RECHERCHES LINGUISTIQUES DE VINCENNES

Recherches linguistiques de Vincennes

29 | 2000
Langage et surdité

Delayed Phonological Development in ASL : Two Case Studies of Deaf Isolates

Jill P. Morford

OpenEdition Journals

Electronic version
URL: http://journals.openedition.org/rlv/1202
DOI: 10.4000/rlv.1202
ISSN: 1958-9239

Publisher
Presses universitaires de Vincennes

Printed version
Date of publication: 1 May 2000
Number of pages: 121-142
ISBN: 2-84292-074-0
ISSN: 0986-6124

Electronic reference
Jill P. Morford, « Delayed Phonological Development in ASL : Two Case Studies of Deaf Isolates », *Recherches linguistiques de Vincennes* [Online], 29 | 2000, Online since 09 September 2005, connection on 22 April 2019. URL : http://journals.openedition.org/rlv/1202 ; DOI : 10.4000/rlv.1202

Recherches linguistiques de Vincennes 29 - 2000 - p. 121-142

Jill P. MORFORD*
University of New Mexico

DELAYED PHONOLOGICAL DEVELOPMENT IN ASL : TWO CASE STUDIES OF DEAF ISOLATES

ABSTRACT

The study of signed languages has enriched our general understanding of how language is acquired by humans. This article summarizes research on the acquisition of signed languages and reports the results of a three year longitudinal study of two deaf individuals who first learned American Sign Language (ASL) in adolescence. The study focuses on the mastery of the phonological parameter of handshape. Both individuals demonstrate relatively high levels phonological production accuracy within their first year of exposure to ASL. These results are discussed with respect to the issues of modality differences in language acquisition and why delayed language acquisition has long-term detrimental outcomes on language processing in adults.

KEYWORDS

Delayed language acquisition, handshape production, iconicity, language acquisition, language modality, phonological development.

1. Language Acquisition and Deafness

One area of psycholinguistics that has been enriched by the study of signed languages is language acquisition. The unique circumstances of language acquisition among deaf individuals allows several theoretical issues to be addressed that cannot be resolved from the study of spoken languages alone. Two primary issues are (1) how the modality of language and the sensory systems used for processing information in that modality affect language acquisition, and (2) how the age at which a child acquires a language affects acquisition. In other words, signed languages are informative to our understanding of language acquisition because they are composed of visual symbols produced in three-dimensional space and perceived with the eyes instead of the ears, and because they are acquired at different ages. In this article, I will briefly summarize previous research relevant to each issue, and describe a study that has implications for both.

2. Acquisition in the visual modality : similarities and differences with respect to spoken language acquisition

Prior to any systematic examination of signed languages, many people assumed that they were primarily pantomime or gesture. Even after pioneering research identified the presence of linguistic structures in signed languages (see Blondel & Tuller, this volume), many casual observers still assumed that signed languages would be easier to learn than spoken languages. In response to this widespread assumption, signed language acquisition research from the 1970s and 1980s focused primarily on whether the modality of signed languages facilitated their acquisition in some way.

2.1. Does iconicity facilitate acquisition ?

Many of the earliest studies of signed language acquisition were motivated by the question of whether or not the iconicity of signs made them easier to acquire than spoken words (e.g., Bellugi & Klima, 1982 ; Jackson, 1984 ; Meier, 1987 ; Orlansky & Bonvillian, 1984 ; Petitto, 1987). Orlansky and Bonvillian (1984), for example, investigated this question by grouping the earliest signs that children learned into iconic vs. non-iconic signs. They found that children acquiring a signed language as their primary language in childhood do not learn iconic

signs first. Their vocabularies are a mixture of iconic and non-iconic signs, determined by semantics rather than form.

Other researchers addressed this question by observing the acquisition of a grammatical morpheme and asking whether the pattern of acquisition was predicted by the iconicity of the signs, or the grammatical complexity. For example, Jackson (1984) studied the acquisition of possessive pronouns in a hearing child of deaf parents who was learning both American Sign Language (ASL) and English. The possessive form in ASL is clearly iconic. The first person possessive pronoun is produced by placing the outstretched hand on the chest (MY/MINE). This same handshape is directed to other possessors to indicate the other possessive pronouns. If iconicity guides acquisition, Jackson reasoned, the child acquiring both ASL and English should master possessive pronouns in ASL first, and in English at a later age. Alternatively, if grammatical considerations guide acquisition, possessive pronouns should be learned at approximately the same ages in both languages. Jackson found that the iconicity of ASL possessive pronouns did not account for their acquisition. Her subject first used proper names instead of pronouns to indicate possession in ASL, and even after possessive pronouns were beginning to be mastered, the child some-times substituted names. The same pattern was observed simultaneously for possessive pronoun mastery in English (cf. Meier, 1987 for acquisition of verb agreement in ASL and Petitto, 1987 for acquisition of personal pronouns in ASL).

In general, there is little evidence that iconicity facilitates acquisition. It would be premature to conclude that iconicity plays NO role in the acquisition of signed languages since there may be times that children exploit the iconicity of signs to increase their communicative competence. However, the studies described here all indicate that many of the same factors that influence acquisition of spoken languages, such as semantic relevance and grammatical complexity, influence acquisition in the visual modality as well. Moreover, these factors appear to dominate iconicity in the earliest stages of acquisition.

2.2. The timing of signed language acquisition

A second issue related to modality is whether signed language acquisition follows the same time course as spoken language acquisition given the different developmental timetables for the sensory systems involved. This question was most thoroughly investigated for the acquisition of first signs and the acquisition of the first ten signs (see Bonvillian & Folven, 1987, and Volterra & Iverson, 1995, for review and

discussion). Several investigators have reported that signing children produce their first signs several months before speaking children produce their first words. Other researchers have criticized these conclusions. At issue is whether the earliest communication of signing children are indeed « signs » or gestures, imitations of signs, and manual babbling. Other researchers suggested that the « sign-advantage » was real, but could be explained by factors such as earlier motor development of the hands than the vocal tract, better detection of early signs than early words by parents, and the ability of parents of signing children to mold the articulators (Bonvillian *et al.*, 1983 ; Meier & Newport, 1990). According to this view, there are no major differences in the language abilities of children acquiring signed and spoken languages, but modality factors allow children acquiring signed languages to produce RECOGNIZABLE signs several months before speaking children can make their first words understood. Subsequent research on the production of referential signs vs. words (i.e., signs and words that are produced in novel contexts), revealed no significant difference in age of onset (Folven & Bonvillian, 1991). This research provides additional support for the view that any differences in early language production are differences in performance and not in competence.

2.3. Modality and phonological development

More recently, research on signed language acquisition has investigated phonological development (see Cuxac, this volume, and Miller, this volume, for discussion of phonological structure in signed languages).

Most current analyses of the acquisition of phonological form are based on Stokoe's (1960) division of signs into three parameters — handshape, location and movement. Changing just one of these parameters while keeping the others the same can result in a sign with a completely different meaning. For example, in French Sign Language the sign meaning ÉDUCATEUR uses the same location and movement parameters as the sign SURVEILLANT, but the two signs differ in handshape. Thus, these parameters are considered essential components of the form of signs — meaningless alone, but capable of changing the meaning when produced in combination with other parameters. Analyses of these phonological parameters provide evidence of both similarities and differences with respect to phonological development in children acquiring spoken languages [1].

2.3.1. Differences in phonological development across modality

One question that concerns researchers of phonological development is the order in which phonemes are acquired. Children acquiring both signed and spoken languages exhibit variability in the order of acquisition of phonemes, but this variability is qualitatively different across modality. One remarkable difference in signed language phonological development is the very early mastery of one phonological parameter : location.

Several studies of ASL phonological development find that children as young as one to two years old display mastery of the location parameter of signs at levels ranging from 81 %-89 % accuracy (Conlin *et al.*, 2000 ; Marentette & Mayberry, 2000). Moreover, relatively few substitutions are made for this parameter. Marentette & Mayberry (2000 : 87) have proposed that children use a « body schema as an initial representation of this parameter. » In other words, the location primes appear to be mastered as soon as children are aware of the existence of a location on their bodies, and substitutions can be explained by children's confusions of anatomically related body parts. The development of this parameter is quite unlike the development of the other parameters of signs (movement [2] and handshape), as well as the development of spoken language phonemes or features.

2.3.2. Similarities in phonological development across modality

Most parallels between spoken and signed language phonological development concern handshape. For example, there are constraints on the first handshapes that children acquire. Just as children acquiring spoken languages are likely to master those phonemes first that are easiest to produce (Sander, 1972) and most frequent (Ingram, 1992), children acquiring signed languages also acquire certain handshapes earlier than others. Several investigators have provided evidence that the earliest handshapes acquired are among the easiest to produce (Boyes-Braem, 1973/1990 ; McIntire, 1977 ; Siedlecki & Bonvillian, 1997) and the most frequent in the target language (Marentette & Mayberry, 2000). Accurate handshape production is also constrained by the locations and movements with which the handshape is combined just as accurate phoneme production in spoken words is influenced by the neighboring phonemes (McIntire, 1977 ; Siedlecki & Bonvillian, 1997). Similar factors appear to influence handshape substitution.

Further, Marentette & Mayberry (2000) propose that handshape substitutions are also constrained by phonological features that the target and the substitution have in common, such as finger selection and extension. This finding parallels the tendency of children acquiring spoken languages to substitute phonemes that share features such as voicing or place of articulation.

These studies show that there are some parallels in phonological development despite modality differences, particularly in the area of handshape acquisition. However, the results are not as straightforward as for acquisition phenomena at the level of the sign. Both areas indicate that the development of motor and perceptual systems may influence acquisition milestones even though there is no evidence for differences with a linguistic basis per se between language development in one modality or the other (see Volterra & Iverson, 1995, for additional discussion of this issue).

3. When language acquisition does not begin at birth

Spoken languages are acquired by hearing individuals almost without exception from birth. In contrast, deaf individuals acquire signed languages at widely varying ages. A variety of factors can influence the age that a deaf child is first exposed to a signed language, including the age that deafness is diagnosed, the hearing status of the parents, the regional educational philosophies and options, the availability of sign language models, and cultural attitudes about deafness and signing. As research in the previous sections suggests, children acquiring a signed language from deaf parents (i.e., from birth) master language in much the same way as children acquiring spoken languages. In this section, I review research reporting on the outcomes of language acquisition that does not begin at birth.

3.1. Communication prior to language exposure : Homesign

One of the most striking outcomes of delayed acquisition is how deaf children who are not able to speak communicate prior to exposure to a signed language. These children use gesture in innovative ways to fulfill their communicative needs. The extensive use of gesture by deaf children is called HOMESIGN because it is a signed language created at home. Comparisons of children using homesign systems with children

using spoken or signed languages reveal interesting similarities and differences in early communicative development (see Morford, 1996 for a review). Two of the most important similarities are the stability of the homesign lexicon over several years of signing (Goldin-Meadow, Butcher, Mylander & Dodge, 1994), and the sign order regularities observed in homesign usage cross-culturally (Goldin-Meadow & Mylander, 1998).

Some differences have also been observed in the use of homesign systems. For example, Morford & Goldin-Meadow (1997) found that although homesigners use their gestures for reference to non-present objects and events, they do so much more rarely and with a developmental delay when compared with hearing children acquiring a spoken language. These results suggest that although children can generate communication systems that have structural and functional similarities to natural languages, their development may suffer from the different frequencies and types of interactions they engage in with their families as a result of not sharing a common language.

3.2. Delayed Language Acquisition

There are a few studies documenting homesign usage in adolescents and adults (Morford, 1996), but these cases are rare since most deaf individuals eventually learn to use a spoken or a signed language. In contrast, a growing body of literature reports the long-term outcomes of ASL acquisition by deaf individuals who first started learning it in adolescence or later. These studies investigate a phenomenon that is not paralleled in the literature on spoken language acquisition, that is, how a first language is mastered following a period of linguistic isolation in childhood.

There are a few characteristics of signed language mastery that do not seem to be affected by delayed exposure. The use of SVO sign order in ASL was comparable in native and delayed language learners in a study reported by Newport (1990) [3] and the speed of signing was comparable in native and delayed language learners in a study reported by Mayberry (1993). In contrast to these two measures of signed language production, most comparisons between native signers and delayed signers demonstrate significant differences in their language processing skills.

Mayberry and her colleagues (Mayberry & Fischer, 1989 ; Mayberry & Eichen, 1991 ; Mayberry, 1993) have studied the ability of delayed language learners to comprehend ASL by asking subjects to perform a task called SENTENCE RECALL. Subjects view a videotape of a native signer producing a sentence in ASL, and repeat the sentence as soon as it is complete. This task, which may seem relatively simple on first reflection, typically leads to some errors once the sentence exceeds the amount of information we can retain in short term memory [4]. Even native signers produce errors when performing this task. However, the errors produced by native signers are different than those produced by delayed language learners, even learners who began to acquire ASL as early as age five. Native signers will typically replace a sign with a synonym or a related sign, retaining the general gist of the sentence being recalled. This type of error suggests that the native signer has comprehended the sentence so rapidly that much of the phonological information used to access lexical entries is no longer active in memory. Delayed language learners also make this type of error, but they make a second type of error as well. Some signs in the target sentence are replaced by signs that are phonologically related to the target signs, but have no semantic relation. For example, Mayberry & Fischer (1989) report that one subject replaced the sign AND with the sign SLEEP. Both signs have the same handshape and movement parameters, but they differ in location. According to Mayberry (1994 : 74), « […] the nonnative signer may produce phonological lexical substitutions in the course of language processing because he or she cannot easily (*i.e.*, without cognitive effort) identify signs and retrieve meaning. This would mean that the nonnative signer must pay more attention to the surface phonological structure of signs than the native signer. » This difference in processing cannot be accounted for by differences in short term memory or years of experience using the language (Mayberry & Eichen, 1991). It appears to be related only to the age that the individual first learned ASL.

Mayberry's explanation for the propensity of delayed learners to produce phonological lexical substitutions is consistent with the results of a study by Emmorey & Corina (1990). These investigators asked subjects to guess the identity of a sign from viewing only short segments cut from the sign onset. The subjects identified the signs on average after only 239 msec, or after seeing approximately one third of the sign signal. However, native signers consistently identified the sign one

video frame (about 33 msec) earlier than delayed signers. It follows that native signers are able free their attention from phonological information earlier than delayed signers in order to focus on deeper levels of processing, such as semantic integration [5].

4. Two case studies of delayed phonological development in ASL

One issue raised by research on delayed language development is how to best explain the observed deficits in language processing. One possible explanation is that delayed learners have difficulty mastering the phonological structure of signs, and as a result, process signs differently than native signers. Alternatively, phonological processing could occur in much the same way as in native signers, but much more slowly, subsequently affecting all other levels of processing.

Data are presented here from two case studies of delayed learners of ASL in order to investigate their mastery of the phonological structure of signs. The data comprise one observation of each participant prior to any regular exposure to ASL, followed by regular observations of the participants' signing over the first three years after exposure to ASL.

4.1. Participants

Participant 1 is a female who was born with a profound bilateral cochlear hearing loss (> 90 dB in the better ear). Deafness was diagnosed at two years of age. Hearing was not corrected until after the onset of this study. The participant used no speech, but did communicate with her family in homesign at the onset of the study. She was exposed to ASL at the age of 13 ; 7 (years ; months) in a school environment in which a mixture of ASL and varieties of Signed English were in use. The first year of her enrollment in the school, her teacher was a non-native signer, but preferred to use ASL over Signed English and did not speak and sign simultaneously. In subsequent years, her teachers used a mixture of ASL and Signed English. In the first year of her enrollment in the school there was one student who was a native signer in her class.

Participant 2 is a male who was born profoundly deaf. Hearing was not corrected until after the onset of the study. Even after the onset

of the study, the participant chose not to use his hearing aids. According to parental report, the participant could say three words : « What », « Papa » and « Mama, » but depended primarily upon homesign to communicate with his family at the onset of the study. He was exposed to ASL at age 12 ; 1 in the same school and classroom environment as Participant 1.

4.2. Method

Both participants were videotaped once in the home in the week prior to enrollment in a school for the deaf (Participant 1) or in the first week of enrollment in a school for the deaf (Participant 2). Participants were subsequently videotaped at regular intervals over the following three years. Data for this study will be reported from the initial taping session, plus the taping sessions following 1, 3, 9, 20 and 32 months of exposure to ASL for Participant 1, and following 1, 3, 7, 19 and 30 months of exposure to ASL for Participant 2. Participants engaged in a variety of activities during filming, including spontaneous interaction, looking at picture books, retelling wordless stories, playing a picture matching game that required them to describe pictures on a card to another player, and forming storylines from picture cards. Participants also interacted with a variety of interlocutors, including family members, teachers, classmates, native signing research assistants, and the author.

The handshape production of the participants was analyzed by transcribing the first 50 sign or gesture tokens and the first 50 sign or gesture types from each taping session. Transcription included 1) whether an ASL sign or a gesture was used, 2) identifying the target ASL sign or the meaning of the gesture, and 3) identifying the actual handshape produced. [6] Handshapes that could not be reliably coded were combined into a single category. Two coders independently transcribed the data. Eight percent of the data were coded by both coders and analyzed for reliability. Intercoder agreement for identification of signs was 87 % (agreements/agreements + disagreements). Intercoder agreement for identification of handshape was 88 %. Some examples of disagreements for handshape coding are [S] *vs.* [A], and [5] *vs.* [B] [6]. In most cases only a single feature differed (e.g., thumb placement, spread, index extension).

4.3. Results

Both participants used homesign gestures to communicate with their families prior to their exposure to ASL. Previous studies show that an individual's homesign can influence subsequent acquisition of a signed language (Morford, Singleton & Goldin-Meadow, 1995). Thus, it was necessary to identify the primary handshapes in use in each participant's homesign system. Fifty homesign tokens were transcribed from the initial taping session to provide a sample of the most commonly produced handshapes in homesign comparable to the samples to be analyzed for ASL. Both participants used very reduced inventories of handshapes in this sample. Both participants used eight handshape primes in this sample (see Table 1) [7]. An analysis of homesign types had similar results. Again, both participants used very reduced inventories of handshapes in this sample. Participant 1 produced ten handshape primes and Participant 2 produced nine handshape primes (see Table 1). The token and type analyses do not produce dramatically different results. Both analyses indicate that the two homesign systems used by these participants relied primarily on a small inventory of handshapes. These results are consonant with previously published studies on the formational characteristics of homesign systems (*cf.* Kendon, 1980; Goldin-Meadow, Mylander & Butcher, 1995).

Table 1

Handshapes Used Prior to ASL Exposure

	Tokens (n = 50)	Types (n = 50)
Participant 1	[5, 5h, Bb, 1, 1o, A, S, O]	[5, 5h, Bb, 1, 1o, A, S, O, Ô, B]
Participant 2	[5, 5h, B, C, 1, A, S, Ô]	[5, 5h, B, C, 1, A, S, Ô, 1h]

Turning now to the primary purpose of this study, the remaining analyses were carried out on the participants' signing after exposure to ASL to determine the accuracy of handshape production, the order in which handshapes were acquired, and the patterns of substitutions. The first analysis concerns the accuracy of handshape production. Were the older learners in this study able to produce the handshapes of ASL signs

accurately ? Table 2 reports the accuracy of handshape production for both tokens and types. The token sample provides an indication of the accuracy of handshape production in a typical conversational context in which many of the same signs are repeated. The fact that accuracy is slightly higher for the type analysis demonstrates that the inaccurately produced handshapes are recurring in some of the same signs. The results of this analysis show that within a year of exposure to ASL, both participants had a very high level of mastery over ASL handshape primes relative to native learning child signers with similar amounts of exposure. Child signers typically produce handshape with only 25 % accuracy (Conlin *et al*., 2000 ; Marentette & Mayberry, 2000) in their first year of signing (ages 1 ; 0 to 2 ; 0). In contrast, Participant 1 produced the handshape primes with better than 80 % accuracy after just 3 months exposure to ASL for both the token and type analyses, and Participant 2 produced the handshape primes with about 70 % accuracy in the token analyses and 80 % accuracy or better in the type analyses after 9 months exposure to ASL. There was relatively little improvement in accuracy after these observations, indicating that both participants had reached a stable level of handshape production within the first year of exposure to ASL.

Table 2

Accuracy of Handshape Production by Months Exposure to ASL

	Months Exposure to ASL					
Token Accuracy	1	3	7-9	19-20	30-32	Mean
Participant 1	.65	.96	.98	.92	.90	.88
Participant 2	.35	.58	.78	.69	.76	.63
Type Accuracy	1	3	7-9	19-20	30-32	Mean
Participant 1	.73	.84	.98	.96	.96	.89
Participant 2	.50	.67	.86	.83	.82	.73

The order of handshape acquisition also did not parallel findings for child signers. Boyes-Braem (1973/1990) describes four levels of handshapes in terms of the difficulty of production. Table 3 lists the handshapes each participant produced in the first sample collected after exposure to ASL, as well as its level of difficulty in Boyes-Braem's framework [8]. At the top portion of the table, it is evident that both participants drew heavily upon the handshapes used in their respective homesign systems. Interestingly, all of these handshapes can be classified as Level 1 or Level 2 handshapes. In contrast, the newly acquired handshapes from this initial exposure to ASL are primarily Level 3 handshapes. Thus, it appears that prior to exposure to ASL, the participants used handshapes that were relatively easy to produce. It is not surprising that these handshapes are also among the first used after exposure to ASL. The interesting observation from this table is that within only a short time of the participants' initial exposure to ASL, they added handshapes to their inventory that were from the higher levels of handshape production difficulty. Thus, in contrast to child learners, delayed learners of ASL do not begin with a small set of handshapes that are easy to produce. They begin by acquiring handshapes of differing levels of difficulty.

How many of the ASL handshape primes did the participants acquire over the three year period of the study? Recall that some handshape primes were collapsed into a single category since they could not be reliably coded from the videotapes. The 47 ASL handshape primes coded were collapsed into 39 handshape categories. By the final coding session, Participant 1 had produced at least one token of 31 of the 39 ASL handshape categories (80%), and Participant 2 had produced one token of 26 of the 39 ASL handshape categories (67%). It seems then, that by the end of the three year period, both participants had learned to articulate a majority of the handshape primes of ASL.

The last analysis considers whether the pattern of substitutions suggests a phonological organization of target and substitution primes. Table 4 lists the substitutions that affected more than one sign type. Each participant also produced several substitutions that affected only one sign type. These substitutions will not be considered here. Although the substitution rate was much lower for the delayed learners than for child learners, there is nevertheless an important parallel to the substitutions made by much younger children. Namely, the most frequent substitution for children (Marentette & Mayberry, 2000; Siedlecki & Bonvillian, 1997),

Table 3
Handshape Inventory of First Observation After Exposure to ASL

Participant 1	Participant 2	Level of Difficulty
5*	**5**	1
5h	**5h**	Not classified
C	**C**	1
1	**1**	1
A	**A**	1
S	**S**	1
Ô	**Ô**	Not classified
B	**B**	2
	O	2
V	V	3
F	F	2
V'		3
W		3
	Y	3

*Note : Boldface letters represent handshapes that were observed in the participant's homesign.

as well as for the participants in this study, was the handshape prime [5]. According to Marentette & Mayberry (2000), this handshape was used by their participant to replace the handshape primes [B, 5h, C, and Bb]. In the current study, both participants only systematically used the [5] handshape prime as a substitute for [B] [9]. Participant 2 also substituted the prime [5h] for the prime [C], and the primes [V and V'] for the primes [U and U']. One explanation that is consistent with all of these substitutions is that participants used a relaxed hand in the production

of the unspread handshape primes [B, C, U, U'], resulting in the spread handshape primes [5, 5h, V, V'].

Table 4

Substitutions Affecting More Than One Sign Type

	Target	Substitution	Tokens	Types
Participant 1	B	5	7	3
Participant 2	B	5	27	10
	C	5h	7	3
	U, U'	V, V'	3	2

4.3.1. Preliminary Conclusions

In sum, the mastery of handshape by delayed learners of ASL can be characterized by a high rate of accuracy within the first year of language exposure, the addition of handshapes that are fairly complex motorically within weeks of first exposure, and the production of very few substitutions. All of the analyses suggest that these participants did not have difficulties mastering the phonological parameter of handshape despite the delayed onset of their exposure to ASL. These results indicate that the processing deficits of delayed learners are more likely due to slow and inefficient processing of the phonological parameters of ASL signs than to difficulties recognizing and identifying the phonological parameters of ASL signs during processing.

5. Modality differences in delayed language acquisition

The results of this study are rather striking when compared to what we know about delayed language acquisition of spoken languages. A number of investigations of second language learners of spoken languages have concluded that the phonology of a spoken language can rarely be mastered after early childhood (e.g., Asher & Garcia, 1969; Oyama, 1976). The participants in this study demonstrated fairly high levels of accuracy shortly after their initial exposure to ASL despite the fact that they were adolescent learners. Moreover, the majority of sub-

stitutions they produced might not be identified by signers as ERRORS since they involved producing the target sign with a more relaxed handshape. Indeed, the participants' teacher produced many of these signs in precisely the same way. These results suggest that mastery of the phonological parameter of handshape may be possible much later than has been proposed for the mastery of spoken language phonology. Additional investigation of the delayed acquisition of other segmental as well as prosodic characteristics of signed languages are critical to a fuller understanding of phonological development in the manual modality, and the effects of delaying acquisition on long-term outcomes.

NOTES

* This research was supported in part by a grant from the Fondation Charles Cusson and a McGill University Graduate Faculty Research Grant. I am very grateful for the cooperation of the participants and informants, and to Laurice Tuller for feedback on a previous version of this manuscript. Direct correspondence to Jill P. Morford, Dept. of Linguistics, Humanities 526, University of New Mexico, Albuquerque, NM 87131-1196 or to morford@unm.edu.

1. See Petitto & Marentette, 1991, and Masataka, 2000, for research on manual babbling, which precedes the production of signs.
2. Acquisition of the movement parameter of signs is not as uniform as other areas, and will not be addressed in detail in this article. See Conlin *et al*. (2000) for interesting discussion.
3. In this context it is interesting to note that this is also a characteristic of English that was mastered by a hearing delayed language learner, although this individual did not master other English word orders such as WH-question formation and subject-auxiliary inversion (Curtiss, 1977). It is also a characteristic of English that second language learners master as well as native learners (Johnson & Newport, 1989).
4. To try this task yourself, write down the exact wording of this sentence once you have read it without looking at it again until you have written all that you can remember.
5. Differences in the performance of native signers vs. delayed language learners have also been documented for the production and comprehension of ASL morphology (Newport, 1990) and for error detection of morphologically inappropriate sentences in ASL (Emmorey *et al*., 1995).
6. See Appendix 1 for a key to the handshape notation system.
7. Participant 2 also produced one homesign using only his feet.
8. The use of an elicitation procedure could provide more definitive evidence of the participants' control over specific handshape primes. Since naturalistic

data are used in this study, the results are a reflection of the handshapes that are used most frequently and most spontaneously by the participants.

9. Participant 2 was also observed to replace the prime [5h] with the prime [5], but because these primes could not be reliably coded, this substitution will not be addressed.

REFERENCES

ASHER, James J. ; GARCIA, Ramiro (1969). The optimal age to learn a foreign language. *Modern Language Journal* 53-5 : 334-341.

BELLUGI, Ursula ; KLIMA, Edward S. (1982). The acquisition of three morphological systems in American Sign Language. *Papers and Reports on Child Language Development* 21 : K1-K35.

BONVILLIAN, John D. ; FOLVEN, Raymond J. (1987). The onset of signing in young children. In Edmonson, W.H. & Karlsson, F. (eds.). *SLR '87 : Papers from the Forth International Symposium on Sign Language Research*. Clevendon : Multilingual Matters.

BONVILLIAN, John D. ; ORLANSKY, Michael D. ; NOVACK, Lesley L. (1983). Developmental milestones : Sign language acquisition and motor development. *Child Development* 54 : 1435-1445.

BOYES-BRAEM, Penny (1973/1990). Acquisition of the handshape in American Sign Language. In Volterra, V. & Erting, C.J. (eds.). *From gesture to language in hearing and deaf children* : 107-127. New York : Springer Verlag.

CONLIN, Kimberly E. ; MIRUS, Gene R. ; MAUK, Claude ; MEIER, Richard P. (2000). The acquisition of first signs : Place, handshape, and movement. In Chamberlain, C., Morford, J.P. & Mayberry, R.I. (eds.). *Language Acquisition by Eye* : 51-69. Mahwah, NJ : Lawrence Erlbaum Associates.

CURTISS, Susan (1977). *Genie : A Psycholinguistic Study of a Modern-Day 'Wild-child'*. New York : Academic Press.

EMMOREY, Karen ; BELLUGI, Ursula ; FREDERICI, Angela ; HORN, Petra (1995). Effects of age of acquisition on grammatical sensitivity : Evidence from on-line and off-line tasks. *Applied Psycholinguistics* 16 : 1-23.

EMMOREY, Karen ; CORINA, David (1990). Lexical recognition in sign language : Effects of phonetic structure and morphology. *Perceptual and Motor Skills* 71 : 1227-1252.

FOLVEN, Raymond J. ; BONVILLIAN, John D. (1991). The transition from nonreferential to referential language in children acquiring American Sign Language. *Developmental Psychology* 27-5 : 806-816.

GOLDIN-MEADOW, Susan ; BUTCHER, Cynthia ; MYLANDER, Carolyn ; DODGE, Mark (1994). Nouns and verbs in a self-styled gesture system : What's in a name ? *Cognitive Psychology* 27 : 259-319.

GOLDIN-MEADOW, Susan ; MYLANDER, Carolyn (1998). Spontaneous sign systems created by deaf children in two cultures. *Nature* 391 : 279-281.

GOLDIN-MEADOW, Susan ; MYLANDER, Carolyn ; BUTCHER, Cynthia (1995). The resilience of combinatorial structure at the word level : Morphology in a self-styled gesture system. *Cognition* 56 : 195-262.

KENDON, Adam (1980). A description of a deaf-mute sign language from the Enga Province of Papua New Guinea with some comparative discussion. Part III : Aspects of utterance construction. *Semiotica* 32 (3/4) : 245-313.

INGRAM, David (1992). Early phonological acquisition : A cross-linguistic perspective. In Ferguson, C.A., Menn, L. & Stoel-Gammon, C. (eds.). *Phonological Development : Models, Research, Implications* : 423-35. Timonium, MD : York Press.

JACKSON, Catherine A. (1984). Which is MINE/mine ? Acquisition of Possessives in ASL and English. *Papers and Reports on Child Language Development* 23 : 66-73.

JOHNSON, Jacqueline S. ; NEWPORT, Elissa L. (1989). Critical period effects in second-language learning : The influence of maturational state on the acquisition of English as a second-language. *Cognitive Psychology* 21 : 60-99.

MARENTETTE, Paula F. ; MAYBERRY, Rachel I. (2000). Principles for an emerging phonological system : A case study of early ASL acquisition. In Chamberlain, C., Morford, J.P. & Mayberry, R.I. (eds.). *Language Acquisition by Eye* : 71-90. Mahwah, NJ : Lawrence Erlbaum Associates.

MASATAKA, Nobuo (2000). The role of modality and input in the earliest stages of language acquisition : Studies of Japanese Sign Language. In Chamberlain, C., Morford, J.P. & Mayberry, R.I. (eds.). *Language Acquisition by Eye* : 3-24. Mahwah, NJ : Lawrence Erlbaum Associates.

MAYBERRY, Rachel I. (1993). First-language acquisition after childhood differs from second-language acquisition : The case of American Sign Language. *Journal of Speech and Hearing Research* 36 : 1258-1270.

MAYBERRY, Rachel I. (1994). The importance of childhood to language acquisition : Evidence from American Sign Language. In Goodman, J.C. & Nusbaum, H.C. (eds.). *The development of speech perception : The transition from speech sounds to spoken words* : 57-90. Cambridge, MA : MIT Press.

MAYBERRY, Rachel I. ; EICHEN, Ellen B. (1991). The long-lasting advantage of learning sign language in childhood : Another look at the critical period for language acquisition. *Journal of Memory & Language* 30 : 486-512.

MAYBERRY, Rachel I. ; FISCHER, Susan D. (1989). Looking through phonological shape to sentence meaning : The bottleneck of non-native sign language processing. *Memory and Cognition* 17 : 740-754.

MCINTIRE, Marina L. (1977). The acquisition of American Sign Language hand configurations. *Sign Language Studies* 16 : 247-266.

MEIER, Richard P. (1987). Elicited imitation of verb agreement in American Sign Language : Iconically or morphologically determined ?. *Journal of Memory and Language* 26-3 : 362-376.

MEIER, Richard P. ; NEWPORT, Elissa L. (1990). Out of the hands of babes : On a possible sign advantage in language acquisition. *Language* 66 : 1-23.

MORFORD, Jill P. (1996). Insights to language from the study of gesture : A review of research on the gestural communication of non-signing deaf people. *Language and Communication* 16-2 : 165-178.

MORFORD, Jill P. ; GOLDIN-MEADOW, Susan (1997). From here and now to there and then : The development of displaced reference in homesign and English. *Child Development* 68-3 : 420-435.

MORFORD, Jill P., SINGLETON, Jenny L., & GOLDIN-MEADOW, Susan (1995). From homesign to ASL : Identifying the influences of a self-generated childhood gesture system upon language proficiency in adulthood. In D. MacLaughlin & S. McEwen (eds.), *Proceedings of the 19th Boston University Conference on Language Development* : 104-113. Somerville, MA : Cascadilla Press.

NEWPORT, Elissa L. (1990). Maturational constraints on language learning, *Cognitive Science* 14 : 11-28.

ORLANSKY, Michael D. ; BONVILLIAN, John D. (1984). The role of iconicity in early sign language acquisition. *Journal of Speech and Hearing Disorders* 49-3 : 287-292.

OYAMA, Susan (1979). The concept of the sensitive period in developmental studies. *Merrill-Palmer Quarterly* 25 : 83-103.

PETITTO, Laura A. (1987). On the autonomy of language and gesture : Evidence from the acquisition of personal pronouns in American Sign Language. *Cognition* 27-1 : 1-52.

PETITTO, Laura A. ; MARENTETTE, Paula (1991). Babbling in the manual mode : Evidence for the ontogeny of language. *Science* 251 : 1493-1496.

SANDER, E.K. (1972). When are speech sounds learned ? *Journal of Speech and Hearing Disorders* 37 : 55-63.

SIEDLECKKI, Theodore ; BONVILLIAN, John D. (1997). Young children's acquisition of the handshape aspect of American Sign Language signs : Parental report findings. *Applied Psycholinguistics* 18 : 17-39.

STOKOE, William C. (1960). *Sign language structure*. Silver Springs, MD : Linstok Press.

VOLTERRA, Virginia ; IVERSON, Jana M. (1995). When do modality factors affect the course of language acquisition ? In Emmorey, K. & Reilly, J. (eds.). *Language, gesture and space* : 371-390. Hillsdale, NJ : Lawrence Erlbaum Associates.

RÉSUMÉ

L'étude des langues signées a contribué à améliorer notre compréhension du processus d'acquisition du langage par l'être humain. Cet article résume la recherche sur l'acquisition des langues des signes et présente les résultats d'une étude longitudinale sur trois ans concernant deux sourds n'ayant appris la langue des signes américaine (ASL) qu'à l'adolescence. Cette étude est ciblée sur la maîtrise du paramètre phonologique de la configuration manuelle. Les deux sujets font preuve d'une compétence relativement bonne en production phonologique durant la première année d'exposition à l'ASL. Ces résultats sont étudiés en rapport avec les effets des différences de modalité dans l'acquisition et avec la question de savoir pourquoi l'acquisition tardive a des conséquences négatives à long terme sur le développement du langage chez l'adulte.

MOTS-CLÉS

Acquisition du langage tardive, production de la configuration manuelle, iconicité, acquisition du langage, modalité linguistique, développement phonologique.

APPENDIX 1 : HANDSHAPE NOTATION

Handshape	Notation
	5
	5h
	C
	1
	A
	S
	Ô
	B
	O
	V

Handshape	Notation
	F
	V’
	W
	Y
	U
	U’
	Bb
	lo
	lh