

Volume 1: Principles,
Background, and Application

Simplified Signs

A Manual Sign-Communication
System for Special Populations



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7. Use of Manual Signs and Gestures by Hearing Persons

Contemporary Perspectives

So far in this volume, we have discussed the history of the sign languages of Deaf persons and their recognition as true and genuine languages, as well as the unique richness of meaning that can be conveyed through a visual-gestural mode of communication. Signs also have proven to be beneficial to the larger hearing societies in which Deaf people live, as shown by our exploration of the use of signs by hearing persons in various historical contexts. These contexts included the initial interactions of peoples who came from different cultures and/or who spoke different languages, the frequent use of pantomime or iconic gestures during artistic performances, and the use of signs as a means of communication during times of contemplative silence in monasteries. We also have discussed the more recent use of signs with hearing persons with autism spectrum disorder, intellectual disability, cerebral palsy, and aphasia.

In the introduction to this volume, we mentioned the potential use of a sign-communication system in contemporary contexts by other hearing persons. A sign-communication system that is easily remembered and that consists of gestures that visually resemble the concepts for which they stand could potentially be used by modern-day travelers, members of the military, or international aid workers while interacting with people in a foreign country whose language they do not understand. Highly iconic signs and gestures could also be used by healthcare professionals and staff members in nursing homes (whose residents often have experienced a decline in their hearing), emergency rooms

and hospitals (whose patients or staff may speak various languages), and medical emergency situations in areas that may include a wide range of first- or second-generation immigrants. Iconic or representative signs and gestures could also be used effectively with young children who have just been adopted from various countries overseas and who are faced with the daunting task of having to learn a new language with their new family.

Despite the wide range of existing and potential uses of sign languages and sign-communication systems that we have already discussed, there are many other applications that we have not yet covered. Among these is the use of signs by hearing parents with their young hearing infants as a means of fostering early successful communication. In addition, teaching signs to youngsters from economically disadvantaged families may increase their linguistic abilities and provide a sound basis for further academic achievement. In fact, utilizing iconic signs and gestures may be helpful to many young children in primary school and pre-kindergarten educational programs.

Iconic or representative signs may even facilitate the learning processes of persons with attention-deficit hyperactivity disorder (ADHD) and children who struggle with reading comprehension impairment. Highly iconic signs or gestures may also serve as a powerful bridge to learning the vocabulary of a second (or additional) language. Students of all ages may find that pairing to-be-learned foreign language vocabulary items with iconic or representative gestures aids the students in recalling the foreign language's vocabulary. Finally, learning to sign may result in enhanced cognitive abilities for all individuals, deaf or hearing, especially in the domains of spatial memory and mental rotation. Thus, iconic signs and gestures can provide a meaningful and positive impact on the cognitive and linguistic development of hearing persons in a wide range of contexts throughout their lifetimes. Indeed, in light of the many apparent advantages that may be attained by either learning a genuine sign language of Deaf persons or a large lexicon of iconic signs, we encourage everyone to take advantage of opportunities to learn to sign. Let us first focus on the use of signs by hearing parents with their hearing infants.

Teaching Signs to Hearing Infants of Hearing Parents

After investigators (e.g., Bonvillian et al., 1983; Folven & Bonvillian, 1991; McIntire, 1977) reported that very young children of Deaf parents often attained early language milestones in sign at younger ages than children learning to speak did so for spoken language, other investigators began to study the learning of signs or symbolic gestures by the young hearing children of hearing parents (Acredolo & Goodwyn, 1996; Goodwyn & Acredolo, 1993, 1998). In this research, those infants who were taught a collection of “baby signs” typically acquired the signs faster than speech-trained infants acquired a collection of target words, although there were wide individual differences in acquisition rates. The investigators attributed the children’s slower acquisition of words to the difficulties and complexities involved in spoken language production early in a child’s development. In other words, a child’s physical ability to produce speech or control the muscles needed for recognizable speech seems to lag behind the child’s physical ability to control the arm and hand movements needed for recognizable signs. This implies that most children have the mental capacity to communicate before they are able to effectively do so through spoken language (Loncke, 2019).

Sign-trained youngsters were then followed longitudinally by Goodwyn and Acredolo (1993, 1998) to determine whether there were any lasting effects of early signing or symbolic gesturing on subsequent development. In comparison with those children who had not had the sign intervention, the children in the sign-trained group showed an advantage on a number of verbal language acquisition measures throughout early childhood, as well as higher school-age IQ scores (Acredolo, Goodwyn, & Abrams, 2002; Goodwyn, Acredolo, & Brown, 2000). These findings clearly indicate that early signing or symbolic gesturing does not hamper verbal development and may, in fact, enhance it.

In an attempt to account for the positive outcomes associated with baby-signing in their research, Goodwyn and Acredolo have advanced the view that the children’s symbolic gestures or signs may have elicited more spoken language input from the children’s parents as well as indicated to the parents the specific topics in which the children were interested. There are, however, other possible interpretations. One is

that combining sign and spoken language input may facilitate the vocal production of typically developing babies much as it apparently does for many children with Down syndrome (Özçalışkan et al., 2016; see Chapter 4) or autism (Özçalışkan et al., 2017; see Chapter 5). A second possibility is that because “baby-signing” typically involves caregivers producing signs for only the key words in their utterances, this combining of signs and spoken language may help infants segment the speech stream by making the signed words more prominent, thus facilitating their acquisition (Mueller & Acosta, 2015). Another possibility is that the combination of visual, auditory, and gestural processing that occurs when babies learn signs together with words may make information acquired that way more memorable. Although the use of multiple symbolic coding systems has been advanced as an explanation for findings of enhanced learning and retention in adults (Paivio, 1990), it is not clear whether the use of multiple representational or symbolic coding systems operates similarly in infants (cf. Lukowski et al., 2005).

Along with the claim of potentially fostering more rapid spoken language development, the early use of signs also has been associated with fewer and less severe temper tantrums in infancy and early childhood (Acredolo et al., 2002). Additional support for this claim of improved social behavior is seen in a study of hearing infants who were taught manual signs early in their lives. Once these infants acquired minimal functional sign skills, their incidence of crying and whining decreased substantially (Thompson et al., 2007).

The claims about the positive effects of signing apparently have resulted in signs making major inroads among hearing families with young children. This group consists of parents who have embraced baby-signing as a way to enhance their communicative exchanges with their babies before their babies can effectively communicate with them in spoken language. More specifically, hearing parents who have adopted baby-signing often express their hope that signing with their young children will result in earlier and clearer communication between them, as well as encourage more socially appropriate behaviors by their young children (Pizer, Walters, & Meier, 2007).

Two additional studies have examined the impact of mothers using manual signs together with spoken language on their infants’ language development. In one study (Seal & DePaolis, 2014), the development

of eight infants exposed to baby signs was compared with that of eight infants who were not exposed to baby signs. The data for this study came from videotapes of the sixteen infants obtained when they were between nine and eighteen months of age. Analyses of the tapes showed that the infants exposed to baby signs achieved the four-, ten-, and twenty-five-word points in development earlier than the non-signing infants, but that the differences in vocabulary acquisition rates between the groups were not statistically significant. The investigators also reported that the level of manual activity that accompanied vocal productions did not differ between the two groups. For both the infants exposed to signs and those not exposed to signs, there was a very high rate of manual activity accompanying vocal production. This finding underlines the view that manual activity and vocal activity are often closely interlinked.

In another investigation (Kirk et al., 2013) of the impact of “baby signs” or symbolic gestures on infant language development, forty infants were followed from the age of eight months to twenty months. Half of the mothers modeled signs or gestures for a limited number of target set signs, whereas the remaining half of the mothers focused on spoken language input. During the course of the study, many of the infants in the sign-input condition learned some or most of the signs or gestures modeled by their mothers. But these infants’ sign learning evidently did not affect their language development more generally, as there were no differences on measures of spoken language comprehension or production between these infants and those who received only spoken language input. There was, however, one clear difference between the sign-input and the no-sign-input groups: the mothers in the sign- or gesture-input conditions became more sensitive to their infants’ nonverbal cues than the mothers in the speech-only condition. This increased sensitivity to their infants’ nonverbal cues may be an important benefit of sign input as such sensitivity may contribute to close mother-infant bonding.

We should also point out that the learning of signs by hearing children growing up in hearing families may not precisely mirror those patterns seen in children growing up in Deaf families. Although we noted earlier (see Chapter 3) that sign iconicity did not play an important role in the initial acquisition of signs by the very young children of Deaf

parents, whether or not a sign is highly iconic may be important in the sign learning of slightly older hearing children of hearing parents. In several studies involving hearing children ranging in age from two to five years, the children associated iconic signs or gestures with their referents much more successfully than they associated arbitrary signs or gestures with their referents (Brown, 1979; Magid & Pyers, 2017; Namy & Waxman, 1998; Tomasello, Striano, & Rochat, 1999). In addition, children's ability to recognize the meaning of iconic signs evidently improves greatly during the preschool years (Tolar et al., 2008). Thus, sign iconicity may become a factor in the rate of sign learning and ease of retention as children mature. Young children also produce a wide range of representational gestures on their own, although the incidence of this spontaneous production may vary across cultures (Marentette et al., 2016). Finally, four-year-old children are able to use iconic gestures produced by a human adult to obtain a reward much more often than they could use an arbitrary gesture to secure a reward (Bohn, Call, & Tomasello, 2016). Chimpanzees, in contrast, were not nearly as adept in their understanding of iconic gestures as the children. This latter finding may suggest that humans are noticeably better at comprehending iconic gestures than their closest living relatives.

Evaluative Comments

In recent years, a controversy has arisen about some of the claims made by investigators about the positive effects of baby-signing. The issue that appears to be the principal source of controversy in the "baby sign" literature is whether signing with hearing babies facilitates these babies' acquisition of spoken language skills. There does not seem to be the same level of disagreement over whether most hearing babies are able to acquire a target vocabulary more rapidly in the visual-gestural modality as opposed to the auditory-vocal modality. As Kirk et al. observed (2013, p. 580): "...infants did acquire the gestures and used them to communicate about the target set of referents long before the onset of speech." So, if the question under examination were whether signing increased early communication and naming, regardless of communication modality, then a case could be advanced for the beneficial effects of signing.

Goodwyn and Acredolo's finding that signing with hearing infants does not interfere with these youngsters' acquisition of spoken words appears to be well supported. Parents and investigators, however, should exercise caution before accepting some of their other claims about the positive effects of baby-signing. There are several reasons for recommending such restraint. One is that their findings about the positive effects of signing on spoken language development were small in magnitude and not consistently statistically significant throughout the course of the study. A second reason is that the findings are not based on a very large number of study participants. Another methodological concern is the possibility that the participants in the parent-child sign-training group may have differed from the participants in the parent-child comparison group in important ways from the beginning of the study. That is, those parents who embraced the idea of signing with their babies back when the study started may have differed from the comparison-group parents in ways other than the use of signs.

It should also be noted that as the Goodwin and Acredolo study progressed, there was a fairly high participant attrition rate (Johnston, Durieux-Smith, & Bloom, 2005). This loss of participants over time means that the claims from the latter stages of the study were based on considerably fewer participants than those from the initial stages. Furthermore, those participants who did not continue in the study may have differed from those who did continue in ways undetected by the investigators, making the interpretation of any findings difficult at best. In light of these concerns, more scientific studies clearly need to be conducted and findings replicated before the various claims about the positive effects of baby-signing can be given substantial credence (Barnes, 2010).

Overall, a review of the various studies of baby-signing does not provide clear support for the view that signing with your baby during infancy will lead to significantly enhanced spoken language abilities in early childhood (Fitzpatrick et al., 2014); the evidence remains inconclusive. When differences have been reported, while tending to support the facilitative effect of baby-signing use, they have been relatively small and not long-lasting. These general trends, however, may mask some important differences that will need to be probed more thoroughly in the future. For example, in the Kirk et al. (2013)

study, three low-performing boys evidently benefited from the gesture-communication training they received. This finding led the investigators to “suggest that gesture is beneficial for infants who have weaker language abilities than others” (p. 581).

Another aspect that should be examined in the future is whether gesture- or sign-communication interventions affect young children from different socioeconomic classes in the same way. In the above studies of baby-signing, it appears that the large majority of participants came from middle-class families with strong educational backgrounds. For example, in the Kirk et al. (2013) study, only one of the participating mothers did not have an undergraduate university education. Children reared in such families often are bathed in language beginning in infancy. If studies of baby-signing were to include a much more diverse population, then it is possible that trends favoring the use of baby-signing to facilitate spoken language development might emerge among late-talking children and children from more economically disadvantaged households. Moreover, other aspects of child development besides spoken language development (e.g., cognitive growth, social development) probably should be examined as well in studies of baby-sign training. We say this in light of the array of positive findings of the effects of baby-signing on the development of young children from predominantly lower-income families in a Latino community (Mueller, Sepulveda, & Rodriguez, 2014).

Finally, it should be noted that in the studies of “baby-signing” discussed above, the participating parents typically were hearing persons who were neither fluent nor even proficient in a genuine sign language used by Deaf persons. Furthermore, the signs that the participating mothers used in their interactions with their hearing infants came primarily from baby-signing books and lists or lexicons of signs taken from dictionaries of genuine sign languages. The participating mothers thus were dependent on outside source materials as opposed to relying on a communication system that they had fully internalized. In addition, it appears that the mothers’ use of baby signs accounted for only a small portion of their communicative exchanges with their babies. If the mothers who participated in these studies had been more fluent signers, it is likely that they would have begun to sign with their babies much earlier in their infancy than occurred in the studies examined, and that

the infants would have been fully enveloped in a signing world. Instead, it appears that the “baby sign” infants existed primarily in a speaking world punctuated by periodic symbolic gesture or manual sign input from their mothers.¹ If the potential efficacy of baby-signing on young children’s development were to be truly tested, then it would appear that it would be necessary to ensure that the participating mothers were adept and dedicated signers (see Snoddon, 2014).

Socioeconomic Intervention Programs and Language

During the 1960s, a view emerged among many educators and social scientists in the United States that intervention programs needed to be introduced to help combat the adverse effects of children being reared in poverty. The best known and largest of these programs was Project Head Start, although there was a wide range of other smaller-scale intervention programs as well. Project Head Start focused primarily on improving the lives of three- and four-year-old children from families with incomes below the poverty line. Participating children typically would receive nutritious meals in a safe educational environment along with regular medical and dental care.

Because Head Start has been in operation for decades, it is possible to assess its effectiveness over time. In many ways, those individuals who participated in Head Start showed significant long-term benefits. Head Start participants were more likely to graduate from high school and enroll in college and less likely to repeat grades or engage in adolescent drug use and acts of delinquency (Garces, Thomas, & Currie, 2002; Love, Chazan-Cohen, & Raikes, 2007). At-risk children who participated in Head Start preschool programs also were much less likely to be placed in foster care than those children who attended non-Head Start preschools or day care programs (Klein, Fries, & Emmons, 2017). This outcome may be a product of the additional support provided by Head

1 Although children under the age of twenty-four months do not effectively acquire new spoken words through video presentations (DeLoache et al., 2010), the same pattern does not occur for manual sign learning. When fifteen-month-olds were shown ASL signs at home through instructional videos, the infants demonstrated considerable sign learning (Dayanim & Namy, 2015). This study indicates that baby signs may be acquired through educational videos, even when a caregiver is not present.

Start programs to the children's entire families. The evidence in support of academic benefits, however, is more limited. In general, gains in IQ and academic achievement scores by Head Start participants were no longer evident by the end of first grade in comparison with those of non-participants (U.S. Department of Health and Human Services, 2010). More targeted analyses of the effectiveness of Head Start have shown that benefits varied widely among participants. Those children from the lowest risk subgroup of participants were largely unaffected by their participation in the program. In contrast, children from higher risk subgroups (e.g., children with lower initial academic skills, children with mothers with lower education levels) often benefited significantly from Head Start participation (Cooper & Lanza, 2014).

What might be behind the lack of progress in academic skills seen in many children from families with lower socioeconomic backgrounds? Children reared in economically disadvantaged (or less advantaged) families often are talked to less frequently and exposed to fewer different words by their parents (Hart & Risley, 1995, 2003; Hoff, 2003, 2013). Not only are children from lower socioeconomic backgrounds talked with much less frequently by their parents at home, but the complexity and diversity of the language that these children receive from their teachers in kindergarten is significantly more limited (Neuman, Kaefer, & Pinkham, 2018). This lower level of input is important as studies have shown that the quantity of words and the number of different words spoken by adults to infants and young children are strong predictors of their language development (Pan et al., 2005; Shneidman et al., 2013; Topping, Dekhinet, & Zeedyk, 2013; Zauche et al., 2016). Furthermore, smaller vocabulary sizes and lower language-processing abilities already are evident in children from lower socioeconomic backgrounds by eighteen months of age (Fernald, Marchman, & Weisleder, 2013).

Children from economically disadvantaged families typically do not have the experiences that foster reading acquisition skills, specifically the development of phonemic awareness, a substantial vocabulary, and oral language knowledge (Buckingham, Beaman, & Wheldall, 2014). Children reared in low income households also typically are read to at home much less frequently in the years before they enter first grade than children reared in higher-income homes (Adams, 1990; Whitehurst, 1997). These book reading experiences are important because children

who are read to more frequently tend to have larger vocabularies, evidence greater language complexity, and demonstrate better cognitive outcomes than children who are read to less frequently or not at all (Needlman & Silverstein, 2004; Raikes et al., 2006; Rodriguez et al., 2009; Schmitt, Simpson, & Friend, 2011; Zauche et al., 2016).

There is also a social class difference with regard to maternal gestural input and infant gesture production. Mothers from higher socioeconomic backgrounds typically use more gesture types in their interactions with their infants than do mothers from lower socioeconomic backgrounds (Rowe & Goldin-Meadow, 2009a). That is, mothers from higher socioeconomic backgrounds use gestures to convey a wider range of meanings to their infants than do mothers from lower socioeconomic backgrounds. The participating children's subsequent spoken language vocabulary comprehension at four-and-a-half years was predicted by the number of gestures they produced as infants. Evidently, there are distinct differences by family socioeconomic background in both maternal gestural and spoken language input during infancy, and these two forms of communicative input are related to each other and with children's eventual language development. Children from economically disadvantaged families likely enter pre-school programs with less developed language skills than their peers from middle-class backgrounds. In general, the lower a family's socioeconomic status (SES), the greater the likelihood that the children have impaired language acquisition (Donkin et al., 2014).

Another possible reason for the lack of clear long-term benefits in language development and literacy for most Head Start participants may reside in the way Head Start classrooms are composed. Children in Head Start classrooms are grouped together with preschool-aged peers from families with very low incomes. Typically, children from such low SES backgrounds have low language skill levels. When preschool children with low language skills are placed in a classroom with peers with similarly low language skills, the children show noticeably less language growth than preschool children who are placed in a classroom with children with higher language skills (Justice et al., 2011). If it were possible to group preschoolers with lower language skills together with preschoolers with higher language skills, then the children with lower language skills likely would show greater gains

in their language development. It should also be acknowledged that Head Start preschool programs often include children with disabilities. In one recent survey, the participating Head Start teachers reported that nearly one-fourth of the children in their classes had some form of disability, with speech or communication problems being the most prevalent disability (McDonnell et al., 2014). Such a high incidence of children with disabilities in Head Start classrooms might account for some of the reported difficulties observed in achieving desired literacy-related skills.

Concerns about the longer-term development of English language and literacy skills by children who participated in Head Start programs have prompted considerable re-thinking by policymakers of the program's structure. Because many three-year-olds spend a second year in their same Head Start classroom, a question has arisen as to whether this approach is an optimal one pedagogically. It is now possible to largely resolve this issue in that another option to combat the detrimental effects of poverty has emerged in the form of publicly funded pre-kindergarten programs for many four-year-olds. These pre-kindergarten programs often offer more intensive educational curricula than those of Head Start; there is typically a stronger focus on literacy, language, and mathematical skills. The research question that has been pursued is whether it is better educationally to keep children in Head Start programs for a second year or to transition them to a pre-kindergarten program. Although this question has not been answered definitively, it appears that children who attended Head Start at age three in most instances develop stronger prereading skills if they transition to a quality pre-kindergarten program at age four (Jenkins et al., 2016). Thus, a change in educational sequencing of academic programs may pay dividends developmentally.

Another approach that should be considered to enhance the spoken language vocabulary skills of young children from families with very low incomes would be to introduce manual sign-communication programs into their preschool and elementary school classrooms. In her book *Dancing with Words: Signing for Hearing Children's Literacy*, Marilyn Daniels (2001) makes the case for adding sign language training and teaching to the educational programs of typically developing, hearing preschool and school-age children from economically disadvantaged

families to increase the children's spoken language vocabulary size. In a series of studies, Daniels convinced teachers to introduce sign instruction to their daily programs. In most of her investigations, hearing pre-kindergarten and kindergarten children were taught American Sign Language (ASL) signs by their teachers. The efficacy of the instruction typically was assessed by administering one version of a receptive English vocabulary test, Peabody Picture Vocabulary Test-Revised or PPVT-R (Dunn & Dunn, 1981), at the beginning of the school year and another at the end. In most instances, those children who participated in the sign language programs showed substantial gains in their English vocabulary size, whereas children in comparison groups did not. When English-language vocabulary scores were converted into standard scores (with a mean of 100 and standard deviation of 15), the children in the sign-learning condition typically showed increases of about 13–16 points over the school year, a highly significant improvement. (Although the PPVT-R is not an IQ test, it should be noted that scores on the PPVT-R correlate highly with full scale scores on the Stanford-Binet IQ test.) Furthermore, Daniels found that these gains continued over time. When children in a kindergarten program who had been taught signs the previous year were tested the next year, they continued to show evidence of increased English vocabulary size. These findings may be of particular importance to parents and educators of young children because vocabulary size in the preschool years has been shown to be predictive of language and literacy skills years later (Lee, 2011; Storch & Whitehurst, 2002).

There are several other aspects of Daniels' studies that merit discussion. One is that some of the teachers in her studies had only the most rudimentary knowledge of signing and fingerspelling. According to Daniels, teachers should not be discouraged by their lack of signing expertise; the teachers need only to be slightly ahead of their pupils in their knowledge of signs. A second aspect is that the findings of substantial gains in vocabulary scores came from students in schools in more disadvantaged neighborhoods. When students in more middle-class neighborhoods were taught ASL signs, there was not a similar gain in receptive vocabulary scores. It is likely that these children already were in quite stimulating language environments. A third aspect is that while the sign input was associated with English vocabulary gains by

many children from more disadvantaged neighborhoods, it is not clear why these gains occurred. One possibility is that when vocabulary items are both taught and learned as signs and spoken words, this approach may more fully engage the children's sensory and motor abilities. The use by children of their visual and motor skills, in addition to their auditory-vocal skills, may result in vocabulary items being processed more deeply as well as in different ways. Although just which memory and recall processes are involved in children's vocabulary learning remains unclear, it is evident that language input in more than one modality often results in enhanced vocabulary learning. Another possibility is that sign instruction may help children learn to visually attend to their teacher and to better regulate their motor movements. These skills — paying attention and behavioral regulation — may then help children to learn more effectively in a classroom setting. Finally, it should be noted that most of Daniels' studies were relatively small in magnitude and short in duration. In the future, it will be important to gain a better understanding of just which children benefit, how long these benefits last, and why those benefits occurred.

The claims of a facilitative effect of manual signs and fingerspelling on the spoken language development of young hearing children are in accord with observations made long ago by Thomas H. Gallaudet, a pioneering educator of deaf students in the United States. Gallaudet had observed beneficial effects of having children who could hear and speak interact in an educational setting with children who were deaf and non-speaking. Bartlett, in 1853, summarized the principle upon which Gallaudet's view of a beneficial effect evidently was based: "The more varied the form under which language is presented to the mind through the different senses, the more perfect will be the knowledge of it acquired, and the more permanently will it be retained" (p. 33). Although Gallaudet's observations and theorizing were not based on the outcomes of systematic investigations, they appear to fit remarkably with much current thinking in education.

Another factor that may affect the efficacy of early intervention programs is the behavior of mothers from different backgrounds or ethnicities with their infants. Within low-income families, there is a wide range in the quality of mother-child communicative exchanges. Those mothers who engaged in higher quality verbal and nonverbal

interactions (e.g., joint engagement, connected communication) with their two-year-olds typically had children with greater expressive language skills a year later (Hirsh-Pasek et al., 2015). Furthermore, when the behavior of mother-infant pairs from different ethnic backgrounds was compared, it was the African-American mothers who engaged in less gestural communication and language input to their infants than the mother-infant pairs from the other ethnicities examined (Tamis-LeMonda et al., 2012). Additionally, there were some suggestions that the African-American mothers felt that language is largely learned by their children on their own and not the product, to a considerable extent, of maternal language input.

Marilyn Daniels' studies provide evidence of what might be accomplished by introducing sign communication to preschoolers from low socioeconomic status backgrounds. At present, however, relatively little is known about any potential benefits that might be derived from having mothers from economically disadvantaged backgrounds sign with their preverbal infants. One study (Kirk, 2009) tried to examine this issue by comparing the language development of infants from low-income families placed in two different groups. A "general communication" group was composed of mother-infant pairs in which the mothers were urged to foster their infants' communication by including turn-taking, joint attention, etc. in their interactions. The mothers in a "gesture communication" group were urged to also include various signs or gestures (specifically, Makaton signs; see Chapter 4) in their interactions with their infants. Unfortunately, high participant attrition rates in this study substantially limited the strength of the conclusions that can be drawn from the study. Still, it should be noted that there was a trend for the mothers in the gesture group to have infants show greater improvements in their receptive and productive spoken language vocabularies than did the infants in the general communication group.

Some of the mothers in the gestural communication group were interviewed as the study came to its end. These participating mothers observed that they thought that the use of gestures had resulted in improved communication with and better understanding of their infants. The mothers also commented that for gestures to be useful for them as parents, the gestures needed to feel natural and to be produced

virtually automatically. Apparently, in the demands of communicating with and taking care of their infants, there was little time for the mothers to reflect or to look up signs. Thus, it was important for signs or gestures to feel natural to the mothers and be readily formed, and for the gestures to be very easily recalled or remembered.

Finally, another issue in the educational development of children from economically disadvantaged families is that the academic progress demonstrated by many such children during the school year often does not continue during the summer months when schools are closed (Alexander, Entwisle, & Olson, 2014; Heyns, 1978). Many of the children do not advance in their academic skills during their summer break and may show declines. It is possible that some young students' academic skills might be more robust or longer lasting if they were acquired in a learning environment that incorporated more visual and gestural components and was less dependent on the children's listening skills (Daniels, 2001).

Attention-Deficit Hyperactivity Disorder (ADHD) in Academic Settings

Many children experience problems in attention control and impulsivity. For some children, these problems are much more severe than they are for most other children. Those children with more severe problems in attentional control and impulsivity often are identified as having attention-deficit hyperactivity disorder (ADHD). With increasing awareness of the characteristics of this disorder, more and more students are being diagnosed as having ADHD. Current estimates of the percentage of school-aged children who meet the diagnostic criteria for ADHD range from 3–11% of all school-aged children (Biederman & Faraone, 2005; Leung & Hon, 2016), with most estimates between 5–7%. With such a high incidence, ADHD is an issue of major concern in many contemporary classrooms and families worldwide. And, as with many syndromes involving children, boys are diagnosed with ADHD much more often than girls; the ratio is about 4 to 1.

Children with ADHD frequently are very impulsive, constantly fidgeting, inattentive, and quite disruptive of many classroom activities (Barkley, 2003; Brown, 2005; Goldstein, 2011). Individuals with ADHD

often show difficulties or deficits in a range of executive functioning skills, as they have problems with organizing, focusing, and staying alert, as well as managing frustration. These difficulties, furthermore, often are long-lasting; about 40–50% of children with ADHD will continue to show impairments into adulthood (Biederman & Faraone, 2005; Leung & Hon, 2016). Persons with ADHD also typically experience various motor dysfunctions or deficits, although their imitation abilities appear to be intact (Biscaldi et al., 2015). The inability to stay focused on cognitive tasks and to inhibit motor actions in favor of thought processes often results in the children having both academic and social problems. In light of these issues, both parents and teachers frequently embark on treatment or intervention programs for the children involved to lessen the adverse effects of ADHD.

A frequently pursued treatment approach for students with attention-deficit hyperactivity disorder has been to administer a stimulant medication, such as Ritalin, to the students. This approach typically results in improved academic performance, attentiveness, and social interaction with peers. Although stimulant medications are effective with most individuals diagnosed with ADHD, they are not an effective treatment for all; about 20–30% do not show significant improvements in response to medications (Brown, 2005). Some parents, physicians, and students, however, have expressed a reluctance to embark on a long-term course of medication. Moreover, a number of professionals in the field of child mental health have become quite concerned about the use of stimulant medications with relatively young children (Fontanella et al., 2014; Olfson et al., 2010). Many preschoolers evidently are neither receiving mental health assessments prior to embarking on courses of psychoactive medication use nor are they receiving non-pharmacological treatment interventions. If alternative behavioral or educational intervention approaches were to be shown to be effective, then these non-drug approaches would be welcome additions to the ADHD treatment arsenal. And consideration should be given to combining these behavioral or educational interventions with pharmacological treatments in an effort to obtain optimal results.

One non-drug approach that might have substantial potential is to have teachers and parents communicate with their children with ADHD more extensively with representative gestures or signs. When

teachers communicated with students with ADHD through gestures, these students' performance was much better than when the teachers' input to these same students was through spoken language alone (Wang, Bernas, & Eberhard, 2004). In the study conducted by Wang et al., the behavior of forty-five boys, between the ages of seven and eight, diagnosed with ADHD was videotaped while they worked to solve puzzles and while they interacted with one of twelve participating teachers. When the teachers communicated with the boys in gestures alone or in speech combined with gestures, the boys' task performance and attention to the teachers was many times better than when the teachers' input to the boys was solely through spoken language. The boys' task performance and attention to the teachers was especially impressive when the teachers combined their use of gestures with spoken language. In addition, when the investigators (Wang et al., 2004) examined their videotapes, they found that those gestures that were especially helpful to the boys with ADHD were those gestures that were classified as representational (gestures that resembled the shape or motion of an object) or deictic (pointing). In light of these promising results, it would appear that more systematic examination of the use of iconic or representational signs or gestures in communication with students with ADHD is merited.

Some other, more anecdotal, accounts provide support to the view that at least some students with ADHD respond better to visual-gestural (sign) input than auditory-vocal (speech) input. In an informal case study, one of my (John D. Bonvillian) then undergraduate research assistants devoted several hours each week during an academic term to teaching signs to three elementary-school aged students diagnosed with ADHD. One of the students was especially disruptive in class, and his teacher was interested in trying almost any reasonable approach that might result in improved behavior on his part. This lad, and another boy in the class with ADHD, responded very positively to their sign-learning sessions. The boys would often ask my research assistant for the sign-names for different objects and activities, as well as what signs to use in various social interactions. Aside from acquiring a substantial sign vocabulary, these boys' interactions at school also changed for the better. According to their teacher and my undergraduate research assistant, these boys frequently would go around their classroom and school yard

during recess showing the other students and teachers the sign names for various objects and activities. At the end of the semester, the boys' teacher told my assistant that the sign training had been "extremely helpful" for one boy (the more disruptive one) and "very helpful" for the other boy. The teacher assessed the sign training as "helpful" for the girl who had participated, but that her behavioral improvement had been less dramatic than that of the boys. And when my research assistant visited the classroom to say "good-bye" to her students (she was about to graduate), the lad whose disruptive behavior had largely sparked the study thanked her and observed "...for the first time in my life, I was good at something."

Personal communication with some of my other undergraduate students provides additional support for the view that manual signing might be an effective educational approach for some students with ADHD. One University of Virginia student told me (John D. Bonvillian) that he had learned to translate or paraphrase his teachers' and professors' lectures into signs and fingerspelling during class. Prior to adopting this procedure, he observed that his ability to concentrate in classes largely disappeared after ten to fifteen minutes, that he often felt restless, and that he typically wanted to get up and move around the classrooms. He claimed that this approach of translating or paraphrasing much of his teachers' and professors' oral presentations into signs and fingerspelling enabled him to concentrate more effectively and to perform at a relatively high level academically. In order to not be overly disruptive to his classmates near him, he told me that he would typically make his signs in a much-reduced signing space; he called this approach "micro-signing."

Another of my undergraduate students related a similar account of how one of her best friends from high school learned to cope effectively with her ADHD without using physician-recommended stimulants. This person, struggling with ADHD, started to learn ASL during high school. She, too, learned that coding her instructors' spoken English into ASL signs greatly helped her to concentrate and noticeably enhanced her understanding of what her teachers were saying. It is, of course, not clear what is happening in the brains of these two students. One possibility is that spoken language is at some level either an aversive situation or too complex a form of input for some persons with ADHD.

Another possibility is that learning to sign and fingerspell helped the students to inhibit disruptive behaviors and to focus on their academic tasks more effectively. Regardless, by changing the modality to one that the students could control and by paraphrasing their teachers' spoken words, the students had discovered an effective way to learn while reducing their restlessness.

Finally, the use of manual signs with a particularly "disruptive" four-year-old girl in preschool resulted in her greatly improved behavior (Brereton, 2009). This finding adds to the emerging view that manual signs or gestures might be effectively used by teachers or parents with some very inattentive or disruptive students. In this study, the two teachers in the classroom combined spoken English with Signing Exact English² in their interactions with their preschool students. One of the children in the class, Alana, was observed often to be physically aggressive with her peers, to find social interactions very difficult, and not to be able to sit still for more than a couple of minutes. Fortunately, Alana rapidly became an excellent signer, acquiring proficiency in signing more quickly than most of her peers. As Alana acquired more signs, the incidence of her aggressive outbursts decreased substantially. Moreover, in light of her signing skill, Alana often found herself directly helping other students learn to correctly form a number of signs. And, when Alana was supposed to sit still, as in classroom "circle" time, she would usually produce signs along with her teacher. This sign production by Alana apparently provided an acceptable outlet for her need for movement.

The reported changes in Alana's behavior as she acquired more proficiency in signing were quite similar to those seen in the elementary-school aged students diagnosed with ADHD described above. In the future, investigators might wish to examine more systematically which students with ADHD would benefit from programs of manual sign or gestural input and under what circumstances. Investigators might also wish to determine which forms of sign or gestural input, with and without accompanying speech, are more effective in enhancing the behavior and learning of youngsters with ADHD.

2 Signing Exact English uses ASL signs in English syntactical order together with various hand gestures to indicate certain aspects of English morphology.

Using Manual Signs to Improve Reading Comprehension

In recent decades, it has become apparent that many students in the U.S. and throughout the rest of the world have noticeable difficulty understanding the text passages that they have just adequately read aloud. This phenomenon has become known as reading comprehension impairment. According to Hulme and Snowling (2011, p. 139), “children with reading-comprehension impairment (often referred to as poor comprehenders) can read aloud accurately and fluently at a level appropriate for their age but fail to understand much of what they read.” That is, these poor reading comprehenders evidently are adept at decoding the texts they are reading aloud, as they show fully adequate phonological or speech-sound skills.

Most of the students with reading comprehension difficulties have weak vocabulary knowledge, problems with listening comprehension, limited abilities in understanding figurative language, and problems in processing grammatical information (Clarke et al., 2010; Hulme & Snowling, 2011). Without adequate development of these language skills, such students probably are destined to remain poor reading comprehenders and to perform poorly in many school-learning domains. A number of poor reading comprehenders also experienced difficulties on verbal working memory tasks, but not on spatial working memory tasks (Pimperton & Nation, 2014).

Although problems in reading comprehension may not become clearly evident until students reach fourth grade, these problems appear to have their roots much earlier in development. In one study (Elwér et al., 2015), fourth grade students (aged nine to ten years) with poor reading comprehension initially were shown to have deficits in vocabulary, grammar, and verbal memory and that these skill deficits were highly related to their poor reading comprehension. These students’ performance was then traced back to their results on different assessments or tests conducted earlier in their schooling. It turned out that the fourth grade students’ deficits in oral language skills were already evident when the children were in preschool. A similar finding of oral language skills at three-and-a-half years of age predicting reading comprehension at eight-and-a-half years of age also was reported by

Hulme et al. (2015). Among the participants in this study were children at familial risk for dyslexia. Taken together, the results of these two studies indicate that not only are oral language skills important for the attainment of adequate reading comprehension, but that these skills emerge early in development. In light of these findings that difficulties in oral language skills emerge early in development, it might be a good strategy to focus on enhancing these skills while the children are young.

Of the various intervention approaches used with students with reading comprehension impairment, oral-language vocabulary training has achieved the best outcomes. The oral-language training approach in one important study (Clarke et al., 2010) included getting the children to use new vocabulary items in different and relevant contexts, to listen to reading passages, to learn about figurative language (e.g., idioms, metaphors), and to produce spoken narratives. Over time, the children's enhanced vocabulary and oral-language skills were associated with improved reading comprehension skills.

In a study of reading comprehension that involved first- and second-language learners in Norway, Lervåg and Aukrust (2010) found that it was vocabulary knowledge that predicted reading comprehension growth, and that this relationship was especially strong for second-language learners. More specifically, these investigators reached the conclusions that it was the semantic language component that caused much of the differences in comprehension performance between the two language-learning groups, and that oral-language vocabulary training should receive a heavy emphasis among second-language learners. Vocabulary knowledge also was found to be the principal factor that differentiated poor and average comprehenders in a study of English reading ability in Chinese adolescents learning English as a second language (Li & Kirby, 2014). These students, who apparently were all adequate readers in their first language, were participating in an English-immersion program in their eighth grade (aged thirteen to fourteen years) classrooms in China. In light of their findings, the investigators recommended that more attention be devoted to systematic vocabulary instruction.

In as much as vocabulary knowledge evidently is an important factor in reading comprehension and because students with reading comprehension deficits showed real improvements after vocabulary

training, teachers and language therapists might seriously consider expanding their vocabulary training in the early school grades. We (the authors) also suggest that teachers consider combining spoken language vocabulary items with manual signs in their training programs for these students. We make this recommendation for several reasons. The first is that Marilyn Daniels (2001) reported strong and lasting gains in vocabulary knowledge for young children from economically disadvantaged families when their teachers combined signs with speech in their language input. Daniels (2004) also found that hearing kindergarten students from a rural background who received ASL instruction showed impressive gains in their receptive English vocabulary knowledge, as they averaged two years of vocabulary growth over the course of the nine-month school year.

The findings from two other studies provide additional support for including manual signs in the educational programs for young students. In a fourteen-month-long project in the United Kingdom, hearing children, ages five to six, were joined by deaf students one afternoon a week, and together they were taught in part in British Sign Language (BSL) (Robinson, 1997). At the end of the project, the use of signs was reported to have helped the hearing children with their English vocabulary development and assisted in their learning of concepts in mathematics and geography. An explanation advanced to account for this improved performance was that the use of signs had resulted in the young students looking at, listening to, and attending to their teachers more often. In a two-year pilot project conducted in the U.S. state of Louisiana, young deaf and hearing children were taught by teachers who used both spoken English and ASL signs simultaneously (Heller et al., 1998). At the end of the study, the children in this inclusive preschool classroom who had been taught to sign earned significantly higher receptive English vocabulary scores than those children in the other classrooms who had not been taught to sign.

A second reason behind our recommendation is that a number of studies have shown that students effectively learn and retain foreign language vocabulary items when the to-be-learned words are paired with iconic or representative manual signs. Because second-language learners are over-represented in the population of students identified as having reading comprehension impairments, the findings about iconic

signs and foreign language vocabulary learning may be particularly relevant here. Third, when students with reading comprehension impairment produce representative or iconic signs when uttering the to-be-learned vocabulary items, the act of producing the highly iconic signs may serve as an instructional vehicle for learning the meanings of the vocabulary items themselves. To a substantial extent, each highly iconic or representative sign produced is an act of depiction of the meaning or referent of the to-be-learned word. With substantial benefits in terms of increased vocabulary knowledge potentially derived from combining iconic or representative manual signs with English (or other spoken language) input, and no perceived negative effects, we see no reason for teachers and parents not to embark on such a program. And, finally, because manual signs rely on visual and motor processing rather than the auditory-vocal modality, this change in modality might make signs a more effective vehicle of instruction than spoken words for students with verbal working memory weaknesses.

Facilitating Foreign Language Vocabulary Acquisition

A major challenge in acquiring a foreign or second language is learning the words of that language. For children in the U.S. growing up in non-English-speaking homes, English vocabulary knowledge is an area of particular difficulty (Snow, 2014). Foreign language and English-as-a-second-language instructors often devote substantial time trying to impart the meaning of new vocabulary items to their students. The students, in turn, frequently confront long lists of words that they need to store effectively in their memories if they are to make progress in learning that new language. The outcome of these efforts, at least in the U.S., often is not a very positive one. After studying a foreign language in school, the typical American student frequently has made little progress toward acquiring fluency in that language and may have acquired a negative or fearful attitude toward foreign language learning (Asher, 1969). The educational system in the U.S., moreover, is not producing enough students with sufficient foreign-language proficiency needed to compete effectively in a global market place (Wiley, Moore, & Fee, 2012). And with the world's economy becoming an ever more global

one with each passing year, the need for students worldwide to acquire facility in a second or third language is increasing.

In recent years, another large group of individuals who need to acquire skills in a foreign language has emerged on the world's stage. These persons are among the millions of migrants and refugees currently fleeing areas in Africa, the Middle East, and other parts of the world (Clay, 2017). Many of these individuals are both seriously traumatized and in dire straits. If these refugees and migrants were to learn a core vocabulary of words from their potential host countries' languages, then their situation would likely prove less stressful.

Difficulties in acquiring a new or second language are not limited to the present; they extend into the distant past. Correspondingly, teachers have for a long time considered different ways that foreign languages might be taught and learned more effectively. One teacher and scholar, Claude-François Lizarde de Radonvilliers, penned a book in 1768 on how a language could be effectively acquired. De Radonvilliers apparently was quite frustrated by his pupils' inability to remember their Latin vocabulary items after classroom instruction, which relied heavily on lecturing. Furthermore, he realized that it was not possible for his students to adequately acquire a language if they did not understand what the words meant.

Upon reflection, it is apparent that in contrast to the traditional classroom-learning situation, young children acquiring the vocabulary of their native language often learn these words in a context where they view either pictures or encounter instances of the words they are acquiring. Caregivers also frequently point out instances of a word or concept to young children. In addition, young children may acquire new words together with identifying or accompanying gestures. Certain eighteenth-century scholars, including Condillac (1746/2001; see Chapter 2), long ago recognized that a new or second language would be more readily learned and remembered by students if they followed some of the same processes that they had used to acquire their first language, namely through incorporating gestures and conversations in the learning process. Thus, it should be noted that concerns about traditional approaches to second-language learning and the potential benefits of using gesture to foster foreign language vocabulary acquisition were expressed hundreds of years ago (Rosenfeld, 2001).

Although scholars long ago may have recognized the potential usefulness of pairing foreign language vocabulary learning with related movements and gestures, this approach does not appear to have ever been firmly established as a teaching method until much more recently. About two centuries after Lyzarde de Radonvilliers' book was published, James Asher (1969) advanced the idea that foreign language instruction should begin with students acting out the meanings of the words and sentences that they had just heard. This approach, which Asher called Total Physical Response, emphasized students' initial comprehension of foreign language words and phrases and used the students' bodies as tools of learning along with their minds. Despite some empirical support for his claims of more effective language learning and instruction than traditional auditory-vocal instruction, Asher's approach did not succeed in becoming well established in American classrooms.

An emerging and promising approach to foreign language instruction is that being developed by AIM (Accelerative Integrated Methodology) Language Learning. This gesture- and movement-based approach was pioneered by Wendy Maxwell of British Columbia. Before developing this educational method, she was a foreign language teacher in Canada who had become quite concerned by her students' difficulties in learning and retaining foreign language materials. The approach she has developed uses pantomimic and emblematic gestures to help convey the meaning of foreign language words or phrases in video-based lessons and stories. The production and understanding of spoken language also are introduced with program onset.

As AIM Language Learning is of relatively recent origin, long-term systematic examinations of its efficacy in foreign language learning are largely lacking. One difficulty in conducting such systematic examinations of AIM's effectiveness in fostering foreign language learning has been that individual teachers apparently vary considerably in how closely they follow AIM routines and teaching strategies (Arnott, 2011). Two studies conducted in Canada that did compare the effectiveness of AIM with more established approaches to teaching French yielded inconclusive results; the AIM-instructed students in most instances were not significantly more proficient in French than their more traditionally educated peers (Bourdages & Vignola, 2009; Mady, Arnott, & Lapkin, 2009). Clearly, additional research investigations of the efficacy of AIM Language Learning will be needed before firm

conclusions as to its effectiveness can be reached. Nevertheless, anecdotal accounts from teachers using the system often have been quite positive.

Meanwhile, noticeable progress has been made in the last few decades in understanding human memory through laboratory research. The findings from this laboratory research provide an empirical foundation for incorporating the use of gestures and actions in foreign language teaching and learning. In investigations that began about forty years ago, Johannes Engelkamp and Ronald Cohen independently found that if one encoded information through the production of actions, then the performance of these actions positively influenced one's ability to remember the information (Zimmer et al., 2001). Experimental studies showed that research participants recalled action phrases better if the participants simulated the actions in the phrases as opposed to forming visual images of the actions or through just listening to the phrases. This effect of gestures or actions on memory was called the *enactment effect* (Engelkamp & Krumnacker, 1980). Research also revealed that to obtain the maximum facilitative effect of gestural actions on memory, it was important for each participant to perform the action himself or herself (*subject performed task effect*) (Cohen, 1981), as viewing someone else perform the action was not quite as effective (Engelkamp & Zimmer, 1994). From the findings of these studies and others of the efficacy of self-performed actions on memory, it became evident that incorporating gestures into the learning and recall of verbal material often was a more effective approach than relying primarily on auditory-vocal rehearsal or repetition to facilitate recall.³ Although the evidence for the efficacy of self-performed actions (or enactment effect) on adult participants' memory is quite compelling, the evidence for such an effect in children has been inconsistent (Foley & Ratner, 2001). At least some six-year-old children, however, are able to take advantage of the enactment effect to facilitate their verbal recall (Chatley, 2013).

With the use of gestures established as an effective way to learn and retain verbal material overall, a number of studies were conducted that

3 Although the primary focus of this section of the present chapter is on students' learning of foreign language vocabulary and phrases, we do not mean to suggest that the use of self-performed actions or gestures is limited to students' learning of foreign languages. To the contrary, self-performed task effects have been reported for different types of materials and for a wide range of participants (e.g., persons with intellectual disabilities, Alzheimer's disease patients) (Zimmer & Cohen, 2001).

demonstrated the effectiveness of gestures on the learning and retention of foreign language words and phrases. In a U.K. study (Mistry & Barnes, 2013), Makaton signs were taught in both a weekly discrete training session and also in child-led play settings in a classroom in which four of the pupils were learning English as an additional language. Makaton was found to noticeably increase those four students' production of English; the authors also noted that Makaton seemed to serve as a common language among all of the persons in the class. Allen (1995) showed that accompanying French expressions with emblematic gestures (e.g., "thumbs up") resulted in the students recalling more of the French expressions they were learning than the students in the no-gesture comparison groups. Lindstromberg and Boers (2005) found that when students pantomimed or demonstrated the meaning of foreign words or expressions, then they were more likely to retain and understand those foreign words and expressions than the students who relied on a more traditional verbal identification and translation approach. Finally, in a study that involved students' learning of pseudo-words (word-like constructions), the use of iconic gestures (Simplified Signs) was shown to facilitate the student participants' learning in comparison with various approaches that did not include iconic gestures (Loncke et al., 2009). Although the results of these studies and others established that the use of gestures was a potentially important way to increase foreign language vocabulary learning, a number of important questions about this approach still remained to be answered.

An important question about the use of gestures to accompany foreign language vocabulary learning that needed to be answered was whether the type of gesture used had an effect on the number of vocabulary items students learned. If it were simply the case that it is the production or enactment of any gesture that helped students learn new vocabulary, then it would not matter whether the learner produced either a meaningless gesture or an incongruent gesture (a gesture that did not match the meaning of the word being learned) as opposed to a congruent gesture or representative (iconic) gesture. The answer to this question is that the nature of the gesture is a very important factor in the learning and retention of foreign language vocabulary. Congruent or representative (iconic) gestures that accompany spoken word production greatly enhance foreign language vocabulary acquisition in comparison

with the use of incongruent gestures or meaningless gestures (Kelly, McDevitt, & Esch, 2009; Macedonia, Müller, & Friederici, 2011). The use of an incongruent or unmatched gesture with a foreign language word typically has a negative or adverse effect on learning (Kelly et al., 2009). Thus, the production of gestures to successfully facilitate foreign language vocabulary learning appears to rely not on the attention-getting or dynamic movement that gesture production involves, but rather on how successfully the produced gesture is integrated with the word to be learned.

A second issue or question that needed to be examined was whether the use of gestures to accompany foreign language learning was effective with a wide range of word classes or whether it was limited to only certain types of words, such as concrete nouns or action verbs. It turns out that producing an iconic or representative gesture with a foreign language vocabulary item contributes to that item's learning regardless of whether that word is a concrete noun, verb, abstract noun, or adverb (Macedonia & Knösche, 2011). Although the learning of all four classes of words was significantly enhanced by the production of accompanying iconic or representative gestures, concrete nouns tended to be recalled the most frequently and adverbs the least. The investigators, Macedonia and Knösche, then examined their student participants' production of new sentences using the words that the participants had just learned. Again, the words that had been learned with accompanying iconic gestures were used significantly more frequently in the production of the new sentences. This latter finding would appear to indicate that foreign language vocabulary items learned with accompanying iconic gestures are more easily accessible in the learners' memories.

A third question that needed to be examined in determining the potential efficacy of using iconic or representative gestures in the acquisition of foreign language vocabulary items was whether the words acquired in that manner differed in how long they stayed in students' memories in comparison with words learned in the more traditional auditory-vocal approach. The findings from three studies answered this question. In Kelly et al. (2009), undergraduate students were tested on their recall and recognition of Japanese verbs after delays of five minutes, two days, and one week from their initial training. At all three of the time periods since training, the words learned through

saying them while also producing congruent gestures were recalled and recognized at higher levels than words learned through the other approaches (i.e., speech, repeated speech, and speech with incongruent gestures).

In the Macedonia and Klimesch (2014) study on this issue of retention, German-speaking college students were assessed through cued recall of artificially constructed vocabulary items at five different points in time: day 1 (after a learning phase), day 8 (after a learning phase), day 15 (test only), day 73 (test only), and day 444 (test only). At all five time points, the artificially constructed “words” that were learned through hearing, reading, and saying the words while producing semantically related gestures were recalled much more frequently than the words learned the same way but without the production of synchronous, semantically related gestures. In a third study that examined retention over time, Mayer, Yildiz, Macedonia, and von Kriegstein (2015) found that adult participants remembered significantly more foreign language words two- and six-months post-learning when the words were learned with self-performed representative gestures than when learning was accompanied with pictures or with verbal presentation alone. The results of these three studies show that the inclusion of congruent or semantically related gestures to the process of learning foreign language vocabulary items has a strong positive effect on the likelihood that those items will be remembered over time. Also, it should be noted that the Macedonia and Klimesch study involved the teaching and testing of students in an on-going classroom situation, so the results obtained from this study are likely to generalize to other classrooms.

Another important question in the use of additional modalities in foreign language instruction is whether learning is better when the to-be-learned items are accompanied by pictures or when they are accompanied by related gestures. In one examination of this question, Tellier (2010) assessed whether five-year-old French-speaking children acquired more English words when each word was paired with a picture of the item (or of the activity involved) or when each word was paired with a representative gesture. In one group, the children repeated the English words they heard while looking at the associated pictures. In the other group, the children repeated the English words they heard and also produced the representative gestures they saw demonstrated.

By the end of the 4-week study, the children who had learned the words with accompanying gestures had produced significantly more English words than the children in the picture condition. In a second study (Porter, 2016), children's learning of short foreign language sentences was examined when the sentences were accompanied by pictures alone and when the sentences were accompanied by both pictures and related gestures. The children, ages four to seven years, remembered many more words from the sentences when gestures accompanied their presentation. And in a third examination of this question, Mayer et al. (2015) found that adult participants' learning of foreign language vocabulary items by performing representative gestures was a significantly more effective strategy than learning those items with accompanying pictures. Both these strategies were more effective learning strategies than traditional verbal learning approaches. While these results provide additional support for the view that the enactment of gestures related to foreign language vocabulary items facilitates their learning, it should be noted that the children and adults in these studies (and other studies) also were getting visual input from seeing the gestures demonstrated.

One final question that has been examined concerns the rate of foreign language vocabulary learning. It turns out that adults (age eighteen to sixty-five years) learned foreign language words to criterion noticeably faster when the words were paired with iconic gestures (Simplified Signs) than when the words were not paired with the gestures (Adams, 2016). With all the adult participants in this study learning foreign language vocabulary items faster when they were accompanied by iconic signs, this outcome would suggest that vocabulary acquisition might be effectively sped up by adopting such an iconic sign-based approach.

What might be behind the evidently successful use of iconic gestures or signs to facilitate students' acquisition of new or foreign language vocabulary? Unfortunately, a clear-cut or definitive answer to this question cannot be provided at present. Several possible explanations, however, may be advanced to help account for this finding. One explanation is that students may find that their teachers' (or experimenters') pairing of spoken words with iconic gestures or signs may make the words' meanings clearer and more understandable, as well as keeping the students alert and interested (Allen, 2000; Gullberg, 2006; Lazaraton, 2004). Another possible explanation is that when

students see an iconic sign or gesture produced first by their teachers and then by themselves, those events may increase the likelihood that students will form a picture or visual image in their minds of that gesture or its referent (Kelly et al., 2009; Riseborough, 1981). The evocation of a visual image has long been known to improve memory performance (Paivio, 1971). Also, when individuals form visual images of concepts, such actions may facilitate the learning of those concepts by focusing the individuals' minds on core features or characteristics of those concepts (e.g., shape, movement, color). Moreover, when individuals produce gestures, that activity in itself may bring action into the individuals' mental representations, which in turn may affect both the individuals' behavior and thinking (Goldin-Meadow & Beilock, 2010).

A third possible explanation for the students' improved learning and retention rates rests on the students' production of the iconic signs or gestures that they had observed being produced. If the students were to actually form the signs or gestures, then the enactment of these gestures might help the students store and retrieve the words (Macedonia & Knösche, 2011) and gestures. Such embodied actions might also serve to anchor foreign language vocabulary items more firmly in the students' minds (Rivers, 1991; see also Asher, 1969).⁴ If, subsequently, the students were to generate the iconic signs or gestures, then these actions might aid the students in lexical retrieval (Cartmill, Beilock, & Goldin-Meadow, 2012; Frick-Horbury & Guttentag, 1998). Furthermore, it has become apparent that language is not solely the province of a delimited area in the left frontal area of the cortex. Rather, language learning and processing now appear often to involve other areas of the cortex (Pulvermüller, 2005), as well as subcortical areas of the brain (Lieberman, 2000). In an exploratory study of the neural representation of novel (artificially created) words, Macedonia and Mueller (2016) found evidence of activation of areas in the brain outside the principal language regions for the words learned with self-performed iconic gestures. These areas included the learners' sensory and motor cortices (see also Kelly et al., 2009), as well as the basal ganglia, and the cerebellum. Apparently, the production of iconic signs

4 When language is embodied, it is said to be grounded in a person's bodily experiences, with bodily experience involved in conceptual representations (see Barsalou, 2008).

or representational gestures along with foreign language vocabulary items may help students to activate more areas of the brain, such as visual and motor areas (Mayer et al., 2015), than is typically the case for just the auditory-vocal repetition or rehearsal of those words.

Another explanation for the facilitative effect of iconic gesture or sign production on vocabulary learning is that these gestures may engage an additional memory system. Vocabulary knowledge is often thought to be part of a person's declarative memory, which consists of knowledge that can be expressed in words. But because the use of iconic signs or gestures in vocabulary learning involves the production of motor actions to a considerable extent, it is quite possible that the engagement of a participant's motor system may result in the use of one's procedural memory system in addition to that of the declarative memory system (Macedonia & Mueller, 2016; see also Corkin, 2013).⁵ Because knowledge of how to do something often is especially long-lasting, then engagement of the procedural memory system in the vocabulary learning process might help explain why vocabulary items acquired through the use of iconic signs or gestures are retained for long time periods.

Each of the various processes described above probably contributes to some extent to enhanced foreign language vocabulary learning. The involvement of auditory-vocal, visual, pre-motor, and motor areas of the brain may result in the foreign language word or concept being widely interconnected in different areas of the brain (Klimesch, 1987). The use of gestural enactment, the formation of a visual image, and the hearing and saying of a word from a foreign language may also result in greater depth of processing (Craik & Lockhart, 1972) of that word. If a foreign language word undergoes greater depth of processing, and its meaning is fully understood, then its acquisition will likely be facilitated (Allen, 1995).

The findings reviewed above clearly indicate that language learners are much more likely to remember a new word from a foreign language if the learners produce an iconic or representative gesture as they say that word (Macedonia, 2014). What has yet to be determined is whether

5 The procedural memory system involves knowledge of how to do something and this knowledge is often expressed in actions or behaviors as opposed to words, as in declarative memory.

there is an optimal word-learning approach involving the enactment of iconic gestures, the viewing of pictures of the words or concepts, the reading of the words, and the repetition of the to-be-learned words. It will also be important to determine whether these various word-learning approaches are effective with all learners, or if certain groups of learners benefit more from particular approaches.

Learning to Sign May Positively Affect One's Cognitive Abilities

In addition to the potential benefits of learning to sign documented in previous sections and chapters, there is substantial evidence that acquiring signing skills may improve one's spatial cognitive abilities as well. This claim is based on studies of the performance of both deaf signers and hearing signers on standardized tests of intelligence, as well as on tests of spatial memory, mental rotation, and facial discrimination. While the enhanced performance of signing individuals in all these domains is noteworthy, it is the performance of signers on tests of spatial memory and mental rotation that may be of special significance. These skills evidently are very important in engineering and other scientific and mathematical domains (Sorby, 2009; Wai, Lubinski, & Benbow, 2009). One way to develop these skills may be to increase students' opportunities to learn to sign.

Intelligence Tests

One set of studies that examined the effects of learning to sign on cognitive development and processing consisted of studies that used standardized tests to measure intelligence. In one meta-analytic investigation (Braden, 1994) that involved using IQ test scores of large numbers of deaf students collected over a number of decades, the IQ scores of deaf students with deaf parents were compared with the scores of deaf students with hearing parents and with the scores of students with hearing in the normal range. Presumably, the children of deaf parents would in most instances have grown up in a signing environment, whereas hearing parents of deaf children historically were advised not to sign with their children but to emphasize spoken

language acquisition instead. The most frequently used instrument to assess the intelligence of deaf students was the Performance IQ Scale (e.g., block design, puzzle completion) of the Wechsler Intelligence Scale for Children — Revised (WISC-R) (Wechsler, 1974). For the deaf students with hearing parents, their mean performance IQ score of 99 did not differ significantly from the mean of 100 for students with normal hearing. But the mean performance IQ score of the deaf students with deaf parents, 108, was significantly higher, clearly outperforming on average the students with normal hearing. Please note that deaf students as a group typically earn below average verbal IQ scores; in the U.S., the verbal IQ section of the Wechsler tests involves considerable mastery of English. A likely reason for the superior performance of the students with deaf parents on the performance scale is that their signing skills facilitated their processing on tasks entailing spatial knowledge and memory.

Other studies of the effects of learning to sign on intelligence test scores involved hearing children who were taught to sign. In a follow-up of the participants in their study of baby-signing, Acredolo and Goodwyn (2000) administered the WISC-III (Wechsler, 1991) IQ test to the children when they were eight years old. Those children who had learned signs in infancy scored significantly higher than the children in the (non-sign) comparison group, both on the Verbal IQ scale (116 vs. 103) and the Performance IQ scale (109 vs. 101). In a second investigation involving hearing children, Italian children were introduced to Italian Sign Language early in elementary school in two studies (Capirci et al., 1998). Those children who opted to learn to sign in each study received about two hours each week of sign instruction during the school year over a two-year period. Other children in the investigation chose to participate in one of several additional enrichment programs (e.g., music, English-language learning) for two hours each week. Although the children in each of the different enrichment and control programs scored very similarly (about the fiftieth percentile on the average) near the beginning of the school year as they began their participation, those children who were learning to sign, in comparison with their classmates who were not, improved much more rapidly over time in their test performance. The sign-learning children subsequently scored substantially higher than the other children on measures of

visuospatial cognition and nonverbal reasoning, the Raven Progressive Matrices (Raven, 1949).⁶ By the end of the second school year in which they participated, the mean score of the children in the non-signing enrichment groups remained at about the fiftieth percentile, whereas the scores of the children who learned to sign approached the ninetieth percentile on the Raven's test. In conclusion, the findings from these various investigations suggest that children, deaf and hearing, who learn to sign relatively early in their development often show real cognitive benefits as assessed by their performance on various tests of intelligence.

Spatial Memory

In addition to higher average scores on broad measures of intelligence, learning to sign also has been found to be associated with enhanced performance in a number of more specific domains (Hauser & Kartheiser, 2014). Among the domains investigated have been spatial memory, mental rotation, and face-processing. The Corsi block-tapping task (Milner, 1971; Orsini et al., 1987) is a frequently used instrument for assessing individuals' short-term visuospatial memory. In this task, an examiner taps a certain number of blocks arranged irregularly on a board; immediately afterward, the participant is asked to tap out the same pattern. The hearing children who had learned Italian Sign Language in the Capirci et al. (1998) study discussed above had significantly larger spatial memory spans than the children in the other (non-sign instruction) enrichment groups. Similarly, deaf children who sign have been found to outperform hearing, non-signing children on this task (Wilson et al., 1997).

This pattern of signers showing an advantage over non-signers also has been shown for adult participants on the Corsi block-tapping task. In one study (Romero Lauro et al., 2014), deaf signers significantly outperformed hearing non-signers on both versions (forward and backward) of the Corsi blocks. The deaf participants in this study reported that they had been exposed to Italian Sign Language before

6 The Raven Progressive Matrices measure an individual's ability to analyze figures and detect patterns. In this test, each participant needs to select the missing piece to complete the matrix.

the age of six years and had used it as their principal means of communication since early childhood. In a second study (Geraci et al., 2008), deaf signers also outscored hearing non-signers on the Corsi block-tapping task; the hearing participants, however, outperformed the deaf participants on a test of word/sign span. Even when signing skills are acquired in early adulthood, the experience appears to heighten spatial memory. Adult hearing participants with one to five years of signing experience also showed a greater spatial memory span (on the Corsi blocks) when compared with adult hearing non-signers of the same age (Keehner & Gathercole, 2007). However, in contrast to this superior performance on the Corsi block-tapping test, the deaf signers in the Romero Lauro et al. (2014) study did significantly worse than the non-signers on the Visual Patterns Test (Della Sala et al., 1999).⁷ The investigators advanced the interpretation of their findings that the Corsi block-tapping tasks involved a spatial and movement component that appeared to be advantaged by signing skills, whereas the Visual Patterns Test involved a stable or static presentation. Furthermore, this presentation of stable shapes on the checkerboard might have facilitated their naming in a verbal code.

In a different approach to assessing spatial memory skills, the performance of deaf and hearing British Sign Language (BSL) users was compared with that of hearing non-signers on the game of *Concentration* (Arnold & Murray, 1998).⁸ When the cards consisted of pictures of objects, there was no difference in the level of performance among the three groups. But when the cards consisted of human faces, both the deaf and hearing signers outperformed the hearing non-signers. The deaf signers, moreover, also showed better memory for the location of faces than the hearing signers, who had not acquired facility in BSL until adulthood. When Arnold and Murray examined the relationship between years of sign experience and memory for faces performance, they found that the two were highly related: the number of years signing highly predicted memory for faces performance. An interpretation advanced for these findings is that signing experience was tied to facial

7 This test, designed to assess visual short-term memory, requires participants to reproduce checkerboard patterns.

8 In this game, cards are placed face down and a player turns over two cards in an effort to find a matched pair. If the two cards match, then they are removed from the table; if they do not match, then the cards are returned to their original locations.

discrimination skills and to remembering the location of these faces, whereas the objects in the first task were easily nameable in both signs and speech and so did not differentiate among participants based on their language skills.

Finally, the performance of deaf and hearing signers was compared with that of hearing controls on a haptic (by touch) spatial configuration learning task (van Dijk, Kappers, & Postma, 2013). The deaf signers were prelingually deaf adults whose first language was the Sign Language of the Netherlands; the hearing signers were adult Dutch sign language interpreters; and the hearing controls were Dutch adults who reported no sign language experience. In the experimental task, the participants were instructed to match ten shapes by touch to cut-outs in a board as fast as possible while blindfolded. Both the deaf and hearing signers outperformed the hearing controls, as the signers were significantly faster than the non-signers across the three test trials. This pattern of results, furthermore, also occurred when the cut-out board subsequently was rotated 90°. These findings suggest that sign language experience may be related to improved spatial memory skills, especially that of relative location in space.

Mental Rotation

Signing experience also has been associated with enhanced performance on tests of mental rotation. In mental rotation tasks, a participant needs to be able to rotate an observed scene or stimulus in his or her mind. The adult participants in the Keehner and Gathercole (2007) study discussed above were assessed on their mental rotation abilities as well. The hearing participants who signed outperformed the hearing non-signers when the visual stimuli were rotated 90° and 180°, but not when the scene was tested at a 0° rotation (i.e., without rotation). In a related study (Emmorey, Kosslyn, & Bellugi, 1993), in which participants were asked whether the rotated shapes were the same as the target shape, both the hearing and deaf signers outperformed hearing non-signers when the stimulus shapes were rotated. Similarly, deaf signers were more accurate than hearing non-signers when they were examined on a task that involved both rotation of a scene and the orientation of an object (Emmorey, Klima, & Hickok, 1998). Although both groups

of participants were less accurate when rotation was involved, the deaf signers were significantly better than the non-signers in mental rotation as well as in remembering object orientation.

Finally, in a fourth study (Talbot & Haude, 1993), fifty-one adult women (two reported that they were hearing impaired while forty-nine reported normal hearing) were tested on their mental rotation ability. The participants varied widely in their experience using American Sign Language. Those participants with more ASL experience scored significantly (and much) higher than those women with less experience signing. The findings from these four studies indicate that it is signing experience that apparently is the critical factor in enhanced mental rotation skills, not a person's hearing capacity. Another possible, although we think unlikely, interpretation is that persons, deaf or hearing, with a strong aptitude for mental rotation and spatial cognition tasks, tend to become more proficient signers.

Facial Discrimination

Signers have been shown to outperform non-signers on certain tests of face-processing as well. In the test of Facial Recognition by Benton et al. (1983), a participant views a person at the top of the page and then must identify that person from among pictures of other people at the bottom of the page. It should be noted that this test is seemingly more one of facial discrimination than facial recognition. What makes this task somewhat challenging is that the lighting conditions and angle of presentation are different for the person being identified at the bottom of the page than at the top. Signing deaf children performed better than hearing non-signers on this test (Bellugi et al., 1990).

This finding of better performance by signing deaf children in comparison with hearing non-signers raised the question as to whether this heightened performance was the product of sign language skills or the outcome of deaf persons compensating for a relative lack of auditory-vocal input. Additional studies showed that it was the former, the acquisition of signing skills, which contributed to this advantage. Deaf non-signers did not perform as well on the test of Facial Recognition as either the hearing signers or the deaf signers (Parasnis et al., 1996). And in a series of experiments, Bettger et al. (1997) showed that both deaf

and hearing signers outperformed non-signers on facial discrimination tasks. From these results, it appears that it is the ability to sign that is the important factor in elevated results, not whether a person is deaf or hearing. If one learns to converse in a signed language, then one needs to attend to and interpret the facial expressions of others while they are signing. As a consequence, signers may become more adept at discriminating facial expressions (Emmorey, 2002).

Discussion

What factors or experiences might be contributing to sign-learning individuals' enhanced performance on measures of nonverbal intelligence and spatial cognition? If a person learns to sign, then that individual gains substantial experience in learning how to transmit information effectively in a visuospatial environment. For example, an individual acquiring a signed language will learn that the location of a sign and the direction of a sign's movement are important in transmitting information about who (or what) is performing the action and who (or what) is the recipient of the action. And as a sign learner becomes increasingly proficient in his or her signing, that individual likely will increasingly rely on establishing an imaginary stage and locating different persons or objects on that "stage" for subsequent reference. This "stage" typically is located in the space in front of the signer's body and reflects a direct representation of objects, persons, or actions on that stage. This approach probably results in increased efficiency in the sign learner's transmission of information, but also makes greater demands on the signer's and viewers' spatial and gestural memories.

If other persons sign to a sign-learning individual, then that individual needs to learn to process those sign utterances and grasp their meanings from different spatial or visual perspectives. Because most signers convey information to others from their own perspectives, a sign learner looking at a signer directly in front of him or her needs to mentally rotate or transform the signer's sign production 180° to fully comprehend what was just signed. If the sign learner is located to the signer's right or left, then he or she needs to mentally rotate the sign utterance about 90° to fully understand it. With time, the sign learner may become increasingly adept at understanding sign communications

viewed from a wide range of visual angles. Indeed, as a person gains experience in comprehending others' signing, the process of rotating or transforming these utterances may become fully automatic! In addition, as the sign learner becomes proficient in understanding others' signed communications, the sign learner receives extensive practice in mental rotation skills with regard to manual signs. The mental skills needed to successfully understand another person's signed communication may provide a strong foundation for success in the mental rotation tasks assessed by various standardized tests.

Another way for an addressee of a signed utterance to understand the spatial relationships in such an utterance would be to adopt the viewpoint of the person generating the signed utterance. An initial step in developing this skill would be to recognize that visual perspectives differ depending on one's location. Then one would need to be able to create the scene as viewed from another's perspective. It appears that signers learn to imagine themselves in other persons' bodies (motor embodiment) in order to view the scene as depicted from those persons' vantage points (Pyers, Perniss, & Emmorey, 2015). This placement of oneself in other persons' vantage points may become easier with increasing age and signing experience, as well as prove cognitively less demanding than constantly mentally rotating the scene that is being depicted.

While signers often score higher than non-signers on tests involving visuospatial skills, it should be noted that there are exceptions to this pattern. In a number of instances, hearing individuals without signing skills have scored as high as or higher than deaf persons on measures of visuospatial abilities (Marschark et al., 2015). Moreover, one may not need to have learned to sign to show enhanced performance on spatial problem-solving tasks through the gestural modality. When hearing, non-signing college students simply were encouraged to gesture when solving such spatial visualization tasks as mental rotation and paper folding, they performed significantly better than those students who did not receive these instructions (Chu & Kita, 2011). Regardless, it should also be recognized that the finding that individuals, deaf or hearing, who learn to sign often score significantly higher on tests of spatial memory and mental rotation than non-signing individuals indicates that the visuospatial skills involved in these tests are, to at

least some extent, learnable. That is, as one becomes more proficient in signing, one typically appears to become more adept at spatial memory and mental rotation tasks. These claims should not be considered as surprising ones in that the comprehension and production of a signed language involves the use of such visuospatial skills as memory for spatial locations, discrimination of handshapes and facial expressions, and mental rotation or transformation of visual scenes. Whereas users of a signed language would frequently be exercising those portions of their brains involved in spatial memory and cognition, users of spoken languages would not receive the equivalent practice effects (Hauser & Kartheiser, 2014).

This finding that learning to sign is associated with enhanced performance on measures of spatial skills is also consistent with other current reports that spatial thinking is malleable (Sorby, 2009; Uttal, Miller, & Newcombe, 2013; see also Casey, 2013); that is, with appropriate experience, spatial thinking can improve. And because women historically have been found to score lower on measures of visuospatial processing than men (Halpern et al., 2007), it would be of interest to see whether experience in signing would reduce or eliminate this reported sex difference in cognitive ability. Moreover, young girls might likely reap the most benefit from early spatial intervention programs (cf. Casey et al., 2008).

Finally, it is quite possible that the use of manual signs and gestures will prove beneficial in the learning of mathematics more generally (Macedonia & Repetto, 2017; Roth, 2001). When representational gestures were used to explain mathematical equivalence to school-age children, the children receiving this gestural input demonstrated significantly better performance than those children who did not receive the gestural input (Cook et al., 2017). Moreover, it has become apparent that both teachers and learners often make abundant use of pointing and representational gestures in their teaching and learning of mathematical concepts (Alibali & Nathan, 2012). What is not yet well understood, though, is just how such gestural production and processing improves students' learning.

Concluding Remarks

Although the original goal of the Simplified Sign System was to provide a manual sign-communication system that might facilitate the communication of minimally verbal individuals with autism, Down syndrome, cerebral palsy, or aphasia, the contents of the present chapter show that there are many other individuals who might benefit from learning to sign or using Simplified Signs. In fact, it seems likely to us that many more typically developing hearing individuals will make use of our Simplified Sign System than those individuals for whom we originally designed the system. A simple reason behind this assessment is that there are many millions of individuals who need to acquire a foreign language vocabulary for their economic livelihoods, much less the millions of children who need assistance in attaining literacy skills as the pathway to escaping poverty.

Worldwide, many children become fluent in their family's spoken language but encounter serious language issues when they enter school. The difficulty these young students encounter is that their native language, in which these students are fully fluent, may not have a written or printed form. For these students to have a chance at literacy and educational success, they will need to acquire substantial proficiency in a language that has a written form. Furthermore, this proficiency probably needs to be attained relatively quickly so that the students do not fall behind in their educational achievement. And, because many countries where such educational hurdles occur frequently have only limited resources to overcome such hurdles, then any intervention program ideally should be relatively inexpensive to operate.

In light of the findings about the facilitative effects on learning of having students produce iconic gestures as they utter foreign language words, we see no reason why this approach should not be widely used in the teaching of vocabulary items. If this approach were to be transferred to a classroom setting, teachers adopting such an iconic gesture approach to word learning could first produce an iconic gesture while simultaneously uttering the to-be-learned word. The students could then perform the gesture they just saw as they said the word they are trying to learn. A limiting factor with the widespread adoption of this pedagogical approach, however, is that many teachers would likely

find it difficult and stressful to generate an effective iconic gesture for a particular word or concept on the spot while standing in front of a classroom of students. Fortunately, this task could be more easily accomplished and the problem largely overcome if these teachers were to avail themselves of the signs from the Simplified Sign System or another system of iconic signs or pantomimic gestures. And, if the students were to learn their foreign language vocabulary items on their own by pairing the to-be-learned words with their Simplified Sign equivalents, then the learning process would likely be much more successful and noticeably less tedious than traditional auditory-vocal rehearsal of the words on a foreign language vocabulary list. At the same time, it should be recognized that there is much more to learning a foreign language than mastering a core vocabulary. But if students could understand and produce a large number of words from a foreign language after having learned them by pairing them with iconic signs, then an important language acquisition hurdle would have been overcome.

We also can easily see many preschool teachers devoting at least a portion of their class days to showing their young students a small number of Simplified Signs. Teachers may wish to pair each sign with its spoken language equivalent and to show how each sign is formed. Although some young children may perceive the relationship between a sign and its meaning, many teachers may wish to point out how a sign's formation relates to its meaning. One benefit of including Simplified Signs (or iconic signs from a similar system) in the classroom routine by pairing signs with spoken words is that the children's vocabulary knowledge is likely to increase. This building of vocabulary knowledge through manual signs may prove of special importance to young children from lower socioeconomic backgrounds and to children whose parents are immigrants. The reasoning behind this claim is that these young children often do not receive the level of spoken language input at home that is necessary for attainment of full literacy in the language used in the school system.

A second potential benefit of preschool and kindergarten teachers including signs in their classes is that young children may acquire better motor control, manual dexterity, and improved eye-hand coordination through sign learning. Although Simplified Signs were designed to be relatively easy to form, they still entail some degree of motor skill to

form accurately. Young children may need repeated demonstrations of how signs are formed by their teachers, as well as assistance from their teachers in molding their hands and fingers into the correct sign formation. This involvement of teachers in the demonstration of signs may also result in the children learning to look at their teachers more often. Another possible benefit of incorporating manual signs into the school experience is that some of the young children's restlessness and need to move around may be absorbed into their production of signs.

Furthermore, the findings of a number of studies on the impact of learning to sign on cognitive processing should be encouraging news to persons considering such a course of study for themselves or their children. In addition to learning to communicate in another modality, many hearing children who learn to sign show elevated scores on subsequent vocabulary and IQ tests. And if teachers or school officials are worried about the time commitment needed to obtain substantial effects, then they should review the study conducted by Capirci and her associates (1998). In the Capirci et al. study, Italian elementary school students received only two hours a week of training in Italian Sign Language for two school years, yet they demonstrated major gains in their nonverbal reasoning abilities over this period. It would be difficult to find another pedagogical intervention that would return benefits of this magnitude for such a limited investment of time and effort.

Finally, the results of studies on the impact of learning to sign on cognitive processing are of interest for another reason: they show that a language can affect one's thinking or cognitive processes. This notion that one's language could affect one's reasoning and mental activities was advanced in the nineteenth century by the German philosopher and linguist Wilhelm von Humboldt (von Humboldt, 1836, Trans. P. Heath & Intro. H. Aarsleff, 1988), but it is better known today as the Sapir-Whorf hypothesis. Support for this hypothesis, though, has been modest at best (McWhorter, 2014). This assessment, however, was based solely on examination of the outcomes of studies of spoken languages and their impact on cognitive processes. If one were to include signed languages in these analyses, one could reach a very different conclusion. That conclusion is that learning to sign may significantly affect one's cognitive abilities. In particular, persons who learn and use a sign language often show enhanced spatial memory, mental rotation, and

nonverbal reasoning abilities. While key word signing with Simplified Signs may not bring the same boost in cognitive abilities as using a full and genuine sign language, it may have its own unique or similar benefits. At the same time, while learning to sign likely will improve various cognitive abilities, this does not mean that signers are viewing the world in fundamentally different ways or are endowed with new conceptual abilities.

In conclusion, acquiring signing skills and using Simplified Signs appear to bestow a number of educational benefits on the sign learners. Just how extensive such potential benefits will be and for whom will need to await the outcomes of future investigations. Regardless of who benefits and the magnitude of such benefits, it should be an exciting experience determining how best to use manual signs to elevate the lives of sign learners. We spent an extensive amount of time selecting, modifying, and creating signs to be as iconic, easily remembered, and easily formed as possible for all of these various sign-learning populations. In the next chapter, we discuss the steps we followed in developing the Simplified Sign System, including the testing of the signs with different individuals and groups.