or YOUR(s) to refer to themselves. The full pronoun system was not mastered until around 27 months. Petitto noted that the observed pattern of pronoun avoidance, errors and acquisition displayed striking similarities in timing to the development of spoken language pronouns: pronouns emerge in early speech between 18 and 20 months, but are unstable and prone to error (including reversal errors) until 30 months (Charney 1978). Although this particular pattern of pronoun development has not been replicated by other researchers, Petitto's data have been widely interpreted as evidence that children do not transition smoothly from purely gestural, non-linguistic pointing to formal ASL deictic pronouns. The transparent nature of the latter does not accelerate the mastery of pronouns by sign-exposed children with respect to their speech-exposed peers.

Meier (1982) investigated the development of verb agreement in ASL with present referents. He reported that from 2;0 to 2;06, his three ASL-exposed subjects used verbs that participate in agreement, but produced most of them in citation (uninflected) form, an early preference also documented by Hoffmeister (1978) and others. Meier concluded that his subjects did not acquire verb agreement (under the stringent criterion of suppliance in 90 % of obligatory contexts for acquisition) until between 3;0 and 3;06. This is late compared to children learning languages like Turkish that feature rich, regular, and phonetically salient verbal morphology, yet comparable to children learning languages like English, where verbal morphology is less reliable (Slobin 1982). Meier concluded that the iconic qualities of the ASL verb agreement system do not facilitate acquisition, nor lead sign-exposed children to analyze inflected verbs as holistic, 'mimetic' representations of real world actions.

The age of acquisition reported by Meier (1982) applied to agreement with present referents, but sign languages also allow agreement with non-present referents. In these cases, referents are associated with locations established in signing space, a task that presents difficulty for children. For example, Loew (1984) reported that agreement with non-present referents was not consistently correct until 4;09 for her subject, well after agreement with present referents was controlled. Her data included spontaneous narratives with multiple characters, and revealed interesting errors. Between 3;06 and

3;11, Loew observed 'stacking' errors, in which the child used the same location in space for more than one referent. In other instances, the child established multiple referents in different locations, but in an inconsistent way. Between 4;0 and 4;09, she directed verb forms towards real life objects standing in for non-present referents (e.g. establishing a chair habitually occupied by her father as the location for her non-present father); agreement with these 'semi-real world forms' had been previously noted by Hoffmeister (1978).

If agreement with non-present referents is controlled a full year later than agreement with present referents, this could indicate that children acquire the two as separate systems. However, Lillo-Martin et al. (1985) and Bellugi et al. (1988) argued against this conclusion, claiming that difficulties related to spatial memory are behind the delay in acquiring agreement with non-present referents. Their deaf ASL-exposed subjects scored poorly on act-out and picture selection tasks testing comprehension of agreement with non-present referents (Lillo-Martin et al. 1985) and continued to make errors of the type described by Loew (1984) in their production until the age of 5;0 (Bellugi et al. 1988). However, subjects as young as 3;0 were successful in a task requiring them to watch the experimenter place two or three referents in space (e.g. BOY HERE_a, GIRL HERE_b) then answer questions about associations between specific referents and spatial locations (e.g. WHERE BOY or WHAT HERE_a). Furthermore, they performed more accurately on test items involving two referents than on items with three referents (Lillo-Martin et al. 1985). Thus ability to associate spatial locations with referents, crucial for verb agreement in sign language, appears to be in place by 3 years, although it is subject to memory limitations.

Recent work on sign verb agreement has both extended investigation crosslinguistically and demonstrated that our understanding of this aspect of sign acquisition is still far from complete. Hänel (2005) reported productive verb agreement with both present and non-present referents emerging together (e.g. with no lag) for two deaf children learning German Sign Language (DGS). Casey (2003) extended the search for "directionality" to gestures, reporting directional gestures and ASL verbs much earlier than previous studies (as early as 0;08 for gestures and 1;11 for signs). Additionally, Casey noted production of directionality with verbs "denoting literal, iconic movement prior to those denoting metaphorical movement", a sequence she interpreted as evidence that children attend to iconicity in their development of verb agreement (contra Meier 1982). Perhaps most surprisingly, de Quadros and Lillo-Martin (2007) reported that their ASL and LSB data included virtually no instances of verb agreement omission in obligatory contexts, even as early as 2;0. They included eye gaze as a possible marker of agreement, contributing to a higher rate of target-like production than reported in earlier studies like Meier (1982). They also found that a sizeable portion of children's uninflected forms were judged as acceptable by native-signing adults, and indeed were also produced by adults interacting with the children (see also Morgan/Barrière/Woll (2006) for reports of similar verb agreement variability in child-directed BSL). Counting these forms as target-like not only reduces the number of obligatory contexts, but also calls into question the traditional, strict categorization of agreeing verbs as always requiring inflection.

Finally, some researchers have pointed to parallels between the development of verb agreement in sign languages and non-linguistic spatial and representational skills (Emmorey 2002; Jackson 2006), such as the ability to understand a scale model of a room

as a spatial representation of a real room (Blades/Cook 1994). The possible influence of developing spatial coding strategies on children's acquisition of verb agreement in sign languages is an interesting line of investigation that deserves further exploration.

5.4. Constructions formerly known as classifier predicates

One of the long-standing challenges to sign language research is a comprehensive yet coherent account of what was known in the early literature as 'classifier predicates' (see chapter 8 for discussion). This original label invoked a deliberate parallel with classifiers in spoken languages, whose function is to "categorize nouns by salient, perceived characteristics of their referents" (Kantor 1980, 41). Recently, however, this perceived parallel between spoken and sign classifiers has come under heavy scrutiny, prompting multiple proposals of new terminology to replace the term "classifier" in sign language research (although I will continue to use the term "classifier predicates" in this section for the sake of simplicity). Recent studies are also reconsidering the effect of iconicity on the acquisition of classifier constructions. Iconicity is a striking characteristic of these constructions; to describe a car driving past a tree, adult signers maneuver a dominant handshape representing a vehicle past a non-dominant handshape representing a tree. The degree to which children perceive (and reproduce) such representations as analogue or mimetic has been a topic of considerable debate.

The earliest reports on children's production of classifier constructions, focusing on 'complex verbs of motion' such as the example above, noted a very protracted course of acquisition and a pattern of errors suggesting that children approach these constructions as morphological complexes. Newport and Supalla (1980) reported that ASL-exposed deaf children under 3;0 failed to express manner of movement (e.g. producing simple linear movement when the target called for linear + bouncing movement) and often omitted secondary ground objects (e.g. the tree in the adult example given above); similar omissions of ground objects have been noted crosslinguistically (e.g. by Morgan et al. (2008) for BSL, and Tang/Sze/Lam (2007) for Hong Kong Sign Language). Older children continued to omit aspects of target movement or produced them sequentially rather than simultaneously (e.g. linear movement followed by bouncing movement), even as late as 5 years. Researchers interpreted these errors as evidence for a morphemic analysis of classifier predicates, by which each element of the described event (e.g. path, manner, entity undergoing movement) is composed of discrete subunits drawn from a finite list of possible values (e.g. an upward movement in an arc is composed of upward + arc). Furthermore, children's error patterns were taken as evidence for a universal bias towards componential analysis of language, indicating once again that "the potential iconicity of ASL morphology does not assist in its acquisition" (Newport/Meier 1985, 908).

Other early studies reported sequences of acquisition for the three subcategories of classifiers traditionally distinguished in the literature, based on the type of information encoded by the classifier handshape. Handle classifiers specify the shape of the human hand when handling a particular object (e.g. the ʔ-handshape used for holding a glass or can). In the size and shape or SASS classifiers, the handshape encodes "visual geometric features of the object" (Schick 2006), capable of showing not only the shape of the referent, but also its depth (e.g. two ʔ-handshapes representing thin disk-like

objects like a plate, versus two ↱-handshapes for a deeper pot). Finally, in entity classifiers, also known as class or semantic classifiers, the handshape represents a semantic category (e.g. the ↱-handshape representing upright entities).

In a picture elicitation task with 24 ASL-exposed deaf children aged 4;05 to 9;0, Schick (1990) found that with respect to handshape, children were most accurate with entity classifiers, followed by SASS, then handle classifiers. Schick attributed this pattern to the morphological complexity of SASS and handle handshapes, which she analyzed as including morphemes for size, depth, and movement, in contrast to monomorphemic entity handshapes. Kantor (1980) suggested that classifier status in itself seemed to add processing complexity; as mentioned in section 3.3.3, she noted that some handshapes already controlled in lexical signs were produced with errors when they appeared as entity classifiers. In contrast, with respect to location accuracy, children demonstrated more accuracy for handle classifiers than for either entity or SASS classifiers. Schick surmised that this was because it might be easier to use syntactic space for verb inflection (of which she analyzed handle classifier predicates to be one case) than to encode locative relationships (as in the case of entity and SASS classifier predicates). She cited the late acquisition of the latter, despite their highly iconic representation in ASL, as further evidence that “iconicity has little effect on the acquisition of a morphological system despite the potential for such an analysis” (Schick 1990, 370).

More recently, however, Schick (2006) has argued that earlier studies were too simplistic in their assessment of children’s sensitivity to iconicity. Effects were regarded as all or nothing, when in fact it is more likely that iconicity affects some aspects of acquisition more, and others less. For example, Schick (2006) points out that although complete mastery of the classifier system occurs late in acquisition, parts of it are in place from as early as 2;0 (Lindert 2001). Children between 2;0 and 3;0 recognize contexts that call for classifiers and select semantically appropriate (if not formationally accurate) forms (Schick 2006; Kantor 1980). They comprehend signed classifier predicates depicting figure and ground despite frequent omissions of ground in their own production (Lindert 2001). They do not resort to lexical strategies for encoding spatial relations (e.g. prepositional signs like ON or IN), even when these are available in their sign language, and despite a preference for lexical strategies in other domains of sign acquisition (e.g. as an alternative to certain grammatical non-manual markers (Reilly 2000), summarized in the next section).

Slobin et al. (2003) also argued for an effect of iconicity on classifier acquisition, citing the early ability of their ASL- and NGT-exposed deaf subjects (as young as 2;0) for meaningful selection of handshapes with a visual relationship with the referent. They rejected earlier proposals that classifier acquisition is difficult because object categorization is difficult (Newport/Meier 1985), arguing that classifiers do not actually categorize at all. Rather, they simply depict some property of the referent, a task well within the abilities of a two-year-old. De Beuzeville (2006) expanded on this perspective, framing her investigation of classifier acquisition in Australian Sign Language (Auslan) in terms of depicting verbs (Liddell 2003). Consistent with previous observations from ASL and NGT, she reported that handling depicting verbs were the earliest to be controlled in Auslan. She also drew parallels in timing and stages between the development of depiction and the development of visual representation (such as drawing or gesture). Whereas early sign language studies automatically equated discreteness

with arbitrariness, de Beuzeville argued that both depicting verbs and visual representation incorporate elements that are analogue and iconic with elements that are discrete and iconic.

In short, many now argue that the representation of iconic relations through a linguistic system is not difficult for children and can be observed in their early production (Schick 2006). These researchers propose that the protracted course of acquisition observed for classifier constructions is due to the complex discourse functions that children must control when they use these constructions, including establishment of referents represented by classifier handshapes, coordination of the relation of figure to ground, manipulation of focus or perspective, and so on (Slobin et al. 2003).

5.5. Non-manual markers

It is well known that sign languages grammars involve not only a manual component, but a non-manual component as well. Research on non-manual activity has traditionally focused on the face and head, with more limited reference to positions of the rest of the body (e.g. shoulder shrugs and body leans). One can broadly distinguish between *lexical*, *communicative* (or *affective*), and *grammatical non-manuals* in sign languages (see Pfau/Quer (2010) for an overview). The first refer to specific non-manual configurations that are lexically specified for particular signs; these will not be discussed in this chapter. Affective non-manuals convey emotional and affective information (e.g. scowling during angry signing). They occur with great variability across structures and signers and are considered to be communicative or paralinguistic. Only grammatical non-manuals are considered to be fully within the domain of linguistic organization, their appearance subject to grammatical constraints on form and scope (Reilly 2000). This chapter takes as its point of departure the traditional literature on ASL, recognizing distinct and obligatory non-manual markers for yes-no questions, wh-questions, relative clauses, conditionals, topics, and various adverbial constructions (Liddell 1980). Readers should be aware, however, that the degree to which these non-manuals are obligatory varies across sign languages (cf. Zeshan 2004), and traditional assumptions about the obligatory status of grammatical non-manuals in ASL are beginning to be questioned.

On the surface, some communicative and grammatical non-manuals overlap considerably in form, prompting speculation that the latter category developed via grammaticalization of related communicative non-manuals (MacFarlane 1998; Pfau/Steinbach 2006; also see chapter 34, *Lexicalization and Grammaticalization*). For instance, the same headshake that is used as a communicative non-manual among hearing populations is also used as a grammatical non-manual marker for negative construction in ASL. Similarly, as can be seen in Figure 28.3, the non-manual marker for wh-questions bears a resemblance to the affective expression adopted when one is perplexed or confused (both are characterized by a furrowing of the brow).

Communicative non-manuals are acquired by hearing and deaf children alike within the first year of life (Hiatt/Campos/Emde 1979; Nelson 1987; Reilly 2006). Given the resemblance of some grammatical non-manuals to communicative non-manuals, an interesting question is whether sign-exposed infants are able to transfer their early control of the latter to serve grammatical purposes. This question has been extensively



Fig. 28.3: The ASL wh-non-manual (left; © 2006, www.Lifeprint.com; used by permission) and the communicative non-manual indicating that one is perplexed or confused (right)

investigated by Judy Reilly and her colleagues over a series of studies on early ASL (summarized in Reilly 2006). The general pattern observed by these researchers is that grammatical non-manuals are acquired much later than communicative non-manuals, manifesting error patterns that reflect the complexity of coordinating the manual and non-manual channels used in sign language.

The case of negatives serves as an illustrative example. Anderson and Reilly (1997) reported that deaf children learning ASL begin to use communicative headshakes as gestures around their first birthday, similar to their hearing, non-signing counterparts. By 18–24 months, the first negative signs (NO and DON'T-WANT) emerged in their data, followed over the next 26 months by NONE, CAN'T, DON'T-LIKE, NOT, DON'T-KNOW, and NOT-YET. Crucially, each time a new negative sign emerged, it initially appeared without the obligatory headshake. Anderson and Reilly interpreted this pattern as evidence that children cannot recruit their ability with communicative non-manuals directly into the domain of grammatical function. They must first analyze the manual and non-manual components of ASL grammatical structures as distinct, independent elements before they can combine them appropriately.

This process may take years, a fact that is most clearly demonstrated by the protracted pattern of errors characterizing the development of the ASL wh-non-manual. Reilly, McIntire, and Bellugi (1991) reported that their ASL-exposed subjects produced around 18 months what appeared to be well-formed combinations of simultaneous wh-signs (e.g. WHAT) and the ASL wh-non-manual (brow furrow). Reilly and her colleagues argued that these were actually unanalyzed sign + non-manual amalgams, because subsequently (around 30 months), children dropped the non-manual, signing wh-signs with a blank face. Alternatively, they marked their wh-questions with an inappropriate non-manual marker, brow raise (also attested in the mothers' child-directed signing, particularly when the mother actually already knew the answer to the wh-question). Around 5 years of age, children combined wh-signs with brow raise, but restricted the scope of the non-manual to just the wh-sign. Only around 6 or 7 years of age did children finally manage proper coordination of wh-signs and the wh-non-manual with appropriate scope (see also Lillo-Martin (2000), discussed in section 5.2.1).

The error patterns described above for negatives and wh-questions, as well as those for other non-manuals investigated by Reilly and her colleagues, reveal an important generalization about how children approach the acquisition of grammatical non-manu-



Fig. 28.4: Wh-signs with blank face (left) and raised brows (right)

als: until children are able to coordinate the manual and non-manual components of structures that are normally (redundantly) marked by both, they systematically opt to preserve the manual channel, sacrificing the non-manual channel in an apparent “hands before faces” bias (Reilly 2006, 286). This bias is in contrast to the adult language, in which negative and question signs may remain unexpressed because their corresponding non-manual markers are sufficient to encode their illocutionary force.

A second generalization noted by Reilly and her colleagues relates to how children react when the same non-manual component serves as a grammatical non-manual marker for multiple distinct syntactic structures. Reilly and her colleagues noted that children’s strategies in this situation followed from the principle of unfunctionality (Slobin 1973), by which children initially assume a one-to-one mapping of grammatical form to function, and resist marking multiple construction types with the same marker. Brow raise is a salient feature of several grammatical non-manuals in ASL, including conditionals, yes-no questions, and topics. Prior to the age of 3 years, subjects in the Reilly studies began producing all three of these constructions, but only yes-no questions were correctly marked with brow raise (Reilly/McIntire/Bellugi 1991). Both topics (or more accurately, preposed objects that were plausible candidates for topics) and conditionals appeared without the obligatory brow raise. Instead, children marked these two structures from within the manual channel. Topics were signaled by moving the topic signs to the front of the clause (and possibly by marking them with prosodic patterns as described earlier by Chen Pichler (2010)). Conditionals were signaled by using lexical markers of conditionality (e.g. the signs *SUPPOSE* or *#IF*) that are optional in the adult system. Both of these strategies also lend further support for the “hands before face” bias mentioned earlier.

Finally, to the extent that some grammatical non-manuals resemble the communicative non-manuals for related affective reactions (e.g. the ASL wh-non-manual vs. non-manual indicating that one is puzzled or perplexed), it could be argued that these grammatical non-manuals are iconically motivated. If sign-exposed children are sensitive to the iconic link between communicative and grammatical facial non-manuals, they might potentially use the former, which are reportedly acquired early, in the first year of life (Hiatt/Campos/Emde 1979; Nelson 1987), to ‘break into’ the system of grammatical non-manuals in the target sign language. This again raises the question of whether this iconic link is recognized and exploited by the sign-exposed child, affecting the acquisition timetable. As we have seen, this does not appear to be the case. ASL

grammatical non-manuals are acquired fairly late, indicating that the potential iconic link between grammatical non-manuals and related affective non-manuals does not facilitate the acquisition process.

6. Discourse development

As children progress into their fifth year of life, their signing demonstrates increasing command of spatial syntax, classifiers, and non-manuals at the sentence level. However, children often require several more years before they are able to use these same syntactic devices appropriately at the discourse level, where additional pragmatic constraints come into play. This lag is quite apparent in the narratives of young signing children, which differ from those of adults in many respects. Research in this area has largely focused on the development of referential shift (also known as role shift or constructed action), a device commonly used in sign narratives (see chapter 17 for discussion). In adult signing, referential shift allows the signer to switch between narrating an event and showing a particular character's point of view of that same event. Shifts between the points of view of multiple characters within a single narrative are also possible. In both cases, adult signing includes a variety of features to ensure that referents can be properly distinguished and identified by the addressee. For example, as discussed by Reilly (2006), an adult signer using referential shift to express a direct quote by Baby Bear in a narrative about Goldilocks and the Three Bears would typically preface the shift by labeling the character whose perspective is about to be shown, by pointing to the locus previously established for baby bear, and/or signing *BABY BEAR*. As the actual referential shift begins, often with a physical shift to one side of the head and upper torso, the signer's eye gaze and non-manual expression change to reflect that of Baby Bear. Additionally, all instances of pronouns, verb agreement and other spatial syntax produced during referential shift are interpreted from the point of view of the character.

In a study of 28 Deaf, native ASL signers between ages 3;0 to 7;05, Reilly (2006) found that referential shift for direct quotes occurred in elicited narratives of even their youngest subjects, signaled by a disengagement of eye contact from the addressee. From 3 to 4 years of age, children also assumed non-manual expressions associated with the shifted character, but were inconsistent in their timing and scope until the age of 6 or 7 years. A similar pattern was reported by Lillo-Martin and de Quadros (2011) in a study of two Deaf children between 1;07 and 2;05, one acquiring ASL and the other LSB. Almost all instances of referential shift produced by these children were marked by changes in eye gaze and/or non-manual expression, with greater accuracy in scope and timing than was reported for the children in the Reilly (2006) study. This difference is likely a reflection of methodology: Lillo-Martin and de Quadros (2011) examined instances of referential shift that occurred spontaneously in natural production, a context imposing fewer cognitive demands than the elicited narratives of the Reilly (2006) study.

Both Reilly (2006) and Lillo-Martin and de Quadros (2011) reported that their youngest subjects were unreliable in labeling the character whose perspective was being represented by referential shift, often resulting in non-adult-like ambiguity. These

errors most likely stem from young children's oft-noted lack of awareness that others do not always share their knowledge and assumptions. Similarly, Morgan (2006) reported that young BSL signers between 4 and 6 years old occasionally used referential shifts to introduce new referents in their narratives, a function that is more appropriately accomplished with a noun phrase label. However, the majority of the British children's referential shifts were used to maintain previously introduced references, so it seems that even very young children are aware of this important pragmatic function of referential shift at the discourse level.

Well-formed sign narratives also require proper organization, including accurate sequencing of episodes within the narrative and pragmatically appropriate reference forms. Morgan (2006) elicited narratives from young BSL signers that included scenes in which two events co-occur. The youngest children (ages 4–6) focused on only one of the two events, and tended to overuse full noun phrases when referring to the same subject in successive sentences. Older children (ages 7–10) produced narratives that included both co-occurring events, but alternated between them without integrating them into a single scene. Only the oldest children in the study (ages 11–13) were able to convey simultaneous occurrence of both events, using entity classifiers in overlapping space and multiple instances of referential shift. Narratives such as these illustrate the complex integration of multiple syntactic devices that is required at the discourse level. It is not surprising, then, that children display a protracted course of acquisition for narratives that extends long after they have acquired sentence-level control of spatial syntax, classifiers, and non-manuals.

7. Acquisition in other contexts

The length of the current chapter testifies to the considerable and rapidly expanding literature that now exists regarding the acquisition of sign language as a first language. The vast majority of this literature, however, is limited to deaf signers with early exposure to the target sign language, only a tiny fraction of the total deaf population (about 5 % in the US, according to Mitchell/Karchmer 2004). As mentioned earlier, this bias has been intentional, reflecting a desire to understand how sign acquisition proceeds under the most optimal conditions, in order to have a baseline against which other types of acquisition can be compared. While studies of late-exposed signers abound (readers are referred to Mayberry/Locke (2003) and Emmorey (2002) as good starting points on this literature), very few test late signers during childhood. Yet childhood studies are crucial for revealing developmental divergences from the baseline. For example, previous studies have reported that control of basic word order is spared in adults who were exposed to ASL after age 12 (Newport 1990), suggesting that age of acquisition has little effect on word order. However, Lillo-Martin and Berk (2003), reporting on two late-exposed children in the two-sign stage, provided a more comprehensive developmental picture: these children not only relied mostly on canonical SVO word order, but their production of non-canonical orders was lower and significantly more prone to error than that of the native-signing children in Chen Pichler (2001). Unfortunately, systematic comparisons between early and late L1 signers in childhood of this type are still quite rare, despite the considerable baseline knowledge we have accumulated so far.

Another aspect of sign acquisition that still awaits further study is bilingual acquisition, as manifested in both deaf and hearing children. Research on spoken language bilinguals has shown us that these individuals display interesting inter-language effects, particularly during the early phases of development. These effects can significantly alter the course of acquisition, such that the early Croatian of a Croatian-Taiwanese bilingual can be quite different from that of a monolingual Croatian speaker at the same developmental stage. In addition to typical inter-language effects, sign-speech bilingualism also displays effects unique to bilingualism across modalities. For instance, van den Bogaerde and Baker (2005), Petitto et al. (2001), and Lillo-Martin et al. (2009) describe patterns of simultaneous mixing of spoken Dutch/NGT, spoken French/LSQ, spoken English/ASL, and spoken Portuguese/LSB, in the production of young bimodal bilinguals. Some of the earliest studies of L1 sign acquisition were actually conducted on hearing sign-speech bilinguals (e.g. Siedlecki/Bonvillian 1997), but researchers are only recently beginning to focus on the interaction of these children's developing grammars in two modalities. Fewer still have investigated sign-sign bilingualism (but see Pruss-Ramagosa 2001), an instantiation of bilingualism that is becoming increasingly common as Deaf adults become more internationally mobile. Because of the potential of these studies to uncover phenomena that do not occur in speech-only bilingualism, they contribute uniquely to our understanding of how the human mind organizes multiple languages, and how these develop and interact with one other (see also chapter 39 for discussion of bilingualism).

Finally, very little research has been conducted on the acquisition of sign language as a second language. Most existing reports in this area focus on phonological aspects of second language signing (Mirus/Rathmann/Meier 2001; Rosen 2004; Chen Pichler 2011; Ortega/Morgan 2010). Like the study of sign bilingualism, studies of second language signing have great potential to uncover modality-specific effects that do not occur in traditionally studied second language acquisition of a spoken or written language. There are also likely to be differences between learners who already know a sign language and those who do not. Some researchers adopt the term 'M1/L2 signers' for individuals who are learning a second sign language versus 'M2/L2 (second modality second language) signers' for those who are learning their first sign language. In addition to standard L2 effects, this latter group might be subject to additional effects of learning language in a new modality. The demand is growing for more research on M2/L2 acquisition as sign language courses rise in popularity across the US and other countries. Effective teaching methods for M2/L2 signers are also critical for hearing parents of deaf infants, who must learn a sign language as quickly and accurately as possible in order to provide accessible language exposure to their children.

8. Conclusions

The studies of sign language acquisition summarized in this chapter span just over four decades and have clearly demonstrated their importance for developing balanced and truly universal proposals about how children develop their first language. Acquisition studies have always served as crucial tests for linguistic theory, and in this sense sign acquisition studies are doubly useful, with the potential to inform us on issues of mo-

dality as well as learnability. For example, two of the studies mentioned in section 3 were explicitly designed to test current theoretical models of sign phonology: Karnopp (2008) for Dependency Phonology approaches to sign phonology (van der Hulst 1995) and Morgan, Barrett-Jones, and Stoneham (2007) for the Prosodic model proposed by Brentari (1998). In the realm of syntax, Lillo-Martin and de Quadros (2005) used acquisition data as a tool to judge between competing proposals on the direction of *wh*-movement in ASL.

The sign acquisition studies summarized here also reveal striking parallels with the acquisition of spoken languages, pointing to fundamental mechanisms that shape language development in either modality. At the same time, we are discovering important modality-specific phenomena that are equally important to linguistic inquiry, as they broaden our understanding of the possible ways in which the human brain perceives, acquires, and organizes language. The next task facing sign acquisition research is to replicate past findings with larger sample sizes and more diverse populations, including bilingual learners and learners with delayed exposure to signed input. More crosslinguistic studies will also remain important. Whereas ASL is disproportionately represented in this chapter, reflecting past research trends, there is now a rich and growing body of comparative work from other sign language communities, including some that have only recently been discovered. Propelled by such a burst of linguistic diversity, the next decades of sign acquisition research promise to be just as fruitful and thought-provoking as the first have been.

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