The Acquisition of Synonyms in American Sign Language (ASL): Toward a Further Understanding of the Components of ASL Vocabulary Knowledge

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Abstract

A receptive, multiple-choice test of ASL synonyms was administered to Deaf children in order to determine both their vocabulary development and the metalinguistic skills necessary for them to identify synonyms. A total of 572 Deaf children who were 4;0–18;0 years of age were tested: 449 Deaf children of hearing parents (DCHP) and 123 Deaf children of Deaf parents (DCDP). The performance of both groups improved with age, with DCDP scoring higher than DCHP from 8–9 years old and up. An error analysis showed a decrease of phonological foil choices with increasing age in both groups. Learners in both groups relied more on semantic knowledge and less on phonological knowledge for this semantic task as they became older, which is the same pattern observed for typically developing hearing children acquiring a spoken language. This indicates that DCHP and

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DCDP resemble hearing children in the strategies they use to identify synonyms. In addition, DCHP follow the same developmental trajectory as DCDP but are delayed, which is consistent with the less than ideal levels of language input they receive.

Investigating children's vocabulary-learning patterns has long been a crucial method of understanding the development of language and metalinguistic awareness (Menyuk 1991). The measurement of children's acquisition of synonyms has been fruitfully used as an indicator of both the breadth and the depth of their vocabulary (Paul and O'Rourke 1988). Recently developed sign language vocabulary tests have shed light on the vocabulary knowledge of Deaf children in Italian Sign Language (Tomasuolo et al. 2010) and in British Sign Language (Mann and Marshall 2012). In the United States, however, research on the American Sign Language (ASL) vocabulary development of Deaf children is limited (Mann and Prinz 2006). This article investigates the performance of Deaf children of Deaf parents (DCDP) and Deaf children of hearing parents (DCHP) four to eighteen years of age on a test of ASL synonyms and examines the errors they made.[1]

First we discuss the acquisition of sign language vocabulary in general. We then define and describe the development of synonym knowledge in hearing children and Deaf children. Next we discuss the developmental literature on semantic and phonological knowledge of ASL, and we conclude with a presentation of the current study predictions.

Vocabulary Acquisition in Sign Language

Deaf individuals who are exposed to sign language at an early age are given an opportunity to acquire a language naturally, just as do hearing individuals who are exposed to a spoken language. However, the great majority of Deaf children (roughly 90–95 percent) are born to hearing families (Mitchell and Karchmer 2004). Many of these children are exposed only to oral language from birth, and if they are exposed to sign language at all, it typically happens when they first attend school or a program for Deaf children (i.e., around the ages of 4;0–6;0 years). For Deaf children who are first mainstreamed, their matriculation into a school or program for Deaf students may occur much later—and in many cases only after they do not succeed in the mainstreaming environment. In addition, if their hearing parents do learn ASL, these parents tend to sign only when directly addressing their Deaf child and not while in conversation with other hearing family members (Marschark 1997). Thus, the opportunities for a Deaf child of hearing parents to be exposed to sign language by observing the interactions of others is usually limited (ibid.). In contrast, the acquisition of sign language by Deaf children whose Deaf parents expose them to it from birth resembles the acquisition of spoken language by typically developing hearing children (Corina and Singleton 2009, among others). Deaf babies babble gesturally (Petitto 1987), they enter a one-sign stage at 6–12 months, and their first ten signs are produced around the end of the first year (Mayberry and Squires 2006). Deaf toddlers reach the fifty-sign milestone around 20 months (ibid.) and combine signs at 18–24 months (Newport and Meier 1985). In addition, the vocabulary of particular semantic domains (e.g., question words, emotion words, cognitive verbs) of native Deaf children acquiring ASL is similar to that of their hearing peers (Anderson and Reilly 2002).

Language assessment tasks also provide similar results with regard to vocabulary development in children who use a sign language and children who use a spoken language (Mann and Marshall 2012; Tomasuolo et al. 2010). Tomasuolo et al. (2010) tested thirty Deaf and thirty hearing Italian children, all of whom were 6–14 years of age. All of the Deaf participants had profound bilateral deafness, and none of the children presented cognitive impairments. The participants were tested on the Boston Naming Test (Kaplan, Goodglass, and Weintraub 1983). The results showed that hearing children and Deaf children performed similarly on the task, suggesting that the acquisition of nouns in Deaf children is similar to that in hearing children. On a British Sign Language vocabulary test, twenty-four Deaf participants who ranged in age from 5 to 15 years old performed better on a task of choosing a matching sign for a target picture than on an open task of providing a matching sign for a target picture. This result is similar to what has been found for comparable tests in spoken languages (Mann and Marshall 2012), suggesting that recognition tasks are easier than production tasks for children who use sign languages, and that performance in both sign languages and spoken languages depends on the task requirements.

In summary, vocabulary development in sign language is similar to that in spoken language. In the next section we discuss more specifically how facility with synonyms points to one's semantic knowledge of a language.

Knowledge of Synonyms

One's vocabulary depth consists of the number of different meanings and usages that one possesses for individual words, and this knowledge has a large influence on reading comprehension (Paul and O'Rourke 1988). Hoffmeister (1994) suggests that there are three vocabulary skill levels: (1) knowing a direct definition (i.e., "dictionary knowledge"), (2) knowing how a word or sign is used in a sentence (i.e., "contextual knowledge"), and (3) knowing similarities and differences among the meanings of words or signs. Recognizing the similarities and differences among words or signs is a metalinguistic skill that involves the first two skill areas: direct definition and contextual knowledge.

Charles, Reed, and Derryberry (1994) tested this hypothesis by measuring the accuracy on a judgment task of three kinds of adjectival relationships: direct antonyms (e.g., hot-cold), indirect antonyms (e.g., hot-frigid), and synonyms (e.g., hot-warm). The results showed quick and accurate judgment of direct antonyms and more efficient judgment of synonyms than of indirect antonyms. Interestingly, even when the direct synonyms and direct antonyms were equivalent in terms of relatedness (e.g., hot-warm and hot-cold), the direct antonyms were still judged more efficiently. These findings suggest that the relationship of words with similar meaning is more difficult to process than that between words with opposite meanings. Although research shows that synonym acquisition is a complex metalinguistic task that requires an understanding of the nuances of the language, generally most children with access to language naturally develop vocabulary that includes synonyms (Doherty and Perner 1998).

The Development of Synonyms in Spoken Languages and Sign Languages

Hearing children seem to acquire synonyms slightly later than antonyms, as children under the age of 4 typically failed a synonym task, whereas children 4 years of age and older usually passed it (Doherty and Perner 1998). This finding supports the principle of lexical contrast (Clark 1987), suggesting that the meaning of any new word must contrast with that of other words. The synonym task used was described as metalinguistic because "to solve the synonym task, the child has to realize that something can be described (represented) in different ways, for example: 'a bunny' is also 'a rabbit'" (Doherty and Perner 1998, 298). The recognition that a concept may have two or more lexical forms that may be used to represent similar semantic intent is an important milestone in children's metalinguistic knowledge.

At present, only one study has tested synonym knowledge in sign language (Borman et al., 1988). The metalinguistic skills of twenty Deaf children aged 5;7–10;7 years from Total Communication classrooms[2] were tested using a judgment synonymy task (ibid.). The task was presented to the students via video in ASL, Signed English, and Pidgin Sign English.[3] The latter two represent nonnatural signing systems that are used in Total Communication. Before introducing the synonymy task, the students' comprehension was tested to make sure they understood the sentence constructions used in the study (e.g., "We have more toy trucks than balls"). The students were shown nine pairs of pictures and asked to point to the picture that represented the sentence that was assigned to them. All of the students scored 6 out of 9 or better in this pretest, suggesting little or no comprehension difficulties. In the judgment task, two signed sentences were presented. Participants were to determine whether the meanings of the sentences were the same or different. The sentences varied in the presentation format (i.e., ASL, Signed English, or Pidgin Sign English). The results showed that performance was only slightly better than chance and did not vary according to the sign format, indicating that the children lacked the metalinguistic awareness needed to judge the synonymy of sentence pairs regardless of the sign format used. The researchers concluded that an understanding of synonymy in the three sign formats might not appear until the Deaf children are older (after the age of 10), which would be a significant delay compared to hearing children. Another explanation is that the participants' level of sign development was quite low and did not allow them to perform the task. However, the design of the study does not allow this alternative to be excluded.

The Borman et al. (1988) study did not include an important control group: Deaf children of Deaf parents (DCDP) who are exposed to natural sign language. In a Total Communication environment, Deaf children obtain only partial exposure to ASL; therefore it is questionable whether any of the participants in this study had a language base that would promote their success on this task. In order to address this issue, the present study tested DCDP who have had access to ASL, their native language, from birth. We were thus able to explore the nature of language development of Deaf children in two contrasting conditions: DCHP who are exposed to diverse input and receive possibly incomplete exposure to the language and DCDP who experience consistent natural language input from birth.

There is always the question of the degree of knowledge even when a child does not know the correct synonym for a word or a sign. The current study explores the types of errors Deaf children produce when they lack full access to or knowledge of a target word. The next section discusses how we can learn more about this partial knowledge in spoken languages and in sign languages.

Phonology and Semantic Knowledge of Signs

Semantic Knowledge. Studies have shown that sign languages and spoken languages are similar in their linguistic structure (MacSweeney et al. 2009). Thus, we expected to find similar lexical-semantic acquisition in both signed and spoken lexical items (Mason et al. 2010). In order to explore semantic knowledge in sign language, Tomasuolo et al. (2010) compared the types of errors children aged 6–14 years produced in spoken and signed (Italian Sign Language) modalities when tested on a naming task of nouns presented in pictures (Boston Naming Test; Kaplan, Goodglass, and Weintraub 1983). Although Deaf and hearing children obtained similar percentages of correct responses (70 percent and 67 percent, respectively), they differed in their errors. When failing to label the objects, Deaf children described them using their visual characteristics (e.g., for a picture of a mask one child described the threatening expression and sharp teeth instead of producing the correct sign). In contrast, the hearing children described the function of the object. Tomasuolo et al. (2010) argue that this difference can be explained by the characteristics of the language used. They suggest that Deaf signing children pay more attention to the visual characteristics of the target objects, reflecting the salience of the visual channel for Deaf children. Other studies describe the semantic similarities between the spoken and sign modalities. Marshall et al. (2012) tested twenty-two Deaf signers ages 4–15 years on a semantic fluency task of British Sign Language; in this one-minute task a child is asked to sign as many signs as possible from two semantic categories: animals and food. With age, the children demonstrated an increase in productivity and semantic clustering of responses in their signs (e.g., a cluster of farm animals; a cluster of fruits). The two studies (i.e., Marshall et al. 2012; Tomasuolo et al. 2010) present similar correct-performance levels in Deaf children, thereby supporting the hypothesis that lexical processes in sign languages are comparable to those in spoken languages.

Knowledge of Phonology. A sign-reproduction task revealed that signers acquire the phonological structure of a language over time during language development (Mayberry, Hatrak, and Morgan 2011), suggesting that the types of errors signers make represent their phonological knowledge of the language. When comparing the phonological characteristics of spoken languages and sign languages on different tasks, children present similar patterns for the two modalities. In Tomasuolo et al. (2010), the phonological errors on the naming task (termed "form errors") were rare in both groups: 11 percent in the Deaf group and 3 percent in the hearing group. The low percentage of phonological errors in both groups could be a result of the task itself, as no time limit was imposed; both groups described the target when they could not name it. This small proportion of phonological errors aligns with previous research of typically developing children on naming tasks (Dockrell, Meser, and George 2001). Mayberry and Fischer (1989) also demonstrated that proficient signers tend to make more semantic errors, whereas less proficient signers (the nonnative signers in their study) tend to make more phonological errors in a shadowing narratives task. These results suggest that as one becomes more proficient in ASL, one makes fewer phonological errors (ibid.). In a study that used a recognition task with signs and pictures, Deaf children were affected by phonologically related sign pairs (Ormel et al. 2009). The children (aged 8;1–12;2 years) had to decide whether a sign and a picture presented on a screen referred to the same concept. They showed longer response times and made more errors when the signs and the signs for concepts that the pictures represented were phonologically related, which is similar to the types of mistakes made in spoken languages on comparable tasks. The task in this study is not a direct vocabulary acquisition task but rather a high-pressure, language processing task. However, the results suggest that, when signs share phonological features, inhibition occurs, which leads participants to slower and less accurate responses. These findings are important for the current study as they suggest that neighborhood phonological density affects psycholinguistic tasks, and that at these ages (8–12 years) Deaf children process the phonology of signs.

The current study tested vocabulary development in a receptive synonyms task that included both semantic and phonological foils. It is generally accepted that this type of contrast can provide clues regarding which stage of lexical-semantic processing has been disrupted in atypical language acquisition (Breese and Hillis 2004): phonological foil choices support failure in an earlier phonological stage of word processing, whereas semantic foil choices support failure in later semantic stages of word processing. In the current study, this assumption has been adopted in order to explore the development of the lexical-semantic acquisition process in a sign language.

We predicted that children would perform more accurately on the task as they increased in age and that the DCDP would outperform the DCHP. Based on both the developmental findings on Deaf children and the similarities between sign languages and spoken languages in the acquisition of their phonology, we therefore predicted that young Deaf children would demonstrate awareness of the phonological structure of signs. Last, we assumed that, with age, Deaf children in both groups become more proficient in ASL and have more extensive semantic knowledge; thus we also predicted that, when participants did not choose the correct answers, they would increasingly select semantic foils with age and decreasingly select phonological foils.

Method

Participants

Data were collected from 572 Deaf students between the ages of 4 and 18 years (see table 1). The participants were grouped by parental hearing status: 449 DCHP, who were first exposed to ASL-using

Table 1. Number of Participants by Age and Parental Hearing Status

Age	4–5	6–7	8–9	10–11	12–13	14–15	16–18	Total
DCDP	9	27	26	12	17	22	10	123
DCHP	9	64	67	66	85	64	94	449
Total	18	91	93	78	102	86	104	572

Deaf adults upon entering the educational system, and 123 DCDP, who were exposed to ASL-using Deaf adults from birth (and are thus considered to be native signers).

It is important to note that although the DCDP group is small in comparison to the DCHP group, it represents 22 percent of the sample, whereas in the population at large, only 5 –10 percent of Deaf children are born to Deaf parents (Mitchell and Karchmer 2004). Participants were divided into age groups spanning two years in order to have larger numbers of DCDP in each group.

Materials

The synonym task used in this study is a video-based, receptive, multiple-choice subtest of the ASL Assessment Instrument (ASLAI; Hoffmeister et al. 1989). Each of the fifteen stimulus items consisted of a prompt (1) and four response options selected from five possible types: the target (a), a semantic foil (b), a close phonological foil to the prompt (c), a distant phonological foil to the prompt (d), or an unrelated foil that is neither related semantically nor phonologically to the prompt (e). Please note that this meant that the fifteen questions varied in the composition of their response options, as only four of the five types of responses were selected for any given question.

Sample test question:

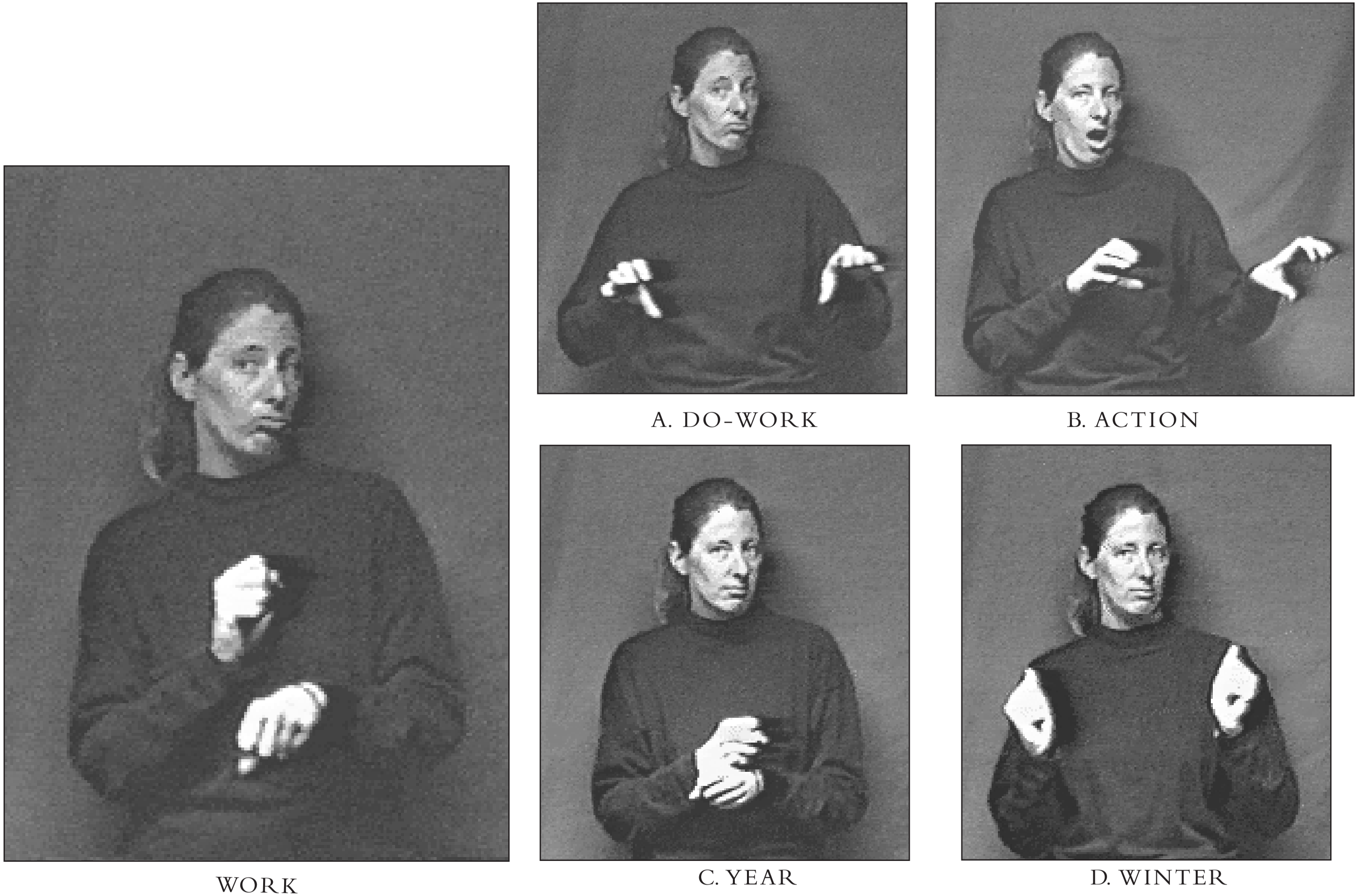
1. Prompt: WORK[4] (see figure 1).
   a. target: DO-WORK
   b. semantic foil, semantically related to both prompt and target: ACTION
   c. phonological foil close to the prompt, a minimal pair, different from the target in only one phonological feature: YEAR
   d. phonological foil distant from the prompt, different from the target in more than one phonological feature: WINTER

The task was piloted on a group of ten native adult signers. Only items that were answered correctly by nine or all ten signers were included in the test.

Testing Procedures

The synonym task was presented to small groups of participants, with videotaped instructions and two demonstration items presented by a native signer. Participants then viewed two practice items followed by the fifteen test items. For each item, the video presented the stimulus followed by four response choices. After the participants had viewed a stimulus and its four corresponding response options, they were to select the response that best reflected the synonym of the prompt. Two types of paper response forms were used: an answer sheet and an answer booklet. The answer sheet contained the item numbers followed by the letters A, B, C, and D, whereas the booklet contained reprints of five video stills from each test item and its response options. The purpose of the answer booklet was to ensure that the task did not become a memory task as it allowed students to recall the items that otherwise faded from view after they had seen the video. Students aged 8 or younger responded directly on the answer booklet for ease of test taking. The older students were provided with both an answer sheet and a booklet and responded on the answer sheet. An example of a question from the response booklet is presented in figure 1.

Analysis. We examined both percent-correct scores and, when errors were made, whether learners chose the phonological or the semantic foil. To compare scores between different age groups and learners with different parental hearing status within the same age group, the Mann Whitney test was used. For the error analysis we analyzed a subset of six questions in which the types of foils were consistent in the following way: the correct response, a semantic foil, a close phonological foil to the prompt, and an unrelated foil. For comparisons between phonological foils and semantic foils, we used the Wilcoxon test to determine whether distributions of our paired samples differed. For planned orthogonal comparisons, we used Dunn's procedure, which is a nonparametric procedure equivalent to the ANOVA test where the level of significance is divided by the number of comparisons



WORK

A. DO-WORK

B. ACTION

C. YEAR

D. WINTER

FIGURE 1.

performed (Kirk 2009, 497). In the current study seven comparisons were performed, resulting in $p \leq .05 / 7 = p \leq .01$, as described in the next section.

Results

Correct Performance Scores

The results reveal a clear acquisition effect for the development of synonyms in our participants. With age, the performance of the participants in both groups increased, as figure 2 shows.

In the DCDP group, developmental growth in performance on the task was found with a maximum score of 84 percent correct at the age of 16–18 years. For the DCHP group, development was more gradual, with a maximum score of 57 percent correct at the age of 16–18 years, which is equivalent to the achievement of the 8–9-year-old DCDP in our sample (figure 2). Both DCDP and DCHP groups performed at chance level at the ages of 4–5 (18 percent and 26 percent, respectively) and performed above chance level at the ages of 6–7 (37 percent and 30 percent, respectively). Although no significant difference was found in the performance of the DCDP and DCHP groups at the ages of 4–5 and 6–7 ($z = 0.57, p = .57$; $z = 0.9, p = .37$,

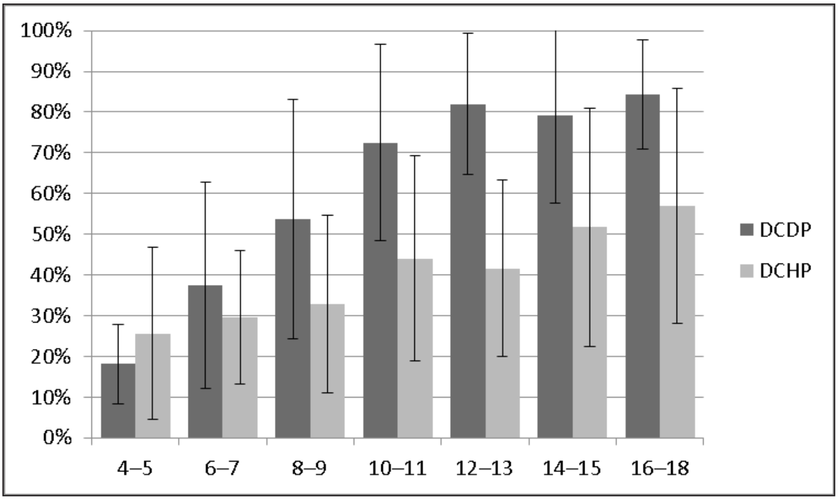


Figure 2. Average correct performance (%) as a function of age and parental hearing status.

respectively), at all ensuing ages the DCDP performed significantly better than the DCHP (ages 8–9: z = 3.03, $p < .01$; ages 10–11: z = 3.28, $p = .001$; ages 12–13: z = 5.41, $p < .0001$; ages 14–15: z = 3.77, $p < .001$; ages 16–18: z = 2.48, $p < .01$).

We further compared the performance of DCDP and DCHP across three time periods of their schooling: preschool and elementary school (ages 4–10), middle school (ages 11–14), and high school (ages 15–18). See figure 3. These groupings allowed us to run a planned orthogonal comparison equivalent to an ANOVA test. The number of comparisons performed was seven; thus for a significant difference, p was expected to be $p \leq .05 / 7 = p \leq .01$ (Dunn's procedure; Kirk 2009, 497). For the DCDP group, a significant difference in performance occurred between preschool and elementary school compared with middle school (z = 5.65, $p < .0001$), with no significant difference in performance between middle school and high school (z = 0.56, $p = .58$). In contrast, the DCHP group showed a significant difference in performance between preschool and elementary school compared with middle school (z = 3.87, $p = .0001$) and a significant difference in performance between middle school and high school (z = 3.03, $p < .01$). These results suggest that the DCDP

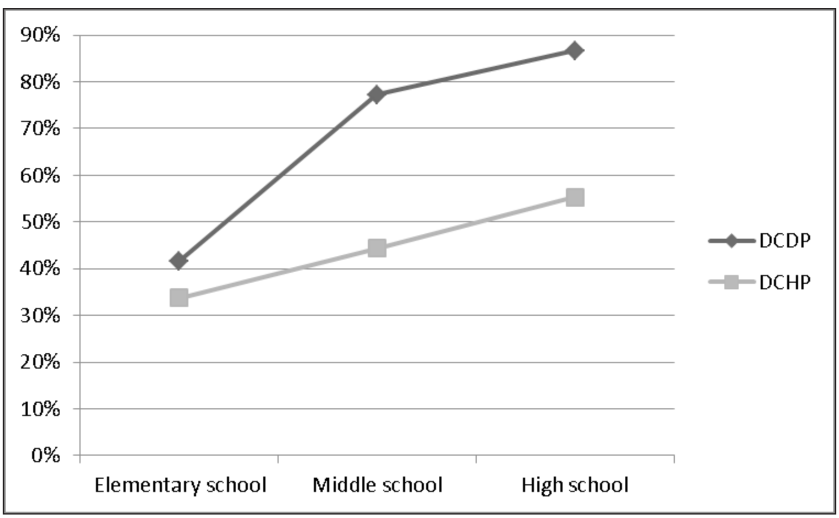


FIGURE 3. Mean percentage correct over three time periods of schooling as a function of parental hearing status.

group achieved high performance levels on the test in middle school and that the DCHP group showed continuous development through high school. The comparison of the two groups in each time period revealed no significant difference between preschool and elementary school ($z = 1.44$, $p = .15$). In middle school and high school, the DCDP group performed significantly better than the DCHP group ($z = 6.5$, $p = .0001$; $z = 4.44$, $p = .0001$, respectively).

In summary, the results demonstrate a developmental path on the synonym task for both groups, with DCDP performing better overall than the DCHP group.

Error Analysis: Semantic versus Phonological Errors. While correct performance on the synonym task is evidence of vocabulary development over time, specifically of vocabulary depth, an examination of the incorrect choices provides insight into what children do know when they do not yet know the correct answer. To explore this question, we analyzed a subset of six questions that represent a contrast between semantic and phonological knowledge based on their foils. In these six questions the foils included a semantic foil, a phonological foil, and an unrelated foil. For example, in one question the prompt was STUMPED, the semantic foil was DIFFICULT, the close phonological foil to the prompt (differing in only one phonological parameter) was NAB, and the unrelated foil was VOICE. As figure 4 shows, correct performance on these six questions resembles correct performance on the complete test, allowing the analysis of the error patterns in these six questions.

To test the difference between phonological foils and semantic foils, we compared the ratio of choosing the phonological foils and semantic foils with the total number of errors in all age groups (sum of 272 errors in the DCDP group and 1,445 errors in the DCHP group) for each child. We excluded eleven children (aged 11–17) from the DCDP group and eight children (aged 14–18) from the DCHP group who performed at ceiling from this analysis and thus had no errors. The remaining children in the DCDP group chose more phonological than semantic foils; however, this pattern was not significant for any of the age groups except the 10–11-year-olds ($w = 7$, $p < .05$).[5] One explanation for this result could lie with the distribution of the errors within the DCDP group, as most of their errors (112/272, 41 percent)

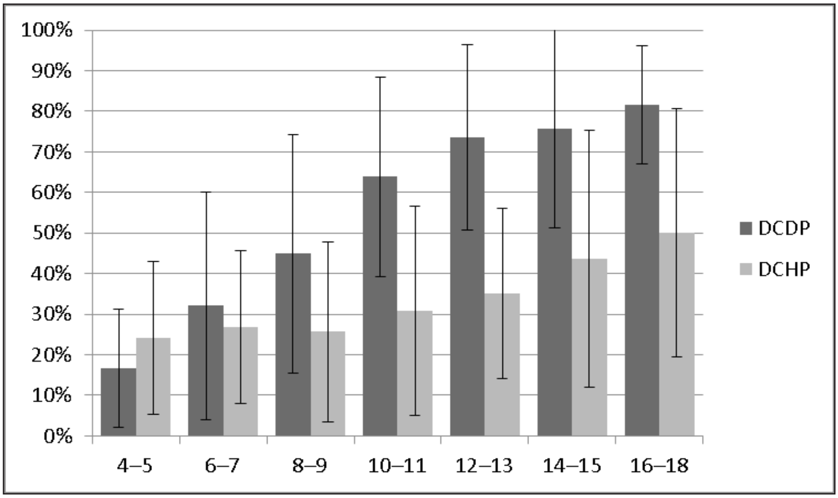


FIGURE 4. Average correct performance (%) on the six selected questions.

occurred in the two youngest age groups (i.e., 4–5 and 6–7), with the two oldest age groups (i.e., 14–15 and 16–18) making only 39 errors total. In the DCHP group, more phonological than semantic foils were chosen by all age groups except for the older age group, in which the pattern was reversed and semantic rather than phonological foils were chosen (figure 5). The difference between phonological and semantic foils was marginally significant (one-tailed *p*) at ages 6–7 (z =1.59,

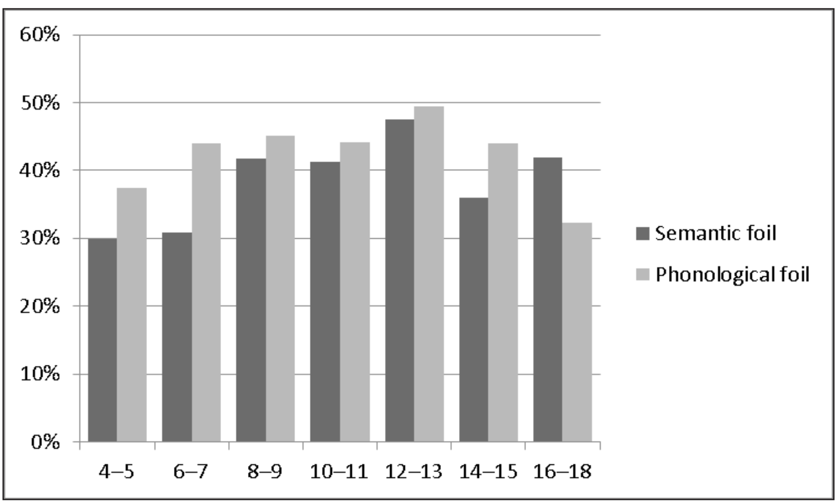


FIGURE 5. Ratio of selection of semantic and phonological foils in the DCHP group.

Table 2. Phonological and Semantic Foil Choices (%) by Age and Parental Hearing Status

	4 –13-Year-Olds			14 –18-Year-Olds		
Age Group	Phonological foils	Semantic foils	Wilcoxon test	Phonological foils	Semantic foils	Wilcoxon test
DCDP	44	32	$z = 2.01$, $p = .04$	38	33	$z = 0.32$, $p = .75$
DCHP	46	38	$z = 2.74$, $p < .01$	37	40	$z = 0.49$, $p = .62$

p =.05), 8–9 ($z = 1.36$, $p = .08$), and 12–13 ($z = 1.56$, p =. 05). The difference was not significant at ages 10–11 ($z = 0.71$, $p = .23$) and 14–16 ($z = 1.13$, $p = .13$). At ages 16–18 the reverse pattern of semantic over phonological foils was marginally significant ($z = 1.51$, $p = .06$). The results indicate that younger age groups prefer phonological foils. This preference then reverses in the oldest age group, which prefers semantic foils.

To further explore this pattern, we then collapsed the subjects into two age groups: elementary and middle school (ages 4–13) and high school age (ages 14–18). In collapsing the percentage of errors into two age groups we had a larger number of errors per age group for the DCDP group. As table 2 shows, both DCDP and DCHP in the young group chose significantly more phonological than semantic foils, but the older age group showed no significant difference between the two types of foils for both DCDP and DCHP.

In summary, both groups performed similarly at the younger ages (4–7-year-olds), with scores just slightly above chance. The DCDP outperformed their DCHP counterparts at ages 8 and through the teenage years. In addition, when young Deaf children (either DCDP or DCHP) did not choose the correct answer, they preferred phonological to semantic foils. This strategy changes at 14–18 years of age for DCDP, when the ratio of choosing phonological foils and semantic foils was nearly identical. For DCHP, the strategy was reversed; this group chose semantic rather than phonological foils at 16–18 years of age.

Discussion

The current results reveal the developmental path of synonym comprehension in Deaf children from the age of 4 through adulthood.

Although the performance of the DCDP was significantly better than that of the DCHP, the nontarget choices were similar for the two groups: the younger age group (4–13) showed a preference for phonological foils, but this tendency decreased in the older age group (14–18). We next discuss the differences and similarities in the performance of the two groups and the implication of these to the development of vocabulary in ASL.

At ages 4–5 and 6–7, both DCDP and DCHP perform similarly on the synonym test, with results that are slightly above chance level for the 6–7-year-olds. At the age of 8, however, the two parental hearing status groups exhibit a significant difference in performance, one that widens with age. Whereas DCDP as a group achieved scores of 84 percent correct at the age of 18, at the same age, the DCHP achieved a score equivalent to that of the 9–10-year-old DCDP group (57 percent). This suggests that the synonym test we used is a sensitive vocabulary measurement of ASL: on the one hand, it shows improved performance of the two groups with age; on the other hand, it is precise enough to distinguish between the two groups and, presumably, the timing of their ASL exposure. The delayed and possibly reduced quality and quantity of exposure to ASL that DCHP receive are plausibly what reduces their ability to perform on this task.

This finding adds to the research literature on how both the timing and the nature of exposure to ASL influence vocabulary acquisition and is the first study to show the effects of sign language input on vocabulary development in sign language. Two findings are of particular interest: first, the highest score of the DCHP, which occurs in the 16–18-year-old group, is equivalent to the score that the DCDP achieved at 9–10 years of age; second, the performances of the DCDP and DCHP on this test first diverge at the age 8, and this gap between the two groups never closes.

The average DCHP score of 57 percent correct for the 16–18 age group is significantly lower than that of the DCDP (84 percent) at this same age. As mentioned earlier, the DCHP score is equivalent to the performance of DCDP at the age of 9–10. Mayberry and Eichen (1991) suggest that the number of years signing is less crucial to developing competence in ASL vocabulary than having access to appropriate adult language models from an early age. Our results support this assumption by demonstrating that DCHP, even at ages 16–18, were not able to achieve average performance levels comparable to those of DCDP beyond 9–10 years of age. For the DCHP, the lack of incidental input during their acquisition of ASL might explain this gap between the DCHP and DCDP groups. Children acquire vocabulary indirectly as well as directly (Luckner and Cooke 2010). Most vocabulary items are acquired indirectly through daily interactions with adults, siblings, and peers; such exchanges include conversations about routines, games, songs, and reading activities (Burns, Griffin, and Snow 1999; Landry and Smith 2006, among others). Whereas individual DCHP may overcome such early delays, the general finding for the overall DCHP group is clear: the key to successful acquisition of ASL (and any other sign language) vocabulary knowledge is consistent, high-quality, direct and indirect input (Hoffmeister 1982; Ramírez, Lieberman, and Mayberry 2011).

The current results are in line with previous studies showing that DCHP who are not exposed to good language models at an early age are at risk of reduced language ability in ASL (Mayberry, Lock, and Kazmi 2002; Mayberry 1992; Mayberry and Eichen 1991). Our results further indicate that compensating for this deficit is difficult even after years of ASL exposure and use in adulthood. These findings raise the question of how consistent and rich the ASL input is for Deaf children in the educational system. One could argue that DCHP are not proficient in ASL and that English is instead their dominant language. These results do not support this assumption, however, as the performance on the synonym task was found to correlate with that of reading comprehension of English ($r = 0.51$, $p < .01$) (Hoffmeister 2000), showing that the DCHP did not perform better in English than they did in ASL. These results show the critical importance for Deaf children of early language input that consists of consistent and high-quality sign language.

The second important finding regarding the developmental path of ASL synonyms is the age at which the gap between the DCHP and DCDP groups appears. At ages 4–7, no difference was found between the two parental hearing status groups; their average performance was slightly above chance. This suggests that the synonym test is difficult for both groups until the age of 8. This result is not surprising as previous findings have shown that, within the domain of vocabulary knowledge, synonyms are acquired relatively late (Charles, Reed, and Derryberry 1994). For instance, synonyms are emerging at the age of 4 in hearing children, and under the age of 4 hearing children failed the synonym task (Doherty and Perner 1998). It is difficult to compare the results from two different tests and languages; thus our results and Doherty and Perner's are not directly comparable. However, although the performance of the younger children in our study was only slightly above chance, an item analysis revealed that even the youngest DCDP (4–5 years old) performed significantly above chance on three items of the test. This result aligns with Doherty and Perner's results, that hearing children understand synonyms after the age of 4, suggesting that, for DCDP, synonym knowledge in ASL is acquired at the same age as in English.

The current results contrast with those of Borman et al. (1988), which show a delay in the acquisition of ASL synonyms by Deaf children. The group of DCDP who are native signers of the language in the current study can account for this difference. Our results suggest that native signers of ASL do not show a delay in their L1 synonym acquisition, as was also demonstrated for other domains of ASL (Mayberry and Lock 2003). These results should encourage parents, educators, and researchers to push for earlier access to ASL in order to provide all Deaf children with a robust linguistic foundation, which will in turn foster stronger academic skills in their L1 and ultimately lead to improved academic skills in their L2 (i.e., written English) (Fish, Hoffmeister, and Williams-McVey 2006a, 2006b; Hoffmeister 2000; Strong and Prinz 1997).

We now discuss the results that show no difference between the two parental hearing status groups in the pattern of errors. At the younger ages (4–13 years), both DCDP and DCHP selected more phonological than semantic foils when not choosing the correct response. After the age of 13, the proportion of erroneous phonological foil choices decreased in both groups. This decrease with age aligns with studies on word recognition in hearing children that show that errors shifted from being primarily phonological for young children (in second grade) to being primarily semantic for older ones (in sixth grade) (in written word recognition: Bach and Underwood 1970; in spoken words: Felzen and Anisfeld 1970; in a false memory task:

Dewhurst and Robinson 2004). However, while the shift to semantic foils in hearing children occurs at the age of 11–12 (sixth grade), this shift does not occur in the DCHP group until the age of 16–18. One possible explanation for this difference is the delay in lexical-semantic acquisition for the DCHP group. This delay is represented both in the low performance at this age (only 57 percent correct performance at 16–18 years) and in the delay of shifting from phonology to semantics in the linguistic mechanism. This assumption predicts that DCDP will show the shift from phonology to semantics at a younger age, similar to hearing children's acquisition of spoken languages. A task that will prompt more errors at the older ages and include a large group of DCDP is required to test this prediction.

Interestingly, the reduction over time of phonological foil choices in the current study is found for participants after age 13. Mayberry and Fischer (1989) showed that proficient signers made more semantic errors and less proficient signers (the nonnative signers in their study) made more phonological errors in sign production on different types of tasks. The authors argued that "to know a language means to be able to see through its phonological shape to its lexical meaning, automatically" (ibid., 753). The current results shed light on the same phenomenon from a developmental angle. With age, more exposure to ASL, and more depth of knowledge of vocabulary, the linguistic mechanism of Deaf children changes. Until high-school age, Deaf children of hearing parents process the language more through its phonological shape, but during high school (at 16–18 years) lexical meaning starts playing a greater role. However, this assumption needs to be further tested in DCDP adolescents on a more difficult task that will prime more errors and presumably show this effect.[6]

Conclusions

The results of the study discussed in this article indicate that Deaf children who are given access to ASL from birth possess metalinguistic knowledge of synonyms comparable to that of hearing children. In addition, our analysis of their errors on the synonym task indicates that both DCDP and DCHP employed a similar linguistic strategy, suggesting that the lexicon of young Deaf children in their signed modality is organized according to phonological parameters of the language. The finding of better performance by DCDP on the synonym task underlines the importance of access to fluent adult models of the language as close to birth as possible.

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Notes

1. This distinction between DCDP and DCHP has often been made in studies of the linguistic development of Deaf children (Newport and Meier 1985; Hoffmeister 1994, 1982).

2. Total Communication (TC) is an educational policy that encourages teachers to use all means of communication at their disposal, including ASL, English, pantomime, drawing, and fingerspelling. In practice, the Total Communication policy has become one of Simultaneous Communication, which is a communication strategy in which speech and signs are produced at the same time. This is also called sign-supported speech (Lane, Hoffmeister, and Bahan 1996).

3. A variety of visual communication methods expressed through the hands, Signed English attempts to represent the English language and generally follows the grammar of English. Pidgin Signed English is a combination of ASL and English.

4. Following convention, all English glosses of ASL signs are written in small capital letters.

5. The letter *w* is used when the number of comparisons is less than 10, as it is for this age group.

6. We have also developed an analogy test and are currently collecting data. We are investigating whether there is a difference between phonological and lexical-semantic foil choices in young and older DCDP.

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