Grammatical development in adolescent first-language learners*

JILL P. MORFORD

Abstract

Studies of first-language acquisition in adolescence are very rare and depend primarily on comprehension measures to evaluate grammatical knowledge. These studies have led to the general conclusion that grammatical development in adolescence is severely impaired and performance is highly variable both within and across individuals. This article is the first to present longitudinal production data on two deaf adolescents as they are acquiring their first language, American Sign Language (ASL), at the ages of 12;1 and 13;7. Analyses of the production of two complex predicate types indicate that these individuals made consistent progress in the acquisition of these structures during the first 31 months of their exposure to ASL. A subsequent study investigates their comprehension abilities after seven years’ exposure to ASL and reveals similar disruptions in comprehension relative to other adult signers who learned ASL in adolescence. However, the degree of disruption varies with the level of processing demands. One explanation of the data is that adolescent first-language learners are particularly sensitive to performance factors and can only show their knowledge of language under ideal conditions. This implies that adolescent first-language learners continue to suffer from linguistic isolation even after being exposed to language because they cannot process the language efficiently enough to recognize patterns in the input under normal conditions. According to this view, deficits in performance relative to native signers are due not solely to lack of grammatical competence, but to closely related problems in processing.

Introduction

For the last thirty years, the famous case of “Genie,” a young girl who was severely neglected and abused from the age of 20 months until 13;7
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(years;months), has been the textbook example of first-language acquisition in adolescence. Susan Curtiss, who published the most extensive report of Genie’s acquisition of language, was very clear about the fact that Genie’s development was influenced by factors such as malnutrition, neglect, and abuse in addition to her linguistic isolation (Curtiss 1977). Nevertheless, the case has been extremely important to our current understanding of the effects of delaying exposure to language. Most often, the case is used to provide support for the theoretical view that learning the grammar of a language is particularly impaired if delayed until adolescence, because although Genie learned “to produce immature pidgin-like sentences,” she is “permanently incapable of mastering the full grammar of the language” (Pinker 1994: 291–292). Actually, according to Curtiss, Genie almost never produced any sentences at all. The data available to document Genie’s language development are made up primarily of Genie’s responses to a set of comprehension tasks. We know very little about what language development in adolescent learners looks like from the perspective of their spontaneous productions. This article describes the language use of two deaf adolescent first-language learners of American Sign Language (ASL). These individuals were not raised in isolation and already had well developed social and cognitive skills at the time of their first exposure to ASL. They were also eager learners of ASL who signed every day and thus provide us with an alternative and complementary view of adolescent first-language acquisition.

**Delayed acquisition of spoken language**

Two bodies of research are particularly relevant to the issue of adolescent first-language acquisition: (1) case studies of the rare individuals who are not exposed to spoken language until adolescence, and (2) studies of the more common experience of deaf individuals who cannot hear the spoken languages they are exposed to, and who are not exposed to a signed language until adolescence. Each of these areas of research will be reviewed briefly, in turn.

The case of Genie (Curtiss 1977) is by far the most well known study of adolescent first-language acquisition. Genie’s language performance was highly variable and cannot be easily described in a few generalizations. The closest to a general conclusion provided by Curtiss (1977: 210) is that Genie did not acquire three aspects of language, including pronominal forms (or deixis, see Curtiss 1977: 192), movement rules, and the English auxiliary system. Curtiss points out that these are all forms that have little semantic content, which may make their function particularly difficult to detect. It is
important to note that these conclusions are based primarily on the fact that Genie did not produce these forms, even though the bulk of Curtiss’s analysis of Genie’s language is based on comprehension measures. She didn’t use any pronominal forms (pronouns, demonstratives, relative markers, wh words, etc.) other than *I, you*, and *me* and was inconsistent in her use of these terms. She did not ask wh questions or use subject–auxiliary inversion or other sentence structures requiring movement. According to Curtiss (1977: 196), “the only possible permutation rule in Genie’s grammar is a rule moving *-ing* after the verb.” Likewise, the use of *be + ing* was the only part of the auxiliary system that Genie produced. She did not use modals or verb tense markers.

Genie was averse to speaking, most likely because she was punished during her years of isolation for any type of vocalization. As a result, comprehension measures are a more reliable way to investigate Genie’s knowledge of English. There is some limited evidence of Genie’s ability to comprehend these three aspects of language. For example, based on transcripts of natural interactions, Curtiss (1977: 140) found that Genie “does not demonstrate any difficulty in understanding the transformed word order with *who, what, when, where, how, or why* questions.” However, these three structures were not systematically evaluated through tests of comprehension. The only structures from this subset that were tested for comprehension were subject, object, and reflexive pronouns, and questions with *what.* As on most of the tests of comprehension, Genie’s performance was variable. In sum, Genie’s production abilities lagged behind her comprehension abilities, and her comprehension abilities were highly variable.

A recent case study provides a direct comparison to Genie, but without factors such as malnutrition, abuse, and neglect affecting the subject’s development. Grimshaw et al. (1998) report the case of a young man who was born deaf in a rural community in Mexico, and who communicated solely through gestures until his hearing was improved to 35 dB through the use of hearing aids at the age of fifteen. They followed his acquisition of spoken Spanish over the following four years, using tests adapted from Curtiss (1977). Their subject, E.M., exhibited some characteristics similar to Genie in his attempts to acquire a spoken language in adolescence. Like Genie, E.M. had enormous difficulties with articulation and voice control, and “flatly refused” to speak “without his hands” (1998: 244). E.M. preferred to use his gestures even after his exposure to Spanish. His gesture use did change to incorporate some spoken words, but he did not spontaneously use Spanish despite the fact that some members of his family were completely unfamiliar with his gestures. The authors report only one two-word utterance ever being produced, and that was during an elicitation task.
E.M. had difficulties mastering Spanish grammatical structures, as evaluated solely through comprehension measures. At a gross level of analysis, this could be said to be comparable to Genie’s performance, but when specific structures are compared, there are surprising differences. For example, E.M. mastered the noun plural in Spanish relatively early, after just eight months’ exposure to Spanish, whereas Genie did not learn the noun plural in English until she had been exposed to English for twenty months. Even then, she did not learn it spontaneously, but through a special visual task that Curtiss developed to teach her the distinction (Curtiss et al. 1974: 531). E.M. also mastered the superlative after sixteen months’ exposure to Spanish, whereas Genie never fully mastered this structure. In contrast to the plural and the superlative, E.M. had great difficulties comprehending simple negation in Spanish. Even after 34 months’ exposure, his performance was at chance. However, Genie comprehended negation in English after thirteen months’ exposure, including sentences with relativization and in which the negation was contracted. Thus, although both individuals had difficulties mastering some grammatical elements of their respective languages, there was variability in the degree of difficulty and the level of ultimate attainment of a specific grammatical element across the two subjects.

It would be particularly interesting to compare E.M.’s and Genie’s mastery of the three aspects of grammar identified by Curtiss as fully lacking in Genie’s use of language. Since Grimshaw et al. (1998) used only comprehension measures similar to those developed by Curtiss, there is no evidence of E.M.’s mastery of these structures. Likewise, since he never produced more than a single spoken word, he had no need for pronominal forms, permutation rules, or an auxiliary system in his spoken production.

The combined results of these two studies point to several common outcomes of adolescent first-language acquisition of spoken language. Both subjects had enormous problems in articulation and were averse to speaking at all. Tests of comprehension necessarily revealed more competence than tests of production since both subjects rarely spoke. Another characteristic of both subjects’ performance was enormous variability in the comprehension of the same grammatical feature from one testing session to another. Curtiss (1977: 209) goes so far as to conclude that the degree of variability in Genie’s grammar is “abnormal and reflect[s] language disorder.”

Background on ASL grammar

American Sign Language is a natural language used across most of the United States and in parts of Canada that is independent of all spoken
languages. It has a unique set of lexical and grammatical characteristics. Like other signed languages, ASL grammar is quite different from the grammar of the spoken languages used in the same communities. For example, in English, constituent relations are expressed primarily through the order of words. Signed languages are produced in three-dimensions and thus are not limited to using the linear order of words or morphemes to mark grammatical relations. Early studies of signed languages concluded that they did not have grammar on the basis that the linear order of signs was not predictable, and because there were few signs bearing purely grammatical functions. A major turning point in signed-language linguistics was the discovery that not just signs, but space itself, can bear linguistic meaning (see, for example, Klima and Bellugi 1979: 272–315). It turns out that only a small subset of the verb forms in ASL depends on sign order to mark constituent relations. The majority of verbs in ASL can incorporate features of their constituents into the verb stem and depend primarily on spatial devices to mark grammatical relationships.

Two complex structures in ASL, among the last structures to be acquired by children, involve the use of space to represent grammatical relations. Verb agreement (Cormier et al. 1998; Janis 1995; Padden 1983) is expressed either by movement of a verb stem relative to subject and object loci, or by the orientation of the handshape of the verb stem relative to subject and object loci. Figures 1 and 2 demonstrate the

![Figure 1. Uninflected form of GIVE](image1)

![Figure 2. Inflected form of GIVE ("You give me")](image2)
difference between the uninflected form of the verb “to give,” and the
inflected form for a non–first person subject and a first person object
(“You give me”). The movement or orientation of the verb stem can be
produced with respect to the location of individuals and entities present
in the signing space, or with respect to spatial loci associated with
nonpresent subjects and objects. Although these forms may appear to be
quite iconic, young children acquiring ASL from birth do not master
them any earlier than hearing children acquire verb agreement in spoken
languages (Meier 1987). In a longitudinal study of three deaf children
with deaf parents, Meier (1982) found that participants began producing
verb agreement reliably between 3;0 and 3;6, but only when the referents
of the verb were actually present. Four- and five-year-old children still
struggle with verb agreement if the verb form moves between loci
associated with nonpresent subjects and objects (Lillo-Martin et al. 1985).

Children in the process of mastering agreement produce several types
of error. In the early stages of acquisition, children are more likely to
produce uninflected forms of the verb stem instead of incorporating the
movement between the subject and object loci. In later stages, they will
overgeneralize the use of agreement to verb stems that do not allow
inflection, or inflect verbs to an inappropriate location, such as the
location of the indirect object instead of the direct object. Lillo-Martin
et al. (1985) have shown that children who comprehend the use of space
for pronominal reference still make errors in the comprehension of
agreement to spatial loci, suggesting that the use of agreement requires
the integration of spatial memory with additional grammatical
competence.

A second structure in ASL that uses space to encode grammatical
relations is polymorphemic verb predicates, which have been compared
to classifier predicates in spoken languages (Schick 1990; Supalla 1986).
The term classifier is used because the signer is required to select one of
a limited set of possible handshapes that identifies a class of objects. The
spatial relationship between the handshapes is then used to encode loca-
tive and movement relationships between those entities. For example, in
ASL the extended index and middle fingers, pointing downward, can be
used to represent animates. To describe a boy climbing a tree, an ASL
signer could produce signs for tree and boy, followed by a classifier
predicate using one hand to represent an animate, and one hand to
represent a tree. The movement of the animate handshape from the
bottom to the top of the tree handshape would encode the boy’s
movement trajectory (see Figure 3).

These structures, like verb agreement, have a notable iconic component.
Nevertheless, like verb agreement, they are not simple forms for children
to acquire. Some typical errors that children produce include omission of one of the classifiers when two are required, selection of an inappropriate classifier or use of a handshape that is not a classifier, and the sequential production of two classifiers or of two path movements instead of a single complex path (Newport 1988; Supalla 1982). Children gradually increase the complexity and appropriateness of their classifier constructions over time, showing continued improvement to age nine (Schick 1987).

**Delayed acquisition of signed language**

Research on delayed acquisition of spoken languages depends on a small number of case studies because it is highly atypical for hearing individuals not to hear speech from birth, or for deaf individuals to suddenly have their hearing restored. There is a much larger and more comprehensive body of literature on the effects of linguistic isolation on the acquisition of signed languages. Substantial numbers of deaf children with hearing parents receive negligible input from a spoken language because of their deafness. Some of these individuals, in addition to their isolation from spoken language, are not exposed to a signed language until sometime in late childhood or adolescence.

A range of studies has shown that deaf adults who acquired ASL in infancy outperform deaf adults who acquired ASL as a first language in adolescence on a variety of tasks, such as the use of verb morphology (Newport 1990), sentence shadowing, and recall (Mayberry 1993; Mayberry and Eichen 1991; Mayberry and Fischer 1989), grammaticality judgments (Boudreault and Mayberry 2000), and several language-processing tasks (Emmorey, Bellugi, et al. 1995; Emmorey and Corina 1990, 1992).

One of these studies specifically investigated the acquisition of verb agreement and classifier predicates, as well as other morphologically

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**Figure 3.**  $CL\{DH\, bentV\{|NDH\, 5arm\}\,-\, up$ (= boy climbs tree)
complex structures, by delayed learners. Newport (1990) compared the performance of deaf individuals who had not learned ASL until after twelve years of age to the performance of native signers on a variety of elicited production and comprehension tasks. She found that delayed signers produced the target structures well above chance but with much more variability than native signers. Among the various production measures, adolescent first-language learners scored lowest relative to native signers on the test of verbs of motion, a task requiring the production of classifier predicates. In this task, subjects see a videoclip of an event, such as a toy car moving up an incline, and are asked to describe the event. Each event can be described using a polymorphemic classifier predicate. Newport (1988) reports that the most common type of error for delayed signers on this task involves a response using monomorphemic signs from the nonproductive lexicon of ASL. An example of this type of error produced by an adult who learned ASL in adolescence is provided by Singleton and Newport (2002), and is glossed here in (1).

(1) CAR MOVE UPHILL

Instead of producing a single polymorphemic predicate to describe this event as native signers most often did on this task, the individual produced three separate single morpheme signs. Newport concludes that delayed first-language learners have difficulty identifying the underlying morphological structure of polymorphemic forms in ASL.

Galvan (1999) identified similar difficulties in school-aged deaf children during the process of language acquisition. He compared narratives based on Mercer Mayer’s (1969) *Frog, Where Are You?* produced by children with varying language backgrounds. Some of the children were native signers and others did not learn ASL until interacting with their native signing classmates in school, around 4–5 years of age. Differences were already apparent between these groups at 5–9 years of age in terms of the morphological complexity of the event descriptions. In a previous report of this work, Galvan (1989) explained that the children who were not exposed to ASL from birth were more likely to use single morpheme signs than polymorphemic predicates. This work suggests that difficulties in morphological analysis may also affect childhood learners of ASL.

These studies of delayed signers of ASL suggest that similar difficulties are encountered by individuals acquiring a language in adolescence regardless of whether they are acquiring a signed or a spoken language. Both signers and speakers appear to have difficulties identifying and using grammatically complex structures in their respective languages. However, there is one striking difference between adolescent first-language learners faced with the task of mastering a signed language vs.
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a spoken language. None of the studies of delayed learners of ASL report any hesitancy on the part of the research participants to produce utterances in the language learned in adolescence. In fact, the few studies documenting a deaf individual’s initial exposure to a signed language in adolescence report that the research participants quickly abandoned gestures used prior to language contact in favor of using the signs of the target language (Emmorey et al. 1994; Morford 1998).

Deaf individuals who are not exposed to a signed language almost invariably use gestures to communicate prior to their exposure to language (Goldin-Meadow and Feldman 1977; Goldin-Meadow and Mylander 1990, 1998). The use of an idiosyncratic gesture system, called homesign within the Deaf community, almost certainly puts an adolescent first-language learner at an advantage relative to someone like Genie, who was punished for trying to communicate. Indeed, it is perhaps misleading to conceive of adolescent first-language learners (who have not suffered from abuse) as coming to language tabula rasa in adolescence. Minimally, in the case of deaf individuals who eventually learn a signed language, they have developed motor skill with the articulators of the language they are trying to learn in adolescence. Most likely, they have also developed important social interaction routines as well as a semantic system mapping gestures onto concepts that will be encompassed by subsequent language learning. The structural properties of a homesign system may even facilitate the acquisition of signed language morphology. Specifically, Morford et al. (1995) found that one homesigner was more successful in the acquisition of ASL morphemes that represented meanings for which he had a gesture than of ASL morphemes that represented meanings for which he did not have a gesture. Thus, the transition from no language to language is not as abrupt a change for these individuals as for a child who has been socially isolated. 3

Goals of the research

Most studies of delayed learners of ASL have investigated the long-term outcomes of acquisition by comparing the performance of adult delayed learners to adult native signers. The current research is unique in that it describes the language production of two adolescent first-language learners during the initial years of their exposure to ASL. Thus, the research is comparable in some ways to Curtiss’s longitudinal study of Genie’s acquisition of English directly after exposure, but the results can be complemented by a larger body of research involving other members of
the same population and other methods of evaluating their language competence.

The research is divided into two studies. The goal of the first study is to investigate the production of agreement verbs and classifier constructions in ASL by adolescent first-language learners, and more specifically, to determine whether and after how much exposure to ASL these structures are produced spontaneously. A second study was carried out to evaluate the comprehension skills of the participants.

Study 1. Grammatical production

Method

Participants. This study was possible because two deaf adolescents, referred to here by the pseudonyms Maria and Marcus, moved with their families from countries with limited educational resources for deaf children to a city in North America where public education for deaf children was mandatory. In their countries of origin, the participants had little or no educational experience, and they had no exposure to the local signed language. After moving to North America, they were enrolled in the same school for the deaf in the same year and placed in the same classroom. The school had a communication policy that promoted the use of signed language, although individual teachers used various forms of communication, including ASL, Signed English, and simultaneous communication (the concurrent use of signs while speaking English). Signed English is a visual form of spoken English that uses the lexicon of ASL for open-class words combined with invented signs to encode English grammatical morphemes. The signs are produced in English word order.

The first participant, Maria, is a female who was born with a profound bilateral sensorineural hearing loss (>90 dB in the better ear). She is the oldest child in her family and has two younger brothers. Deafness was diagnosed at two years of age and is believed to have been caused by maternal illness during pregnancy. No other family members are deaf. She did not receive hearing aids until after the onset of this study, at age 13;7 (years;months). Maria used no speech and communicated with her family in homesign. Her brother was sometimes asked by the parents to “translate” her gestures for them. She did not attend a school prior to the onset of the study and spent most of her time at home. She was exposed to ASL at the age of 13;7 in the school described above. There were no special remedial classes in ASL grammar, but she was exposed
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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 while signing. In subsequent years, her teachers used a mixture of ASL and simultaneous communication. In the first year of her enrollment in the school there was one student in her class who was a native signer. Maria was administered Raven’s Standard Progressive Matrices after three months and after 32 months exposure to ASL. Using norms gathered in 1986 for children in the US, her score after three months’ exposure to ASL was still below the fifth percentile for her age group, but after 32 months’ exposure to ASL, her performance was exactly at the fiftieth percentile for her age group. Norms for deaf children were not available at the younger age, but at the older age her score was comparable to the 75th percentile of a group of British deaf children (Conrad 1979). Rapid increases in IQ are typical for children who are removed from contexts of low stimulation (Skuse 1993). In this case, there are two potential explanations for the rapid improvement in performance. One possibility is that the increased stimulation that occurred with the introduction of sign language led to improved performance. The other possibility is that she understood the task requirements better because of her improved language skills. In either case, her performance on this test indicates that she had normal cognitive functioning despite her isolation from language.

The second participant, Marcus, is a male who was born profoundly deaf of unknown etiology and with no other deaf family members. He is the oldest child and has one younger brother. Marcus did not receive hearing aids until after the onset of this study, at age 12;1. Even then, he chose not to use his hearing aids. According to parental report, Marcus could say three words: “What,” “Papa,” and “Mama,” and depended primarily upon homesign to communicate with his family. He did not attend a school for the deaf throughout his childhood because it was located too far from his home. He visited the school for hearing checkups between five and ten times. At the age of nine, he was admitted to the local school for hearing children to keep him off the streets. He did not learn any signs, and his schooling consisted of copying letters and numbers from a blackboard. He was exposed to ASL at age 12;1 in the same school and classroom environment as Maria.

Marcus was administered four of the WISC-R Performance Subtests after 19 and after 31 months exposure to ASL, including picture completion, picture arrangement, block design, and object assembly. A performance score was computed by prorating from these four tests. Standardized scores from a study of 1228 deaf children in the US were used to evaluate the results (Anderson and Sisco 1977). It is interesting

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to note that these norms include some deaf children who did not share a communication system with the test administrators. Of the population, 1.3% was administered the test using gesture only and 7.3% using pantomime. Marcus’s performance improved by more than ten scale points from the first to the second administration, increasing the corresponding performance IQ from 70.5 to 85 points. As with Maria, his improved performance could be related either to the increased stimulation of his new environment, or to better comprehension of the task requirements. His performance IQ indicates that he had normal cognitive functioning despite his isolation from language.

Procedure. The participants were videotaped while narrating the wordless storybook, *Frog, Where Are You?* by Mercer Mayer (1969). The pictures outline the story of a boy and his pet dog who are searching for an escaped frog. Sixteen target events were selected for analysis. Half of the target events depicted either *climbing* or *falling*, which are typically expressed with classifier predicates in ASL. The other half of the target events depicted *looking at something*, *licking*, or *biting*, which are typically expressed with verbs that take agreement in ASL.

Participants were shown the pictures and asked to browse through the entire story without narrating. Subsequently, the participants narrated the story while looking at the pictures. Participants narrated the story after approximately 2, 8, 14, 20, and 31 months’ exposure to ASL (see Table 1). In the initial taping session, participants were sometimes prompted by their teacher, who would point to one of the characters and shrug, or ask a question about something that wasn’t happening, to elicit a correction. In subsequent sessions, the participants were able to narrate the entire story with little intervention from the interlocutor. A new interlocutor was provided for each narration to maintain the imperative to explain the story to someone who didn’t know it. In each case, the interlocutor was more skilled in ASL than the participants.

<table>
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<tr>
<th>Observation</th>
<th>Maria</th>
<th>Marcus</th>
<th>Mean</th>
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The videotapes were transcribed and coded for specific measures. Only utterances describing the target events are reported in this study. The selected utterances were coded for number of signs per utterance, number of morphemes per verb or predicate, and type of predicate. Signs per utterance was calculated by counting each gesture, uninflected sign, inflected sign, classifier construction, fingerspelled word, and point once. The number of morphemes per verb or predicate was calculated by counting the verb form used to encode the target event as well as each inflection for subject or object. Both participants did produce aspect morphemes, but they were not included in the analysis because they were never produced on the target agreement verbs. Classifier predicates were broken down into primary object, secondary object, and path morphemes. Contrary to previous analyses, additional morphemes were not calculated for orientation, location, position, or manner (Supalla 1982). Thus, a maximum of three morphemes was counted per agreement verb (base form plus subject and object agreement) or classifier predicate (primary object, secondary object, and path). Type of predicate was determined by whether the action was encoded in a homesign gesture, an uninflected sign, an inflected verb, or a classifier predicate.

The narratives were coded by a fourth-generation native signer of ASL, and by the author, a second-language learner of ASL. Intercoder agreement was 88%, as calculated by dividing the number of signs glossed the same way by both coders by the number of signs glossed the same way plus the number of signs coded by one coder but omitted by the other coder plus the number of signs glossed differently by the two coders (agreements/agreements + disagreements). The majority of disagreements were omissions of points and repeated signs (93%). In rare cases there were disagreements about the gloss of a sign (7%). For example, one coder glossed a sign as HURT, produced at the nose with one hand, and the other coder glossed the same sign as the facial expression for “Ow!” plus a point at the nose. Discrepancies were resolved through discussion.

**Results**

Two approaches are used to describe the acquisition of verb agreement and classifier predicates by the participants. First, the numerical measures are reported, including changes in utterance length, morphemes per verb or predicate, and predicate type. Second, each participant’s mastery of classifier predicates and agreement verbs is described in narrative format.
with examples to illustrate the differences in each participant’s learning style.

**General measures.** Table 2 shows the changes in utterance length in the participants’ descriptions of the target events over the three years of the study. Since the narrations were spontaneous, the participants did not include a description of all sixteen target events in each narrative. They described between ten and fourteen events in each narrative, as indicated in each table. At the onset of the study, the participants’ utterances were two to five signs or gestures on average, ranging between one and ten gestures. By the completion of the study, they were typically stringing seven to nine signs together, with utterances ranging between four and thirteen signs.

Table 3 shows the number of morphemes per verb from the selected utterances. At the onset of the study, the participants were not able to use either of the morphologically complex structures to encode the target events. Over the course of the study the use of these structures became more and more common, and by the last observation the participants were using complex structures to encode almost all of the events. Since the maximum number of morphemes per predicate was three, the average production of 2.4 morphemes per predicate is very close to ceiling. Note that predicates that looked like polymorphemic forms but were not used

<table>
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<th>Marcus (n)</th>
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<td>2.3 (11)</td>
<td>3.3</td>
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<tr>
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<td>4.3 (10)</td>
<td>2.9 (10)</td>
<td>3.6</td>
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<td>5.0 (13)</td>
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<td>31</td>
<td>7.6 (14)</td>
<td>9.0 (13)</td>
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<tr>
<td>2</td>
<td>1.0 (11)</td>
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productively were only counted as single-morpheme constructions (see, e.g., examples [3] and [8] below). Thus, the high morpheme count suggests that delayed learners can indeed acquire polymorphemic structures in ASL.

Figures 4 and 5 show the progression over time for these participants from using homesigns to uninflected signs to inflected signs and classifiers. Both participants learn to use complex structures in ASL, but they follow remarkably different paths of acquisition. Consider first the path of acquisition demonstrated by Maria. She produces very few homesigns after the initial taping session. There is a sudden and dramatic rise in the use of uninflected signs to encode the target events as her initial strategy,

![Figure 4](image1.png)

**Figure 4.** Type of predicate produced by Maria as a function of length of exposure to ASL.

![Figure 5](image2.png)

**Figure 5.** Type of predicate produced by Marcus as a function of length of exposure to ASL.
and her use of uninflected signs continues even after she begins to produce morphologically complex structures. By contrast, Marcus continues using his homesigns longer after exposure to ASL, but he begins using classifier predicates and inflecting verbs earlier than Maria. His use of uninflected signs is relatively rare. This contrast will come out more clearly in the next section describing specific utterances produced by each participant.

Mastery of classifier predicates. Maria’s mastery of classifier constructions resembles what has been reported previously in the literature more closely than Marcus’s, but with some discrepancies. In her earliest descriptions of events of climbing and falling, she depended almost exclusively on homesign gestures, in which she used her body or her hand to depict movement, as in (2), which she produced by tracing a path on the picture of the frog climbing out of the jar to escape his captors (see Figure 6). The transcription system is described in the Appendix.

(2) Maria, 1 month exposure

\[ \text{PT > picture hop-out} \]

‘He hops out.’

All of Maria’s responses in the first observation session were homesigns with the exception of one response, in which she used a classifier form for falling, but without evidence of an understanding of the internal structure. Maria’s teacher produced a classifier form to describe the boy falling, which Maria imitated, and several minutes later she produced a similar form spontaneously. This form continues to be produced unchanged over the subsequent two taping sessions.

After nine months’ exposure to ASL, Maria’s responses consist almost entirely of uninflected ASL signs. All of her descriptions of the boy or the dog falling include the same unmodified classifier form, as in (3). She also uses other monomorphemic signs during this observation session; for example, to encode the frog climbing out of the jar, she used the uninflected sign OUT, as in (4), depicted in Figure 7.

Figure 6. Maria’s homesign to express the frog hopping out of the jar (cf. example [2]).
The first observation of Maria’s productive use of a classifier form occurs after 15 months’ exposure to ASL. In this session she describes a beehive falling from a tree by using a classifier construction, as in (5). However, she continues to depend primarily on monomorphemic signs and the unproductive form of an animate falling, as demonstrated in (6).

After 20 months’ exposure to ASL, Maria produces a classifier form to describe an animate falling that differs from the unproductive form used up to this point and is apparently polymorphemic, as shown in (7). However, in the same session, her use of monomorphemic forms is even more striking because the intended meaning now conflicts with the iconic representation in the form. For example, she continues to use the unanalyzed classifier form for an animate falling and extends it to her description of the beehive falling, as in (8). Likewise, in her description of the boy climbing a tree, she uses the ASL sign for climbing stairs. Both of these utterances only make sense if the meaning is overgeneralized to refer to falling or climbing in the abstract, although the specific forms she uses do not allow this interpretation in ASL.
(7) Maria, 20 months exposure
WINDOW-OPEN DOG WATCH CL:[DH:bentV/NDH:B]-contact
(= animal at windowsill) CL:[DH:V/NDH:B]-down (= animal falls)
‘At the open window the dog is watching, crouched on the windowsill, and he falls.’

(8) Maria, 20 months exposure
HOME FALL DOG PT > picture RUN SCARED
‘The [bee’s] home falls–(with legs) and the dog runs away scared.’

In the final observation session, Maria expresses all eight target events of climbing and falling using productive classifier forms, as in (9), depicted in Figure 8. There are a number of indicators that these forms are productive, such as a hold at the apex of the path movement in some instances and changes in the nondominant handshape to fit the context.

(9) Maria, 32 months exposure
IN FROG CL:[DH:bentV/NDH:C]-out (= animal exits container)
WINDOW-OPEN CL:[DH:bentV/NDH:B]-away (= animal moves away from flat surface)
‘The frog was inside, and he hopped out of the jar and through the open window.’

Although Maria appears to follow the path of acquisition described in the literature of using primarily monomorphemic forms instead of classifier constructions at the onset of her exposure to ASL, this trend changes over time, such that her preference is clearly for polymorphemic constructions by the end of the study.

Marcus’s path of acquisition was quite different from Maria’s and differed from what has been reported in the literature as well. With the exception of two ASL signs for FROG and SEARCH, Marcus produced only homesigns in the utterances coded from the initial observation session after three months’ exposure to ASL, as in (10). Figure 9 shows how Marcus expressed the concept of hopping, taking on the role of the

![Figure 8. Maria’s use of a classifier predicate to express the frog hopping out of the jar (cf. example [9])]
frog and using his whole body to act out the movement. Compare this
with Maria’s homesign strategy of tracing the path of the frog’s movement
on the picture book (cf. Figure 6).

(10) Marcus, 3 months exposure

Body getting out of container and down FROG hopping
‘The frog got out of the jar and hopped away.’

He was first observed to use classifier constructions in the second
observation, after seven months’ exposure to ASL, as in (11). These
constructions appear to be productive; however, they are not correct. In
(11), although the choice of handshapes is appropriate, the direction of
movement is toward himself instead of away (see Figure 10). In other
descriptions from this session he uses unusual orientation, deletes a
necessary secondary handshape, and starts and ends a falling movement
at the same location, so that it denotes jumping instead of falling.
Although he has started to use polymorphemic forms after seven months’
exposure to ASL, his signing is still full of homesigns and he produces
more errors than Maria. Unlike Maria, who seems to avoid using home-
signs even if it means expressing herself inaccurately, Marcus is content
to continue using his own created gestures simultaneously with ASL.
(11) Marcus, 7 months exposure
    WINDOW CL:[DH:V/NDH:B]-down (= animate moves down from flat surface)
    ‘He hops out of the window.’

By the third observation session, after thirteen months’ exposure to ASL, Marcus produces only classifier constructions to express the target events of *climbing* and *falling* and continues to do so in the final two observation sessions. He never produces monomorphemic signs like OUT or HIDE to express movement as Maria does. Examples (12)–(14) provide a comparison of his description of the frog’s escape in the final three observation sessions. Figure 11 illustrates one of the classifier predicates produced in (14).

(12) Marcus, 13 months exposure
    FROG CL:[DH:bentV/NDH:C]-in (= animal in container)
    CL:[2H:C]-up (= vertical cylindrical object)
    CL:[DH:bentV/NDH:C]-out (= animal exits container)
    CL:[DH:V]-away (= animal moves away) GONE
    ‘The frog was in the jar, and he climbed out and walked away and was gone.’

(13) Marcus, 19 months exposure
    PT > picture CL:[2H:C]-up (= verticle cylindrical object)
    CL:[DH:bentV/NDH:C]-out (= animal exits container)
    CL:[DH:bentV]-away (= animal moves away) GONE NEXT SEARCH
    ‘He climbed out of the jar and hopped away and was gone, and next they were searching.’

(14) Marcus, 30 months exposure
    CL:[2H:C]-up (= verticle cylindrical object) FROG

Figure 11. Marcus’s correct use of a classifier predicate (cf. example [14])
CL:[DH:bentV/NDH:C]-out (= animal exits container) FROG
GO-AWAY CL:[DH:bentV]-away (= animal moves away) GONE

‘The frog sneaked out of the jar and went hopping away and was gone.’

Marcus’s early use of classifier constructions combined with the absence of monomorphemic forms in his narratives display a path of acquisition that has not yet been identified for adolescent first-language learners. He appears to be acquiring ASL much more like a first-language learner than a delayed learner. This issue will be addressed in more detail in the discussion.

*Mastery of verb agreement.* Verb agreement appeared later in the signing of both participants than classifier predicates. In this case, Maria’s path of acquisition appears more similar to what has been reported for native signers of ASL because she uses uninflected agreement verbs before beginning to use inflection. Note that this pattern is also similar to the pattern of acquisition she demonstrated with classifier predicates, that is, depending on monomorphemic signs before beginning to use polymorphemic signs. Maria did not use verb agreement during the first three observations. She used homesigns to express the target events in her initial narrative after one month of exposure to ASL, as in (15), depicted in Figure 12. Subsequently, she began using uninflected ASL signs, including the uninflected form of verbs that could potentially take agreement, as in (16) from the second session, and (17) from the third session. These utterances all describe the boy just prior to or after his discovery of his pet frog sitting behind a log with a frog sweetheart and frog babies. Note in Figure 13, demonstrating example (17), that the verb is not produced with a neutral orientation as would be expected for a verb that was purposely not inflected. The verb is directed toward a locus, but Maria did not associate any previous sign with that locus, so the object of the verb cannot be determined from the directionality of the verb.

Figure 12. *Maria’s use of a homesign to express looking (cf. example [15])*. 
Maria’s use of the uninflected sign LOOK-AT (cf. example [17])

(15) Maria, 1 month exposure

PT > picture look_surprised BOY look_surprised PT > picture
‘The boy looked in surprise.’

(16) Maria, 9 months exposure

PT > picture BOY LOOK-AT_surprised
‘The boy looked at [it] in surprise.’

(17) Maria, 15 months exposure

FROG DATE BOY LOOK-AT OH-I-SEE
‘The boy looked at the frog couple — aha!’

After twenty months’ exposure to ASL, Maria began to spatially inflect her verbs to agree with the object, as in (18). However, she rarely inflected verbs for subject. This pattern continued at 32 months’ exposure to ASL. She does show some improvement in identifying the subject of the verb lexically after 32 months, but she rarely inflected the verb for subject, as seen in (19) and depicted in Figure 14.

(18) Maria, 20 months exposure

TREE CL:[DH:5arm]-pivot (= tree falls) CL:[2H:C]-apart
(= horizontal cylindrical object) PT > picture FROG MANY_a
FROG MANY_a LOOK-AT_a_surprised WIFE
‘Behind the fallen tree there were many frogs, and [he] looked at them in surprise and saw [the frog had a] wife.’
(19) Maria, 32 months exposure

TREE WOOD CL<sub>a</sub>, [2H:C]-apart (= horizontal cylindrical object)

BOY LOOK-AT, WHERE SEARCH FROG

‘The boy looked behind the log in search of the frog.’

Marcus again shows a more prolonged use of homesign than Maria but also begins using verb agreement earlier than Maria. He produced only homesigns in the first two observation sessions to describe the target events of looking, licking, and biting, as in (20), which describes the boy’s discovery of the empty frog jar, and in (21), which describes the boy holding the dog after he falls out the window, and the dog licking the boy’s face. Figure 15, demonstrating example (20), can be compared to Maria’s homesign description of the same event in Figure 12. Note how much more expressive Marcus’s homesigns are relative to Maria’s.

(20) Marcus, 3 months exposure

look stunned

‘He looked with a stunned expression.’

(21) Marcus, 7 months exposure

PT > picture hold lick

‘[The boy] held [the dog], and [the dog] licked [the boy].’

Unlike Maria, Marcus rarely produced an uninflected verb that could take agreement. He did use the uninflected ASL sign SEARCH, which does not take agreement, just as frequently as Maria. Marcus produces his first inflected verb in the third observation session, somewhat earlier than Maria, as in (22). He depends primarily on inflected verbs to express the target events in the final two observations, but he inflects the verbs for object much more regularly than for subject, as in (23) and (24). This tendency, observed in both participants, may reflect the fact that object agreement is more common than subject agreement in ASL since single agreement verbs agree only with the object. However, it could also be related to the way the participants mapped conceptual space onto signing space. Most often, the participants took on the role of the boy

Figure 15. Marcus’s use of a homesign to express looking (cf. example /20/)
or the dog rather than placing them in a spatial location. They were more likely to set up the object of the actions (e.g. the jar, the hole in the tree, the fallen log) in space and thus have a spatial location for object with which to relate the inflected verb, as demonstrated in Figure 16, depicting (24).

(22) Marcus, 13 months exposure
    CL$_{\text{a}}$[2H:C] (= hole) SEARCH leans over to look in LOOK-AT$_{\text{a}}$
    ‘[The boy] leaned over and looked in the hole.’

(23) Marcus, 19 months exposure
    DOG LOOK-AT$_{\text{a}}$ BOY GIRL BOY PT > picture FROG
    ‘The dog looked at the frog couple.’

(24) Marcus, 30 months exposure
    DOG LOOK-AT$_{\text{a}}$ BOY LOOK-AT$_{\text{a}}$ CL$_{\text{b}}$[2H:B]-up (= vertical object) WHERE FROG WHERE NONE
    ‘The dog and the boy looked at the jar and discovered the frog was gone.’

To summarize across domains, classifier predicates were produced six months earlier than verb agreement by both participants. Marcus produced classifier predicates after just seven months’ exposure to ASL, and Maria produced classifier predicates after fifteen months’ exposure to ASL. By contrast, Marcus’s first use of verb agreement occurred after thirteen months’ exposure to ASL, and Maria did not inflect a verb until she had been exposed to ASL for twenty months. During the period of time that the two participants were not producing the target structures regularly, they differed in their strategies for expressing the target events. Maria depended primarily on monomorphemic signs, while Marcus continued to use homesigns or produced the target structures inaccurately. Both participants increased the frequency and accuracy of their use of the target structures over the 31 months that they were observed.

The consistent progress in the acquisition of classifier constructions and verb agreement by both Maria and Marcus provides a surprising

Figure 16. Marcus’s use of the inflected sign LOOK-AT (cf. example [24])
contrast to Genie’s and E.M.’s extreme variability in performance on the grammatical features of English and Spanish on which they were tested. One factor to consider in the comparison of these cases is that many of the ungrammatical sentences Genie produced were elicited from her during attempts to teach her aspects of English grammar that she never tried to use spontaneously. The participants of this study did not receive direct instruction in the grammar of ASL. The utterances presented in (2)–(24) are representative of the types of structures they used in everyday interaction with their peers and teachers. Also, by observing spontaneous production instead of evaluating comprehension, the participants in this study were able to demonstrate their best performance. There was never a required response, and at times the participants did not describe the target events. It is possible that in at least some instances, the participants did not describe an event because they were not sure how to express it correctly in ASL.

These same considerations are also relevant to the comparison of these data with the results of Newport (1988, 1990), who found that after many more years of signing ASL, adults who had learned ASL in adolescence could produce polymorphemic classifier predicates but depended on single morpheme signs much more often than native signers. The reliance on monomorphemic forms was clearly a transitional strategy for Maria, but only until she was more skilled in producing classifier predicates. In most elicited production tasks, the signer must produce a specific combination of verb stem and subject and object agreement markers, or a specific classifier predicate that contrasts minimally with several others. Using a simpler construction would be considered an error on such tasks. In the current study, specific structures were not elicited. It is possible that the performance level of adolescent first-language learners differs by context. As the task demands increase, delayed learners may fall back on a form of language use that is less demanding. Thus, it is possible that this study shows performance under optimal conditions, in which case adolescent first-language learners typically produce polymorphemic structures, whereas Newport’s study shows performance under higher processing demands, in which case polymorphemic structures are produced more than half the time, but not as the sole response type.

The consistent progress of the participants is also surprising in light of the wealth of data documenting the comprehension problems of delayed learners of ASL. Is it possible to master morphologically complex structures in a language if comprehension is compromised? The second study was carried out to investigate whether Maria and Marcus were comparable to other delayed learners who have poor comprehension skills. Simultaneously, the issue of level of task demands was addressed.
Language comprehension is another area of language use that is clearly affected by delayed exposure. This has been well documented in a series of carefully implemented studies by Mayberry and colleagues (Boudreault and Mayberry 2000; Mayberry 1993; Mayberry and Eichen 1991; Mayberry and Fischer 1989; Mayberry et al. 2002). They have consistently found problems in delayed signers’ comprehension of both ASL and Signed English relative to native signers’, despite similar short-term memory abilities, and even when controlling for years of experience using the language. Mayberry’s studies show that during sentence recall and shadowing, adolescent first-language learners produce a number of substitutions that are phonologically similar to the target signs but differ in meaning. Mayberry (1993: 1268) has interpreted this result as evidence that late first-language learners are “intermittently stuck at the surface level of language structure.” In a fascinating comparison of this subject group with hearing individuals who became deaf and learned ASL as a second language in adolescence, she has been able to demonstrate that age of acquisition alone cannot account for these findings. Second-language learners can complete the same comprehension tasks without producing the types of lexical substitution seen in late first-language learners. Moreover, their responses preserve the constituent structure of the target sentences and are more grammatically acceptable than the responses of the late first-language learners. Mayberry (1993: 1268) proposes that second-language learners may be able “to circumvent the processing limitations posed by acquiring a language at a late age” by using their first language to recode the incoming sentences, or by using their language experience to detect inconsistencies in their processing.

A study by Emmorey and Corina (1990) produced results consistent with this interpretation showing that delayed signers need more visual information relative to native signers to identify signs. Their study suggests that lexical access in delayed signers is indeed slower although not necessarily different than in native signers. Additional evidence that phonological information may “hang around” in working memory for non-native signers comes from a study reported by Emmorey, Corina, and Bellugi (1995). They describe a probe-recognition study in which subjects saw a sentence, followed by a probe sign. Subjects merely respond “yes” if the probe appeared in the sentence, or “no” if the probe did not appear in the sentence. There were no differences between native and non-native signers on accuracy or reaction time for “yes” responses, but non-native signers were much slower to reject distracter probes that were phonologically related to signs that appeared in the target sentence.
The overwhelming difficulties of adolescent first-language learners on comprehension and processing tasks have been interpreted as being consistent with the assumption that adolescent first-language learners simply do not fully acquire ASL. Another possibility is that the comprehension tasks that have been used have placed higher processing demands on the subjects than they were able to handle. It may be that in the area of comprehension, as in production, performance varies with the level of task demand.

When an individual’s grammatical knowledge is the primary concern of investigators, the traditional approach has been to give informants a list of written sentences and ask them to note which are grammatical and which are not. This task reduces the processing load to a minimum by allowing informants to review the utterances at their own speed. By contrast, performing the same grammaticality-judgment task but in real time places a higher processing load on subjects. For example, Johnson (1992) found that adult L2 learners produce more errors on an auditory grammaticality-judgment task relative to a written grammaticality-judgment task.

Manipulating the processing load during a comprehension task allows us to address theoretical considerations about adolescent first-language learners. If the reason adolescent first-language learners have difficulties with language is primarily due to their lack of knowledge of the grammar, then we should predict that comprehension will be uniformly poor under all circumstances. Without language competence, you cannot have adequate performance. If results improve when processing demands are reduced, we know that performance constraints were affecting the results as well. This is a very likely possibility for adolescent first-language learners of ASL since a number of studies have demonstrated difficulties during phonological processing and lexical access. With these issues in mind, a comprehension task was designed with the specific goal of investigating whether processing constraints might be playing a role in the poor comprehension performance of adolescent first-language learners. Since the participants had not learned a written form of ASL, a written task could not be used. Processing load was manipulated by asking the participants to make judgments about sentences produced in real time (high processing load) vs. judgments about sentences that could be viewed repeatedly and in slow-motion (low processing load). Subjects were also asked to repeat sentences, in order to evaluate what portion of the sentences they were able to understand.

Method

Participants. The same participants as in study 1 participated in this experiment after approximately seven years of exposure to ASL.
Materials. A fourth-generation signer of ASL was asked to look through the pictures of Mercer Mayer’s (1969) *Frog, Where Are You?* and then recount the story while looking at each picture. The narrative was recorded on digital videotape. Eight sentences were selected from the narrative. Two sentences describing each of the following event types were selected: *climbing*, *falling*, and *looking*. In addition, the only *licking* event and the only *biting* event in the story were included. The sentences describing *climbing* and *falling* events all included a classifier predicate. The sentences describing events of *looking*, *biting*, and *licking* all included agreement. The eight sentences were transferred from digital video to NTSC video with a five-second pause between each sentence. Sentence length ranged from six to fifteen signs with an average of 9.25 signs per sentence.

Answer sheets were constructed by selecting four pictures from the frog story for each of the eight sentences. One picture depicted the event that the target sentence described, and three pictures depicted events that were related in path movement and/or protagonists. For example, for the target sentence describing the boy climbing a tree, distracter pictures depicted the boy climbing a rock surrounded by trees, the frog climbing out of a jar, and the boy and the dog looking over a fallen tree. The four pictures were labeled A–D. In order to select the correct response, it is necessary to identify the constituents of the predicate, as well as to associate the constituents of the predicate with the corresponding classifier handshapes or with spatial loci. Thus, both lexical and grammatical knowledge are required to select the correct response.

Procedure. Three tasks were carried out using the same stimuli: a comprehension task and a repetition task in the high-processing-load condition, and a comprehension task in the low-processing-load condition. In the high-processing-load comprehension task, participants viewed each of the eight sentences in real time. They were then shown the corresponding answer sheet and asked to select one response. Subsequently, they were asked to perform the repetition task. Participants viewed each of the eight sentences a second time and were asked to repeat the sentence exactly immediately after viewing it. Responses were recorded on digital videotape. Following the repetition task, participants were asked to perform the comprehension task a second time, but in the low-processing-load condition. Participants viewed each of the eight sentences as often as they wanted at either normal or slow playback until they felt confident that they could choose the corresponding picture.
Results

High-processing-load comprehension task. Chance performance for the comprehension task is 25%. Both participants selected the correct picture for 38% of the sentences. Of the incorrect responses there was very little overlap, indicating that responses to these items were random. In only one instance did both participants select the same incorrect picture for a target sentence. The participants’ performance is slightly above chance, indicating that they are able to access some meaning during real-time comprehension. Nevertheless, these results suggest that even with highly familiar content, the participants’ comprehension is severely compromised under normal processing conditions.

Low-processing-load comprehension task. Chance performance for the comprehension task is 25%. Maria selected the correct picture for 63% of the sentences, and Marcus selected the correct picture for 100% of the sentences. Maria asked to view each sentence 2.25 times on average before giving a response. Marcus asked to view each sentence 1.6 times on average before giving a response. Since the participants had seen each sentence twice prior to performing this task, Maria had actually seen each sentence four or five times before responding and Marcus had seen each sentence three or four times before responding.

Both participants improved their performance when allowed to view the sentences multiple times. This improvement demonstrates that their inaccurate performance in the high-processing-load comprehension task is related at least in part to processing constraints. Given more time to analyze the same sentences, their comprehension improved. The contrast in performance is particularly remarkable for Marcus. He actually commented several times during the first task that he had missed the sentence and would have to guess a response. Thus, not only does he suffer from processing constraints, he is aware of the extent to which they are affecting him. His perfect performance on this task is another indication of his awareness of his own processing abilities; he knew how often to look at a sentence before giving a response.

Maria, in contrast to Marcus, still made some errors in the low-processing-load condition. These errors were on the same sentences that she made errors on in the high-processing-load condition, indicating that her correct performance in the real-time task was probably not dependent on chance. For two of the three sentences that she miscomprehended in the low-processing-load condition, she selected the same incorrect response as she had selected in the high-processing-load condition. Interestingly, these responses were reversed. For the target sentence
describing the boy climbing a tree, she selected the picture of the boy climbing a rock surrounded by trees, and for the target sentence describing the boy climbing a rock surrounded by trees, she selected the picture of the boy climbing a tree. These errors suggest that the path movement encoded by the classifier predicate was comprehended. However, she was not able to identify which nouns corresponded to the constituents in the classifier predicate. From the repetition task, it is possible to determine that Maria missed the sign ROCK, which would have disambiguated the target sentences lexically. Nevertheless, the classifier construction should have been sufficient to disambiguate the sentences since the boy climbs a “lump of something” in one case, and he climbs “a tall, narrow object” in the other instance. One interpretation of Maria’s error is that she selected a salient and semantically appropriate noun, TREE, that appeared later in the sentence about the boy and the rock, even though it conflicted with the classifier selection. This interpretation suggests that conceptual processing may take precedence over grammatical processing for adolescent first-language learners since Maria preferred an interpretation of the sentence that was conceptually coherent but involved an error in the classifier selection (the boy climbed the big lump of tree), over an interpretation that was grammatically correct, but conceptually ambiguous (the boy climbed the big lump of ??).

Repetition task. Participants’ responses to the repetition task were transcribed and then compared to the target sentences. Response accuracy was evaluated by identifying the relationship between signs in the response and signs in the target sentence according to one of the following five categories.

1. Identical: signs in the target sentence were reproduced without any changes to the root or to inflections. Responses that included additional morphemes were also included in this category.
2. Reduced: signs in the target sentence were stripped of their inflections or spatial modifications.
3. Semantic substitutions: signs in the target sentence were replaced by signs or phrases with the same meaning.
4. Phonological substitutions: signs in the target sentence were replaced by signs or phrases with similar phonological characteristics but a different meaning.
5. Omissions: signs in the target sentence were not encoded either semantically or phonologically in the response sentence.

Performance of the two participants was very similar on this task. Both participants omitted 51% of the target signs. Figure 17 shows the distribution of the signs they did produce across the other coding cate-
Figure 17. Categorization of responses relative to target signs in sentence-recall task

Figure 17. Categorization of responses relative to target signs in sentence-recall task.

Adolescent first-language acquisition

Each response type indicates a different type of processing by the participant. Identical responses, it could be argued, are not very informative, because it is possible to repeat a sign without understanding it. However, in a list of six to fifteen signs, it would be impossible to recall the list perfectly without some level of comprehension. Since the identical responses were distributed across the sentences and not clustered at the beginning and end of each sentence, we can assume that identical responses reflect signs that were comprehended and not merely parroted. Reduced signs indicate that the sign was perceived and underwent enough processing to extract the root from the sign. Since inflections and spatial modifications are fused with the root, producing a reduced form indicates that the participants were able to access the base meaning of a sign even in an inflected form. Semantic substitutions provide the strongest evidence of deep processing since the participants discarded the phonological form of these signs and retained only their meaning (cf. Sachs 1974). These three categories together provide the best indication of the proportion of signs that were processed, comprehended, and retained by the participants. Together, these three categories account for approximately 38% of all signs produced. These results are consistent with the findings of the real-time comprehension task that indicated that participants could identify the corresponding picture 38% of the time.

The phonological substitutions, in contrast to the other response types, provide clear evidence that correct lexical access was not achieved. Mayberry and Fischer (1989) originally reported this phenomenon for
late learners of signed languages. They found a disproportionate number of phonological substitutions in both sentence recall and shadowing tasks by delayed learners of ASL relative to native signers. Mayberry (1994) has interpreted this phenomenon as evidence that delayed learners of ASL must focus more attention on the phonological form of signs, reducing the attention and effort that can be applied to deeper levels of processing such as lexical access and comprehension. In the current study, this phenomenon was replicated. Participants sometimes produced signs in their responses that had no semantic relationship to the target signs but were clearly phonologically related. For example, in response to a sentence about the dog licking the boy, Maria produced the sign HORSE, which has the same handshape as the sign LICK, but is produced in a different location and with a different movement. Marcus produced the sign HURRY in response to this sentence. This sign also shares the same handshape component as LICK. Neither participant was able to produce a meaningful sentence in response to this target, and neither participant selected the correct picture in the high-processing-load comprehension task.

Combining the results of the three tasks, it appears that these individuals can comprehend sentences in ASL under ideal, but not normal, conditions. Their performance on comprehension tasks with high processing demands may not reflect their full competence in the language because they do not process signs as rapidly as early learners of the language and may need to view a sentence multiple times before fully comprehending the meaning. These results suggest that we should reconsider the role of processing demands in previous work with this population in order to tease apart effects of disrupted processing from effects of incomplete grammatical knowledge.

Discussion

This longitudinal study of two adolescent first-language learners provides a more consistent picture of language development than was demonstrated by Genie (Curtiss 1977) or E.M. (Grimshaw et al. 1998). Both participants made clear progress in the acquisition of two morphologically complex structures in ASL. In the first seven to twenty months of exposure, they began producing the target structures spontaneously and improved upon their use of the structures consistently over the subsequent years they were followed. After seven years’ exposure to ASL, both participants exhibited severe disruptions in their comprehension of ASL sentences in real time, but apparently, these disruptions were not so
severe as to prevent them from identifying and analyzing complex grammatical structures in ASL. If only comprehension measures had been used to evaluate these participants, they would look similar to Genie and E.M., but the language-production data are strikingly different and set these two groups of delayed first-language learners apart. Thus, two patterns in the data are somewhat counterintuitive. First, the fact that Maria and Marcus did not exhibit any of the reticence to produce language that was observed in Genie and E.M. is surprising. Second, it is rare across normal and atypical language learners that production performance is better than comprehension performance.

The differences in the volume of production across these two groups raise an interesting set of questions. How much did prior communication experience influence acquisition once these individuals were finally exposed to language? If Genie and E.M. had been able to articulate more easily, would they have shown the same pattern of better production than comprehension skills? Does the modality of the language influence the degree to which it can be acquired in adolescence? The data do not allow us to resolve these issues, and thus, they leave open the possibility that these two populations of adolescent first-language learners face very different tasks in their attempts to acquire language. But the contrasting results from these populations demonstrate that it is essential to assess both production and comprehension skills in adolescent first-language learners in order to fully understand how delaying the process of language acquisition affects individual outcomes.

The most important finding in this study is the surprising pattern of better production than comprehension performance. This pattern of performance is consistent with the explanation that delaying exposure to language disrupts language processing, which in turn slows an individual’s mastery of grammatical constructs but does not prevent it completely. The narrative retelling task placed fairly low processing demands on the participants because it allowed them to use the target-language structures under their own control, rather than requiring them to produce them on demand. The comprehension task, by contrast, did not allow for any flexibility or choice on the part of the participants. Results from the high-vs. low-processing-load comprehension tasks indicate that performance can improve dramatically when processing demands are reduced. It is possible that previous reports of adolescent first-language learners’ grammatical deficits are an expression of a confluence of multiple factors, not solely a lack of grammatical knowledge. The results suggest the need to investigate language processing in delayed learners more carefully, with particular attention to how changes in processing demands affect performance.
Language development is highly variable across individuals, and with only two individuals participating in the current study, it is necessary to be cautious about generalizing from this data set. However, this is not the only research to suggest that processing efficiency may sometimes make delayed signers appear less proficient in ASL than they are. Emmorey, Bellugi, and colleagues (1995) measured reaction time in a sign-monitoring task. Native signers responded to the target signs much faster than signers who learned ASL from ages four to twenty in sentences that were error-free. An error in verb agreement just prior to the target sign slowed native signers but not delayed signers. In other words, the presence of the error clearly disrupted the normal processing pattern of the native signers, but not of the delayed signers. On first reflection, this pattern of results would seem to suggest that the delayed signers weren’t aware of the errors. However, the investigators controlled for this possibility by giving all subjects a grammaticality-judgment task, which indicated that the delayed signers could identify which test sentences contained errors in verb agreement just as accurately as the native signers. Thus, the results provide an unambiguous demonstration that in some cases processing can proceed differently in native vs. delayed learners of ASL even though their grammatical knowledge is comparable.

Another important finding of this study is that while both participants made consistent progress in grammatical development, the specific learning path of each individual varied. Maria’s acquisition pattern is more similar to what has previously been reported in the literature for adult delayed learners of ASL. In the initial period after her exposure to ASL, she stopped using homesign and depended primarily on monomorphemic signs in ASL. However, she did eventually advance to using polymorphemic structures more often than not to encode the target events. In contrast, Marcus continued using homesign after acquiring some ASL signs but then moved directly to using classifier predicates and agreement verbs without an intermediate stage of dependence on single-morpheme signs.

These differences in the path of acquisition may be related to personal characteristics of these two individuals. Maria was very concerned with conforming to standards set by her teachers and wanted to know the “correct” sign. She hesitated to communicate when she didn’t know an ASL sign and would even use an ASL sign with the wrong meaning before using a gesture that was clear but that was not ASL. Her signing appears to be more complex if we look only at the number of signs per utterance, probably in part because she used many uninflected signs. Marcus was much more motivated by standards set by his peers. He had little motivation to perform well in the classroom but enjoyed and pursued
opportunities to interact with other students. Marcus was very expressive and used many full-body gestures in homesign. He learned to use classifier predicates almost a year earlier than Maria. On superficial measures such as utterance length, Marcus appears to lag behind Maria, but his use of classifier predicates and agreement verbs demonstrates that on some characteristics of language he was relatively advanced. These differences in acquisition style are reminiscent of the differences in child learners described by Peters (1977) as analytic vs. gestalt learners. Some individuals appear to be more sensitive to the individual words before learning how to combine them to create larger units, while other individuals are more sensitive to prosodically salient larger units and only subsequently identify the parts of those units.

The results of this study suggest a need to revise general claims that are made about the impossibility of mastering grammar in adolescence (e.g. Pinker 1994). First, it is possible that acquisition of a spoken language in adolescence after virtually no experience using the vocal tract and the auditory system for the processing of speech throughout childhood is indeed impossible, but that signed languages can still be acquired at these ages because homesigners have been processing gestural information throughout childhood. If this is the case, it suggests that it is not grammar per se but also the sensory systems that allow us to rapidly decode and encode grammatical information that depend upon early experience for proper development. Second, it is possible that previous work underestimates the grammatical knowledge of adolescent first-language learners because these individuals are particularly susceptible to task demands. The extreme variability in Genie’s and E.M.´s results on language-comprehension tasks could reflect performance factors as much as variability in their competence.

Perhaps the most important implication of the study results is that adolescent first-language learners are denied access to language not once, but twice, in their lives: first, during childhood when a set of atypical circumstances, such as deafness, prevents them from being exposed to language, and second, by virtue of the fact that even when they are exposed to language they cannot always process it quickly enough to identify the patterns they are trying to learn. In other words, one of the effects of isolation is continued isolation. What begins as a characteristic of an individual’s environment, that is, no availability of language, conditions a characteristic of an individual’s internal capacities, that is, the ability to access language in the environment. If this is the case, a complete understanding of how delaying exposure to language affects acquisition requires attention not only to the mastery of language struc-
ture, but also to the ability to display this knowledge as processing demands and resources vary.

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Appendix. Notation system

<table>
<thead>
<tr>
<th>Sign type</th>
<th>Transcription</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestures:</td>
<td>lower-case, italics</td>
<td>hopping</td>
</tr>
<tr>
<td>Signs:</td>
<td>capital letters</td>
<td>FROG</td>
</tr>
<tr>
<td>Signs without simple</td>
<td>words connected by hyphens</td>
<td>GO-TO-SLEEP</td>
</tr>
<tr>
<td>translations:</td>
<td>plus</td>
<td>OUT +</td>
</tr>
<tr>
<td>Repeated signs:</td>
<td>locus of point follows “PT&gt;”</td>
<td>PT &gt; picture</td>
</tr>
<tr>
<td>Points:</td>
<td>denoted by CL, followed by the handshapes of the dominant and nondominant hands [DH &amp; NDH], or both hands when they are the same [2H], the path direction, and a gloss in parentheses</td>
<td>CL:[DH:bentV/NDH:C]-out (= animal exits container)</td>
</tr>
<tr>
<td>Classifier predicates:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>denoted by CL, followed by the handshapes of the dominant and nondominant hands [DH &amp; NDH], or both hands when they are the same [2H], the path direction, and a gloss in parentheses</td>
<td></td>
</tr>
<tr>
<td>Agreement:</td>
<td>subscripts: 1 = first person, 3 = non–first person, a &amp; b = locations in space</td>
<td>LOOK_a</td>
</tr>
<tr>
<td>Emotional facial expression:</td>
<td>underline after associated sign</td>
<td>LOOK-AT_surprised</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classifier handshapes</th>
<th>Meaning</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>See Figure 18</td>
<td>animate</td>
<td>bentV</td>
</tr>
<tr>
<td>See Figure 19</td>
<td>animate</td>
<td>V</td>
</tr>
<tr>
<td>See Figure 20</td>
<td>flat surface</td>
<td>B</td>
</tr>
<tr>
<td>See Figure 21</td>
<td>cylinder</td>
<td>C</td>
</tr>
<tr>
<td>See Figure 22</td>
<td>tree</td>
<td>5arm</td>
</tr>
</tbody>
</table>

Figure 18.  bentV handshape
Figure 19.  $V$ handshape

Figure 20.  $B$ handshape

Figure 21.  $C$ handshape

Figure 22.  $S$ arm handshape
Notes

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 University of New Mexico, Humanities 526, Albuquerque, NM 87131-1196, USA.
 E-mail: morford@unm.edu.

1. There is an enormous literature on delayed acquisition of spoken language by second-
 language learners. This literature is not addressed here because adolescent second-
 language learners have enormous advantages relative to adolescent first-language
 learners. Interested readers are referred to Birdsong (1999) for a recent review of work
 in this area.

2. The use of the term “agreement” refers to the fact that information about the subject
 and/or object can be encoded by making modifications to the form of these verbs. It is
 important to point out that not all ASL verbs can incorporate these modifications to
 denote subject and object, thus the “agreement” system of ASL is not directly compar-
 able to agreement in spoken languages. See Liddell (2000) for an alternative analysis of
 these forms in ASL.

3. E.M. provides an interesting triangulation point to Genie and homesigners who learn
 ASL, since he brought the experience of prior gesture use to the situation of adolescent
 first-language learning but had to switch modality to spoken language. It would be
 interesting to compare the acquisition of spoken vs. signed language in such an indi-
 vidual in order to investigate whether the benefits of gestural communication are
 modality-free, as well as the degree to which difficulties in articulation can disrupt
 acquisition of language structure in delayed learners. This population is quite different
 from individuals with severe speech and physical impairments who are not able to
 articulate language, but who have developed comprehension abilities from birth (see
 Bishop 1993 for a review).

4. Morphemes for orientation, location, and position were not included because they could
 potentially exaggerate the proficiency of the participants. A previous study of gesture
 production found that hearing individuals with no knowledge of ASL produced these
 morphemes with near-perfect accuracy if they used one hand to represent the ground
 and one hand to represent the figure in motion events (Singleton et al. 1993). Thus,
 although there were a few errors in these morphemes, the overwhelmingly correct pro-
 duction of them may reflect the fact that the participants are mapping figure and ground
 onto their two hands rather than the fact that they have mastered all of these
 morphemes.

5. After pilot analyses, it was determined that the inclusion of manner in the number of
 morphemes per predicate could be misleading since it was only present on some predi-
cates. Thus, the production of three correct morphemes sometimes reflected the correct
production of both classifier handshapes plus path, while at other times it reflected the correct production of only one of two classifier handshapes plus path and manner. For ease of comparison across event descriptions, manner was not included in this analysis.

6. The figures do not show the actual participants. A deaf ASL signer studied the original sentences on videotape and modeled them as closely as possible.

7. Recall that some verbs in ASL can encode information about the subject and object by moving the verb from a locus associated with the subject to a locus associated with the object (or vice versa). Uninflected verbs are typically produced in neutral space in front of the signer, or with movement away from the signer. For example, the uninflected form of the verb GIVE starts at the location of the signer and moves directly forward. See Figure 1.

8. The term “language processing” is used broadly here to refer to all mental computations involved in comprehension, including, for example, perception, segmentation, lexical access, and retrieval. This term is used to focus the reader on the procedural rather than the propositional component of language use. The data in this study are not sufficient to specify with more precision why language processing is disrupted.

9. I am grateful to Joan Bybee for pointing out this interesting parallel.

References


Lillo-Martin, Diane; Bellugi, Ursula; Struxness, Lucinda; and O’Grady, Maureen (1985). The acquisition of spatially organized syntax. Papers and Reports in Child Language Development 24, 70–78.


