Volume 1: Principles, Background, and Application

Simplified Signs

A Manual Sign-Communication System for Special Populations

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4. Sign Communication in Persons with an Intellectual Disability or with Cerebral Palsy

The 1970s brought a dramatic increase in the use of signs to foster language skills in non-speaking children and adults. When the decade began, there were only a few programs that utilized signs with hearing, but non-speaking, persons. By the time that Goodman, Wilson, and Bornstein (1978) conducted their national survey later that decade, however, there were over 10,000 students in North America alone who were participating in sign-communication training and teaching programs. Many of these individuals were children with an intellectual disability[1] who had extremely limited or no functional speech.

What led to this remarkable increase in the use of signs to facilitate language skills in non-speaking persons? One of the most significant factors was the recognition that the sign languages used by Deaf persons were genuine languages. This was an important conceptual breakthrough: language was no longer equated solely with speech. A second contributing factor was the large amount of attention given to the chimpanzee, Washoe. Washoe, taught by R. Allen and Beatrix T. Gardner (1969, 1971) to communicate through ASL signs, acquired a substantial sign vocabulary and learned to combine signs to express a

1 The term *intellectual disability* now is being used in place of the term *mental retardation* (Schalock, Luckasson, & Shogren, 2007). This transition in usage is particularly evident in the renaming of the American Association on Mental Retardation to the American Association on Intellectual and Developmental Disabilities. Because, in the past, investigators who studied children with intellectual disabilities often employed the term *mental retardation*, it will sometimes be necessary to continue using this terminology when directly quoting their work.

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wide range of concepts.[2] The press reports of Washoe's success helped inform a wide audience about the possibility of communicating through manual signs. Soon after, many non-speaking or minimally verbal persons with an intellectual disability entered sign-learning programs. Later, certain individuals with cerebral palsy, autism spectrum disorder (ASD), and/or aphasia also were exposed to these programs.

After sign-communication programs were introduced to a wide range of persons with serious communication disorders, there were a number of reports of substantial improvements in many individuals' language skills. In these reports, many non-speaking or minimally verbal children and adults were depicted as making great strides in their communication through programs that used either manual signs alone or signs combined with spoken language. With these accounts of positive outcomes, sign-communication programs rapidly became well established as a major form of intervention to increase individuals' abilities to communicate. Indeed, before 1990, programs using manual signs or signs combined with spoken language constituted the most frequently employed form of augmentative and alternative communication training for persons with cognitive impairments or childhood autism in the United States (Beukelman & Mirenda, 2005; Matas et al., 1985). The initial enthusiasm about manual signing interventions was soon tempered, however, by reports of more mixed outcomes among participants in those programs.[3] This variability in outcomes may have helped spark the development of other non-oral communication systems for intervention purposes (see Chapter 5). In some of these newer intervention approaches, signs may be combined with other non-oral communication systems in a more multimodal approach.

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2 This project and similar manual sign-communication studies with primates (e.g., Miles, 1978; Patterson, 1978) were not without critique, however. See Lyn (2017) for an overview of methodological concerns regarding such animal language studies (as well as her rebuttals of many of them) and Pepperberg (2017) for a more personal view of the controversies surrounding the projects.

3 Many of these early manual sign intervention programs were performed in highly structured training sessions over a short period of time and did not focus on generalizing or incorporating sign use into more naturalistic settings or across multiple environments. Such limitations in program design probably had a negative impact on children's motivation to use signs outside of the specific training sessions. A more comprehensive approach to signing, such as immersion in a signing environment, would likely have generated better results or more consistently positive outcomes.

Reviews of the studies of sign-communication training and teaching with various non-speaking or minimally verbal populations, including those with more than one condition that affected their acquisition or use of spoken language, reveal important commonalities in their findings. There often has been a wide range in sign learning among participants, with certain types of signs more frequently acquired, and some environments more conducive to learning signs than others. As well as learning to communicate through signs, many participants in sign intervention programs show improvements in other areas, such as better understanding of spoken language, increased motivation, and improvement in academic skills (Kiernan, Reid, & Jones, 1982; Launonen, 1996, 1998, 2003, 2019b). In addition, as individuals with disabilities gain skills in controlling their environment and conveying their needs through signs, their level of frustration and incidence of tantrums often decrease. With an increased ability to communicate and reduction in behaviors associated with helplessness, these individuals also are more likely to comply with caretaker requests (Bryen & Joyce, 1985). Along with these benefits, the use of manual sign instruction has been consistently related to increases in most participants' spoken language production when signed input occurs together with speech (Dunst, Meter, & Hamby, 2011; Launonen, 2019b; Launonen & Grove, 2003; Millar et al., 2006; te Kaat-van den Os et al., 2015; Valentino & Shillingsburg, 2011). This is an important finding given concerns among parents and professionals that sign learning might adversely affect their children's or clients' spoken language development and use.

An Early Study

Although nearly all contemporary reviews of sign-communication training and teaching programs for non-speaking children with an intellectual disability focus only on studies conducted during the past several decades, it turns out that the use of signs with such children has a much longer history. In fact, many breakthroughs that we think of as recent achievements were known to certain professionals long ago. For example, the usefulness of sign instruction for children with significant cognitive impairments was spelled out in the middle of the nineteenth century by W. R. Scott, Ph.D. (Bonvillian & Miller, 1995).

Scott was the principal at a school for deaf students in the west of England. Although many schools for deaf students in England at that time stressed oral educational approaches, Scott embraced signing as well. He also was concerned about the development of children with serious intellectual disabilities. In 1847, he described a course of instruction for non-speaking individuals with an intellectual disability, observing in his report that those staff members with experience in the education of deaf students "...are not infrequently called upon to instruct children of very low intellectual capacity" (Scott, 1847, p. 7) as well. Scott noted that these children invariably improve as a result of the instruction they receive. With regard to their communication skills, Scott (1847) claimed that the children:

> ...generally obtain a sufficient knowledge of the sign language of the Deaf-mutes, to enable them to converse on the common subject, and furthermore generally learn the names of common objects and their more sensible qualities, and to perform the easier kinds of manual labor; but they seldom get to understand complicated forms of expression... (p. 8)

Along with these children's gains in communication, Scott observed noticeable improvements in their cleanliness, temper, and social behavior.

Scott offered a pair of explanations to account for the success of sign language training with these youngsters. One explanation was that gestural communication developmentally precedes spoken language. That is, virtually all infants use gestures to communicate before learning to speak, so gestural communication may be a more fundamental way to communicate.[4] His second explanation was that words and signs

4 Scott most likely was focused on how the production of meaningful and understandable gestures developmentally precedes the production of meaningful and understandable words. Contemporary studies show that children's gestures may be accompanied by either meaningless or meaningful vocalizations depending on the developmental stage of the child involved. In the early sessions of an observational study of gesture, speech, and word development in six typically developing children between the ages of twelve months and twenty-seven-and-a-half months, Goldin-Meadow (1998) reported that most of the children's communications were vocal in nature (between 60–80%). Of the 20–40% of the communications that did contain gestures, most of those gestures initially occurred without speech (in other words, speech and gestures were not yet part of an integrated system). The speech that the children did produce along with gestures in these early sessions was comprised of meaningless sounds not temporally matched with the peak of the gesture. This relationship, however, changed over time as the

differed in that there often was a discernible tie between a sign and what it stood for (its referent), whereas the relationship between a spoken word and its referent rarely was apparent. This discernible tie between a sign and its referent likely would make a sign more easily learned and remembered. As Scott observed, there frequently was "a natural relation to the notion taught" (1847, p. 34) for those signs the children learned (these signs would be considered iconic in nature). Scott evidently was a man ahead of his time: these explanations for the success of sign-communication programs for non-speaking children were to be advanced anew over a century later.

Although Scott's findings and observations about the merits of sign programs could have had a profound impact on the education of students with various intellectual disabilities, they did not. There probably were several reasons for this outcome, ranging from the publication of his report in an obscure academic pamphlet to the fact that many educators in the late nineteenth century adopted oral-only educational approaches for deaf students (that is, sign language and fingerspelling were prohibited). Regardless, if Scott's observations about the efficacy of sign-communication training and teaching had been more widely accepted, then the lives of many non-speaking persons with an intellectual disability might have been greatly improved.

Intellectual Disability

Intellectual disability is characterized by atypical (lower) cognitive functioning and impaired adaptive behavior. More precisely, intellectual disability is defined as "significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills" (AAIDD Ad Hoc Committee on Terminology and Classification, 2010, p. 1). Furthermore, the onset needs to occur before the age of eighteen years. Many individuals with intellectual disabilities also have motor or neuromotor impairments that may adversely affect their communication skills (Beukelman &

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children started to combine gestures with meaningful words and later started to temporally match their vocalizations (both meaningful and meaningless) with the gestures. At this point, the children's speech and gesture could be considered an integrated system.

Mirenda, 2013). Children with more severe cognitive impairments typically have very serious linguistic deficits as well (Bryen & Joyce, 1985). According to Romski and Sevcik, "the majority of children and youth with significant mental retardation fail to develop functional spoken words even with considerable speech and language instruction" (1996, p. 9). These communication deficits may lead them to experience frustration and indirectly result in a range of behavioral problems. Those persons who fail to acquire useful speech tend to have the lowest IQs (Sheehan, Martyn, & Kilburn, 1968) with many very low-scoring individuals having additional or multiple disabilities.

The particular etiology or cause of the intellectual disability also is an important factor that affects the level of language or communicative functioning that an individual may attain (Fowler, 1998). That is, persons with similar full-scale IQs may have quite different language profiles depending on whether they are identified as having Down syndrome, fragile X syndrome, Angelman syndrome, Williams syndrome, or other syndromes associated with an intellectual disability. Individuals with Williams syndrome, for example, tend to eventually acquire substantial productive spoken language skills, with their intellectual disability much more evident in the difficulties they experience with visuospatial skills (Brock, 2007; Vicari et al., 2004).[5] In contrast, the spoken language development of children with Down syndrome typically is not as advanced as their cognitive development (Barnes et al., 2009; Tager-Flusberg, 1999), with their visuospatial skills relatively well preserved (Dierssen, Herault, & Estivill, 2009; Vicari, 2006) although not immune to disruptions in spatial representation (Uecker et al., 1993; Vallar & Papagno, 1993; Woll & Grove, 1996, 2019).

Fragile X syndrome is a relatively common inherited form of intellectual disability, with males identified with the syndrome considerably outnumbering females.[6] Individuals with fragile X

5 Because signed languages rely heavily on visuospatial processing for effective communication, individuals with Williams syndrome might be expected to experience particular difficulty with this important aspect of sign communication. Findings from a case study of a deaf woman with Williams syndrome showed that she experienced significant difficulty using and understanding spatialized syntax and topographic relationships (Atkinson, Woll, & Gathercole, 2002; Woll & Morgan, 2012).

6 Estimates of the incidence of fragile X syndrome have varied widely, with the ethnic-group composition of the populations studied and the precise definition

syndrome typically are more impaired in their expressive language skills than in their receptive language skills (Martin et al., 2013), with impaired articulation a frequently occurring problem (Barnes et al., 2009; Finestack & Abbeduto, 2010). Some of the difficulties individuals with fragile X syndrome experience in their development of spoken language skills may be attributable to impaired phonological processing (Pierpont et al., 2011; see also Engineer et al., 2014). Although most individuals with fragile X syndrome eventually outperform individuals with Down syndrome on measures of grammatical ability (Finestack, Sterling, & Abbeduto, 2013) and expressive language (Finestack & Abbeduto, 2010), many youngsters with fragile X syndrome learn to communicate initially through augmentative and alternative communication strategies (Brady et al., 2006). The use of manual signs and PECS (Picture Exchange Communication System; see Chapter 5) are the two communication strategies most frequently mentioned by mothers of children with fragile X syndrome as being used by their children (Brady et al., 2006). Mothers of young children with fragile X syndrome, moreover, often facilitated their children's transition to spoken language by effective use of gestures during their interactions (Hahn et al., 2014).

Oral communication intervention programs often have proven unsuccessful in fostering spoken language skills in individuals with a severe or profound intellectual disability[7] even after intense therapy

of intellectual disability used affecting the results. Turner, Webb, Wake, and Robinson (1996) estimated a syndrome incidence of 1 per 4000 for males and 1 per 8000 for females from populations composed mostly of Caucasian families. Crawford, Acuña, and Sherman (2001) provided a range in syndrome prevalence for Caucasian males extending from 1 per 3717 to 1 per 8918. Males also typically are more adversely affected than females.

7 In many research studies, participants with a cognitive impairment have been grouped based on their scores on standardized tests designed to assess intelligence (IQ tests). Individuals who received an IQ score of 55–69 typically were identified as having a *mild* intellectual disability, those with IQ scores of 40–54 as having a *moderate* intellectual disability, those with IQ scores of 25–39 as having a *severe* intellectual disability, and those with IQ scores below 25 as having a *profound* intellectual disability. In more recent years, the distinction between these categories has gotten fuzzier and the boundaries have shifted, particularly in countries like the U.K. In such areas, the use of IQ tests as a basis for ID definition and for the provision of services to individuals with intellectual disabilities has been discouraged or deemphasized in favor of more social- or rights-based approaches that focus on giving families the support they need. In this volume, we acknowledge this ongoing cultural shift in terminology but will often continue to refer to the above

(Bonvillian & Nelson, 1978; Kopchick & Lloyd, 1976). Because the absence of communicative skills is such a serious problem, many researchers and educators who worked with these children eagerly embraced the use of signs several decades ago when it was first brought to their attention. The attention and recognition given to sign languages in the 1960s also helped spur the development of sign intervention programs. In many instances, the children who participated in these signing programs made considerable progress in learning to communicate more effectively (Kiernan et al., 1982).

Some studies that examined the learning of signs or gestures by individuals with cognitive impairments involved participants who had additional disabilities. Levett (1969, 1971) devised a system of mime for a group of non-speaking children with a severe intellectual disability and cerebral palsy. This system consisted of fifty gestures or movements that resembled activities or objects believed to be of interest or relevance to the children. Ten of the twelve youngsters who participated in the project learned to use the mime system effectively. This outcome indicated that a number of the participants had the ability to make important strides in communication skills when the modality was changed from a vocal one to a manual one. The fact that the signs and gestures had clearly visible ties to the concepts they represented probably also played a role in their successful learning. That is, signs and gestures that were pantomimic or highly iconic often were easier to learn and remember.[8]

In addition, sign vocabulary training was explored early on with individuals with an intellectual disability who were also deaf (Sutherland & Beckett, 1969). Prior to sign intervention programs, many of these persons had little or no exposure to a sign language. Deaf or hearing-impaired individuals with an intellectual disability traditionally were excluded from residential and community programs for Deaf persons because of their perceived low cognitive ability (Hall

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categories largely because the research studies we reference used them as a basis for comparison. It is likewise helpful to point out that certain individuals have more complex communication needs than others, and as such, may require different intervention strategies, although which strategies to use with an individual should not be limited by his or her IQ scores.

8 The combination of cognitive age or intellectual, motor, and linguistic disabilities of an individual may prevent that person from consciously appreciating a sign's iconicity, especially if the tie between that sign and its referent is less clear. Regardless, highly iconic signs may still be remembered better than less iconic signs.

& Talkington, 1970). Because some of the factors that cause childhood deafness, such as maternal rubella or German measles, may also result in brain damage and cognitive impairment, deaf persons are over-represented in the population of individuals with a significant cognitive or intellectual disability (Bruce, DiNatale, & Ford, 2008; Guardino, 2008; van Dijk et al., 2010). The various studies of sign acquisition in individuals with intellectual disability showed that the large majority of the participants made some progress in acquiring sign-communication skills. Another important finding was that gains in communication skills among participants were not shared equally. Indeed, in one study involving sixteen participants with either a severe or profound intellectual disability (Hoffmeister & Farmer, 1972), the level of sign mastery extended from almost no learning to the acquisition of 200 or more signs by four participants; those four participants also learned to combine signs. Wide variation in sign mastery was again seen in a study by Cornforth, Johnston, and Walker (1974) in the U.K., where the number of expressive signs learned by fifty-one deaf adults with a severe intellectual disability ranged from 36 to 137. These findings underscore the wide differences in outcomes from relatively similar training and teaching experiences.

The success of deaf individuals with a cognitive impairment in learning to sign raises questions about the accuracy of their initial intellectual disability classification. That is, when an individual has low intellectual ability and deafness, the combination of disabilities may give the appearance of a much lower level of cognitive functioning than is actually present. The results of a systematic comparison back up this claim. Hall and Talkington (1970) compared the sign-learning abilities of thirty deaf students with an intellectual disability to those of thirty hearing students with an intellectual disability. The two groups were matched on IQ (on the performance, or non-language, IQ scale), sex, age, and length of institutional placement. After six months of training, the deaf students had learned to comprehend many more signs than the hearing students (deaf mean = 54.6 signs; hearing mean = 0.1 signs). This finding, together with those from additional studies, led to the conclusion that IQ measures of deaf students with an intellectual disability frequently were underestimating their ability to learn, especially their potential for acquiring signs.

Many children who are congenitally deaf and blind have been assessed as having a moderate to severe intellectual impairment (van Dijk, 2004). Once again, the presence of additional disabling conditions may give the appearance of a very low level of cognitive functioning in these individuals. Unlike deaf children who rely heavily on vision in their learning, deafblind children may need to rely more on touch and proprioception depending on their particular levels of vision and hearing (Deuce & Rose, 2019). Furthermore, it is important to understand that a child's visual and/or hearing skills may be relatively intact at birth but deteriorate further as he or she ages. Thus, family members and interventionists should take existing skill sets into consideration when developing communicative strategies and will then need to adapt these strategies as vision (and/or hearing) skills become more impaired (Deuce & Rose, 2019; Pease, 2000). Still, quite a few deafblind children manage to learn to produce and to understand manual signs and fingerspelling. In one study of 71 deafblind children in Denmark (Dammeyer & Ask Larsen, 2016), of those that had already developed language skills, 39% relied on a visually perceived sign language and 23% used the tactile modality to access sign language. Such use of signs from an existing sign language may in fact be built upon an earlier scaffold of natural gestures that have been developed or adapted by the deafblind person and his or her family members and caretakers for communicative purposes (Nafstad & Rødbroe, 2015; Souriau et al., 2008). A final factor that should be considered is that deafblind persons may also experience motor problems that necessitate changes to any manual signs that they produce. Signs should be altered in such a way as to emphasize that individual's relative strengths and avoid areas of particular difficulty (Deuce & Rose, 2019). These individuals' acquisition of manual communication skills often is associated with a reduction in negative behavioral patterns such as self-injurious behaviors (van Dijk, 2004).

Shortly after the publication of reports on the successful acquisition of signs by persons with both an intellectual disability and another disabling condition, a number of sign-communication programs were established for the broader population of individuals with intellectual disabilities or language impairments (Grove & Walker, 1990; von Tetzchner, 1984a). In these programs, many hundreds of persons, including participants without additional disabling conditions, showed

marked improvement in their language skills through learning signs. The finding that many of these non-speaking children and adults could acquire a large lexicon or vocabulary of signs led to the establishment of numerous sign-based programs. Furthermore, once learned, signs often were retained for long periods even without additional training and teaching sessions (Hobson & Duncan, 1979).

One of the most widely used sign systems for non-speaking persons with severe language impairments is known as the Makaton Vocabulary. The Makaton Vocabulary was initially designed as a signing system to meet the needs of deaf adults with an intellectual disability. After it proved to be a viable communication approach for these individuals, it was successfully used with hearing adults and children with an intellectual disability, autism, a specific language disorder, or an acquired neurological disorder affecting communication (Grove & Walker, 1990; Sheehy & Duffy, 2009).

The signs for the original Makaton Vocabulary came from British Sign Language (BSL), the principal language used by members of the Deaf community in Great Britain. The BSL signs selected for inclusion in the Makaton Vocabulary were chosen based on the signs' perceived usefulness in meeting many of the basic needs and functions of the target populations. The signs were organized for teaching purposes into different stages reflecting the core concepts that needed to be expressed at different levels of development and use. Initially, there were 350 core concept signs; this was later expanded to 450 signs, and access to a much larger resource vocabulary was provided. After achieving a great deal of success in Great Britain, the Makaton Vocabulary was adapted for use in many other countries. In these adaptations, the signs for the Makaton Vocabulary were taken from the signed languages used by Deaf persons in those countries; for example, in Japan, the Makaton Vocabulary uses Japanese signs (Grove & Walker, 1990).

In the Makaton system, signs are used by teachers and caregivers in conjunction with speech. Rather than signing every word in a sentence, they sign only those words in a sentence that convey needed information. This focus on signing the principal content words in a sentence became known as *key word signing*.[9] Another aspect of the Makaton Vocabulary approach is the inclusion of graphic symbols. These symbols are largely

9 The signs from any signed language can be used in a key word signing approach.

pictorial representations of words or signs and operate in a manner similar to a rebus. Many teachers and caregivers who utilize the Makaton Vocabulary system reportedly teach by underlining the visual link between a sign and its equivalent graphic symbol (Grove & Walker, 1990). This inclusion of graphic symbols to help in sign learning and the establishment of a core concept vocabulary, as well as the development of various supplemental teaching aids, make the Makaton Vocabulary an innovative organizational approach to the fostering of communication skills in non-speaking persons (Sheehy & Duffy, 2009).

While many hearing persons with a severe or profound intellectual disability made progress in learning to sign, studies also revealed that there were wide individual differences in the level of sign mastery achieved. This observation of very uneven levels of mastery echoed the findings previously reported for deaf persons with an intellectual disability. Richardson (1975) reported that after one year of sign instruction, there was a range in mastery from one participant who learned only a small receptive vocabulary (understanding signs) to another participant who acquired a large expressive vocabulary, producing 400 different signs. This variability in language outcomes also is evident when considering the speech modality. When expressive communication skills, including both spoken words and manual signs, were examined in children with intellectual disabilities over the course of a two-year longitudinal study, there were very wide individual differences in the vocabulary sizes attained by the participants (Vandereet et al., 2010). Some of this variability in language learning across participants in a range of studies may be attributable to additional disabling conditions, other than cognitive impairment, that could have depressed certain individuals' IQ scores to a level lower than they should have been based on cognitive impairment alone. There also may be different skill patterns within different forms or types of intellectual disability (Dierssen et al., 2009; Jernigan & Bellugi, 1990; Prior, 1977; Vicari, 2006).

Examination of the findings from some of the early accounts of sign learning in individuals with an intellectual disability revealed that certain signs seemed easier to learn than others. This observation led investigators to probe more systematically those characteristics that were associated with more rapid sign acquisition. Signs that were rated as more highly iconic were found to be more readily learned (Griffith

& Robinson, 1980; Lloyd & Fuller, 1990; Snyder-McLean, 1978). Signs identified as high in translucency also were learned more readily by individuals with a moderate or severe intellectual disability (Doherty, 1985; Luftig, 1983).[10] Signs that are useful or relevant to the individual learner also tended to be learned and used more often (Dennis et al., 1982; Doherty, 1985; Meuris et al., 2014). Signs that involved touch or contact with the signer's body or the other hand frequently were learned more quickly (Dennis et al., 1982; Kohl, 1981; Stremel-Campbell, Cantrell, & Halle, 1977), as were those signs that involved symmetrical movements with each arm and hand. An important outgrowth of these results was that teachers and investigators began to focus more intensely on the formational characteristics and iconic nature of the signs they selected for vocabulary training.[11]

Not only may certain individual signs be acquired more easily than others, but signs from different sign systems or languages may be more readily learned as well. Amer-Ind is a sign-communication system based on Plains Indian Sign Language, a system of signs developed by members of different Native American tribes or nations who did not speak the same language.[12] In comparison with ASL signs, a larger proportion of Amer-Ind signs are described as highly iconic (Skelly et al., 1975; see also Kirschner, Algozzine, & Abbott, 1979) and less complex motorically (Daniloff & Vergara, 1984). These characteristics may make Amer-Ind signs easier to learn than ASL signs. This question

10 When a sign is identified as highly *iconic*, it often resembles the concept for which it stands and the sign's meaning is quite "guessable" or transparent. Although related to iconicity, a sign's *translucency* refers to the ease with which people discern the relationship between a sign and what it stands for once the sign's meaning has been provided. For more information on iconicity and translucency, see "The Simplified Sign System" section in Chapter 1.

11 It is important to note that many such studies of sign acquisition in special populations involved laboratory conditions, and thus their results may not fully translate into more naturalistic settings and/or in highly supportive signing environments, where the properties of the signs themselves may turn out to be of less significance than in laboratory settings. The criteria for judging successful acquisition of the signs also varied from study to study, so it is difficult to make direct comparisons among them. Still, it is likely that signs that are taught in laboratory conditions with stricter criteria for acceptance would also be just as likely, if not more likely, to be learned in a highly supportive signing environment that also accepts approximations of signs. Iconic signs also have a distinct advantage in that they have a much greater chance of being understood by persons in the larger environment than signs that have less transparent meanings.

12 Amer-Ind is discussed in further detail in Chapter 6.

of relative ease of acquisition of the two sign systems has been examined in adolescents and adults with intellectual disabilities. In general, participants tended to acquire and to retain more Amer-Ind signs than ASL signs (Gates & Edwards, 1989). This difference in learning rates was attributed to the more concrete and less formationally complex nature of Amer-Ind signs. Although many non-speaking persons with intellectual disabilities learned Amer-Ind signs more easily than ASL signs, it should be noted that the characteristics of the sign learner are quite important as well. In fact, one study (Marquardt, Sanchez, & Munoz, 1999) reported that the best predictor of sign learning among adults with Down syndrome was the cognitive, language, and motor abilities of the participants themselves.

Down Syndrome

Down syndrome is a congenital condition typically characterized by a mild or moderate intellectual disability and distinctive facial features. With an occurrence rate of one in every 700–1000 births, Down syndrome is the most common chromosomal cause of intellectual disability (Dykens, Hodapp, & Finucane, 2000). Fifty years ago, expectations about the educability and eventual level of development of children with Down syndrome were quite low. In more recent years, largely because of the results demonstrated by individuals who participated in early intervention programs, expectations have become considerably higher (Corby, Taggart, & Cousins, 2018; Launonen, 2019a; Spiker, 2011; Turner, Alborz, & Gayle, 2008). Guralnick (2017, p. 214) notes that

> early intervention for all children remains a problem-solving process involving the family, the intervention team and other supports within the community. The information provided by etiology-specific developmental studies is of considerable value as all involved can better anticipate issues and construct intervention strategies more likely to have a positive impact.

Spoken language production often is an area of particular difficulty for individuals with Down syndrome (Martin et al., 2009). Many children with Down syndrome show delayed onset of spoken language (Berglund, Eriksson, & Johansson, 2001), acquire new spoken words at a rate well below what would be expected based on their level of

cognitive development (Zampini & D'Odorico, 2013), and fail to attain levels of expressive language that are expected for typically developing three-year-olds (Fowler, 1990). These delays are particularly evident in the domains of phonological and syntactical development (Barnes et al., 2009; Tager-Flusberg, 1999). Overall, verbal skills typically are areas of relative weakness for individuals with Down syndrome, whereas nonverbal skills often are areas of strength (Grieco et al., 2015). Indeed, gesture production is viewed as an area of strength for children with Down syndrome in comparison with their vocal language skills (Galeote et al., 2011). Perhaps because of the difficulties and delays that children with Down syndrome experience in spoken language development, representative gestures constitute a larger proportion of their utterances than they do for typically developing children (Stefanini, Recchia, & Caselli, 2008). Furthermore, delays in expressive language development continue to be evident with increasing age; many children and adolescents with Down syndrome show deficits in their production of syntax and vocabulary, as well as in the intelligibility or comprehensibility of their spoken language (Barnes et al., 2009; Chapman & Hesketh, 2000; Finestack & Abbeduto, 2010; see also Yoder, Woynaroski, & Camarata, 2016). Available evidence suggests that the marked delays in spoken language development often seen in individuals with Down syndrome may be greatly lessened if a program of language stimulation or intervention is initiated very early in these individuals' lives (Launonen, 2019a, 2019b; Roberts, Price, & Malkin, 2007; Sanz Aparicio & Balaña, 2002). In addition, the use of communicative gestures by young children with Down syndrome may serve as a helpful "bridge" to word production later in childhood (Zampini & D'Odorico, 2009; see also the review study by te Kaat-van den Os et al., 2015).

Are there factors other than cognitive impairment that may account for this particular difficulty with spoken language skills? There appear to be at least several factors that may delay the onset of spoken language in some individuals with Down syndrome and make their speech relatively unintelligible to people unfamiliar with them. One factor may be hearing impairment, as 40–80% of children with Down syndrome experience some hearing loss. A substantial proportion has a mild to moderate hearing impairment (Dahle & McCollister, 1986; Roizen, 1997,

2007), with severe impairment evident in many fewer cases (Marcell, 1995; Marcell & Cohen, 1992). Some of this relatively high incidence of hearing impairment may be attributable to recurrent otitis media or inflammation of the middle ear (Nightengale et al., 2017; Roberts & Medley, 1995; Shott, Joseph, & Heithaus, 2001; Strome & Strome, 1992). Individuals with Down syndrome appear to be especially vulnerable to otitis media because of physical anomalies of their ears and upper respiratory tract. Damage to the inner ear also contributes to their relatively high incidence of hearing impairment. Whereas inflammation of the middle ear is treatable, damage to the inner ear usually is not. Moreover, a hearing loss that occurs when children with Down syndrome are between the ages of two and four years old is likely to have a significant negative impact on the children's development of spoken language skills (Laws & Hall, 2014; Nightengale et al., 2017).

Another factor adversely affecting the spoken language acquisition of many children with Down syndrome is their severe problem with articulation. The production of the correct sounds and sound combinations needed for clear speech often is very difficult for these children (Kumin, 1996). In particular, they experience problems in the oral-motor planning, sequencing, and coordination that result in the production of the rapid movements of the tongue, lips, and other oral structures involved in speech (Barnes et al., 2006; Hamilton, 1993). This difficulty that many persons with Down syndrome experience in oral-motor planning, evident in their problems combining and sequencing sounds into words and sentences, means that they should be viewed as having a verbal (or oral-motor) apraxia (Kumin, 2006). Some of these individuals' articulation problems also may result from their recessed mandibles (lower jaw bones) and, as a consequence, protruding tongues.

A third factor that may influence the spoken language abilities of some children with Down syndrome is the occurrence of poor auditory or phonological memory (Kay-Raining Bird & Chapman, 1994; Laws & Gunn, 2004; Næss et al., 2015). Individuals with Down syndrome have a rather limited capacity for verbal material in their immediate memory system (Purser & Jarrold, 2005). This deficit in phonological memory or storage capacity, it should be noted, also is evident in children with intellectual disabilities more generally (Schuchardt, Maehler, & Hasselhorn, 2011; van der Schuit et al., 2011b). The limited capacity

or poor memory for speech sounds may make spoken language more difficult to process than manual signs or gestures.

Although delayed or atypical development of the auditory system could account for some of the struggles many children with Down syndrome experience learning spoken language, more fundamental neuropathology or neurological abnormalities probably underlie some of their language difficulties. The hippocampus, a brain structure that plays a critical role in memory (Corkin, 2013), is impaired and disproportionately reduced in volume in persons with Down syndrome (Nadel, 2003). Individuals with Down syndrome also show diminished cerebellar size (Dierssen et al., 2009; Guidi et al., 2011; Uecker et al., 1993). This is important because the cerebellum is a brain structure that has long been recognized for its involvement in movement sequencing and motor abilities. More recent evidence indicates that it is also involved in higher order functions such as cognition and language (Kellett, Stevenson, & Gernsbacher, 2012). In contrast, individuals with Williams syndrome, who do not show the same difficulties with expressive spoken language that persons with Down syndrome do, have more normal-sized cerebellums (Chiang et al., 2007; Jernigan & Bellugi, 1990). Finally, persons with Down syndrome may have additional disabling conditions that adversely impact their communication skills, such as the 10–15% of children in one study who displayed early signs of autistic disorder or autism spectrum disorder at age two and then again at ages four or five (Hepburn et al., 2008). Early screening of children with Down syndrome before the age of three years for symptoms of autism and diagnostic evaluation by clinicians may provide critically important information to parents and caretakers. Such a diagnosis would aid in their search for appropriate social and communicative interventions to mitigate the additional disturbances not seen in the general population of persons with Down syndrome (Hepburn et al., 2008).

Parents of children with Down syndrome who have not developed spoken language skills frequently express concern that their children will never learn to speak if they learn how to communicate through signs. Therefore, one important research question has focused on whether signing interferes with spoken language acquisition among children with Down syndrome. When spoken language is combined with manual signs, such individuals evidently benefit from this bimodal

input. For example, children with Down syndrome were shown to imitate novel spoken words more frequently when the words were paired with signs than when the words were presented in speech or sign alone (Kay-Raining Bird et al., 2000). Moreover, the production of manual signs by children with Down syndrome at two-and-a-half years of age positively predicted the size of their spoken language vocabularies one year later (Özçalişkan et al., 2016). That is, these children's success in producing signs in early childhood was highly related to their subsequent ability to produce spoken words. In many instances, the items in the expressive vocabularies of children with Down syndrome who have received multimodal input are in both spoken and signed modalities (Deckers et al., 2017). Overall, the available evidence suggests that signed input together with speech facilitates the development of spoken language and communication skills in children with Down syndrome rather than slowing them down, and that input early in development is particularly helpful (Clibbens, 2001; Dunst et al., 2011; Launonen, 2019b; Millar et al., 2006; Miller, 1992). In light of such findings, Deckers et al. (2016) recommended that parents of children with Down syndrome be told of the apparently beneficial effects of sign instruction on their children's early language development.

The outcomes of several case studies of sign-communication training and teaching in youngsters with Down syndrome illustrate how combining signs with speech may foster subsequent spoken language development. In a case study of a young girl with Down syndrome, Kouri (1989) observed that the girl, who received simultaneous spoken language and sign input, typically made the signs for words or concepts first and then relatively shortly afterward produced the spoken words for those concepts. In another case, the transition to spontaneous spoken language occurred only after a substantial sign vocabulary had been acquired. The boy with Down syndrome in this study (Layton & Savino, 1990) initially participated in an oral (speech-oriented) program, but when he failed to progress, was introduced to a simultaneous speech-and-sign program. He rapidly acquired sign-communication skills. He did not make impressive strides in spoken language, however, until after he had attained an expressive sign vocabulary of approximately 400 signs. At that time, his spoken language vocabulary increased rapidly in size and his use of signs declined dramatically.

In a third case-study report (Launonen & Grove, 2003; see also Launonen, 2019a), the transition from signs to spoken language occurred much later in development. In this study, a boy with Down syndrome was introduced to manual signs when he was three-and-a-half years old and had not yet started to speak. His parents and family learned and made extensive use of signing in natural everyday settings with him, a fact that supported and encouraged his own use of signs. This boy acquired a substantial sign vocabulary and relied on signs for communication throughout his childhood. He started to speak more often from ages twelve to thirteen, and his speech skills improved during his teenage years. Five years later, spoken language had become the resilient young man's dominant mode of communication; he generally signed only when others found his speech unintelligible.

Although the three youngsters described above made a successful transition from signs to spoken language, it might be argued that an intervention program using manual signs could result in more slowly developing or poorer speech skills than a program that did not include signs. This, however, does not appear to be what typically happens. In one longitudinal study (Launonen, 1996; see also Launonen, 2019a), twelve young children with Down syndrome received a communication intervention program that emphasized key word signing whereas twelve other children with Down syndrome had previously received a similar intervention program but without manual signing. It should be noted that the parents in the sign-communication intervention program were urged to sign the *key words* in their spoken utterances. When the children were assessed between three and five years of age, the dozen children who had received the key word signing input were well ahead of the children in the non-signing comparison group on measures of language ability. A follow-up assessment conducted when the children were eight years old (five years after the intervention program had ended) revealed that the children who had participated in the signing program remained ahead on a range of skills, including language comprehension, interaction, reading, and writing. With regard to expressive language, eight children in the key word signing group and five in the comparison group used spoken language as their principal means of communication. Two children in the key word signing group relied mostly on signs, and one child in each group combined manual signs and spoken words.

Of the remaining children, five in the comparison group and only one in the key word signing group were reported as having no functional expressive language (Launonen, 1998, 2003, 2019a).[13] Evidently, there were both short- and long-term benefits from using manual signs early in the development of youngsters with Down syndrome. The use of signs with non-speaking children with Down syndrome may not only provide them with an initial communication system and facilitate their eventual transition to spoken language, but may also help to reduce their frustration and challenging behaviors (Remington & Clarke, 1996).

In conclusion, there are at least several advantages to teaching signs to children with Down syndrome. Not only does sign-communication training and teaching in early childhood not impede spoken language development, it actually appears to facilitate it. Furthermore, as these children's speech becomes more intelligible, they typically reduce their signing. A second advantage is that by teaching children with Down syndrome to sign, they learn how to communicate effectively with other people who may then respond to the children and be interested in their communications (Launonen, 2019b). Finally, a third advantage is that once these children learn to sign with family members and people at school, their level of frustration is noticeably reduced (Miller, Leddy, & Leavitt, 1999). In light of these advantages, it should not be surprising to learn that manual signing is a popular form of augmentative and alternative communication for children with Down syndrome (Brady, 2008; Kumin, 2003).

At the same time, it should be noted that children with Down syndrome who are taught to sign also may show impairments in their use of signs, especially with regard to morphosyntactic skills. In a case study of hearing, identical twin girls with Down syndrome who were born to Deaf parents in the U.K. (Woll & Grove, 1996), the researchers reported that the bilingual girls had difficulties with both their spoken English and their use of British Sign Language (BSL). Consistent with expectations, assessments showed that the twins' nonverbal IQ and visual and motor skills were areas of relative strength in comparison with their verbal skills. However, when tested on their receptive and productive BSL signing skills, both girls showed difficulties with representing

13 One family in the comparison group elected not to participate in the follow-up assessment.

spatial relationships between objects in a way that is typical of adult BSL signers (who depict these relationships based on the location of their signs). Both twins had significant trouble modifying BSL signs to reflect plurality as well. On a third task, one girl correctly modified signs based on size and shape, whereas the other twin was less successful doing so. The girls, however, were adept at distinguishing between related noun-verb pairs. Taken together, these results show that certain sign forms, in particular those that require syntactic markings of spatial location, were an area of particular difficulty for the girls. Other studies have also suggested that children with Down syndrome may experience deficits in spatial representation (Carretti, Lanfranchi, & Mammarella, 2013; Uecker et al., 1993; Vallar & Papagno, 1993; Yang, Conners, & Merrill, 2014) and that these deficits may persist (Woll & Grove, 2019).

In a follow-up study of the bilingual twins when they were sixteen, their problems with BSL spatial grammar with regard to verbs remained. Also, both girls' noun/verb distinctions had declined quite a bit as well (Woll & Grove, 2019). Their skills with size and shape modifiers differed with one girl scoring perfectly but the other girl scoring poorly. However, both girls did relatively well on size, shape, and plurality modifications, and one girl understood some classifier constructions. These findings show that specific sign language skills in persons with Down syndrome may not be static over time — they can either improve or decline. Whether such changes are due to a change in language environment and input (e.g., having less consistent exposure to BSL, leading to a decrease in signing skills), a personal preference for the speech modality, or syndrome-related declines in memory as individuals age remains to be seen.

Angelman Syndrome

Some individuals identified with Angelman syndrome might also benefit from sign-communication programs. Persons with Angelman syndrome are often described as having a severe intellectual disability, a happy disposition, lacking movement coordination, and rarely producing recognizable spoken words (Micheletti et al., 2016; Pearson et al., 2019; Quinn & Rowland, 2017; Smith et al., 1997; Trillingsgaard & Ostergaard, 2004). The difficulties that persons with Angelman

syndrome experience in controlling voluntary muscle movements may account in part for their frequent absence of spoken language (Penner et al., 1993). Another likely reason for the absence of spoken language in most children with Angelman syndrome is their lack of development of the arcuate fasciculus, the white matter tract that connects the language comprehension region with the speech-generating region of the brain (Wilson et al., 2011). Finally, a large percentage of persons with Angelman syndrome (80-90%) have some form of epilepsy (Conant, Thibert, & Thiele, 2009; Micheletti et al., 2016) and all of the ten participants in one Italian study had neurovisual impairments that could have impacted upon their daily activities and functioning (Micheletti et al., 2016).

The difficulties in coordinating muscular movements (ataxia) that may inhibit spoken language use by persons with Angelman syndrome would be expected to similarly affect their acquisition of manual signs. Nevertheless, there have been occasional reports of successful sign learning and usage in some individuals with Angelman syndrome (Didden et al., 2009; Pearson et al., 2019; Quinn & Rowland, 2017). For example, the four non-speaking children with Angelman syndrome studied by Smith et al. (1997) acquired between eight and thirty-five different signs, although it should be noted that three of these children had only relatively mild motor impairments. In another study, Clayton-Smith (1993) examined eighty-two patients with Angelman syndrome. Although the ability to use some sign language was reported for 90% of them, this signing consisted mostly of "personal" signs or gestures. These "personal" signs were based on gestures that a specific individual with Angelman syndrome would produce; these existing gestures were then adapted for communicative purposes with that person. A much lower proportion of the patients, 20%, was able to use Makaton Vocabulary signs. Apparently, not all of the individuals could master the greater complexity of the Makaton signs despite substantial input from both parents and professionals.

In recent years, there has been increased interest in the use of the gestures that individual children with Angelman syndrome already produce as the basis for an effective communication system. Two of the obstacles to the more widespread implementation of such a system were to get children with Angelman syndrome to use the gestures in spontaneous communication and to expand the use of the gestures to

more communication partners in a wider array of settings. Calculator and Diaz-Caneja Sela (2015), using an approach similar to "personal" signs that they termed "natural gestures," succeeded in establishing some spontaneous communicative behaviors in several children with Angelman syndrome. According to the investigators, "The idea is to take actions individuals already associate with objects and events, based on their existing behaviours, and then shape them into purposeful communicative behaviours" (Calculator & Diaz-Caneja Sela, 2015, p. 148). Progress also has been made in getting parents of individuals with Angelman syndrome to establish programs using natural gestures in their homes, thus expanding the range of settings where such gestures are used (Calculator, 2016). A remaining obstacle to more widespread use of this natural gesture or personal sign approach is that because of the idiosyncratic nature of many of these children's gestures or signs, a number of potential communication partners will likely not recognize the meanings of the gestures and react appropriately. Regardless, in light of the difficulties many children with Angelman syndrome experience in acquiring signs from existing signed languages or sign systems, this approach of adapting gestures that the children already make for communication purposes would appear to have considerable promise.

It should be recognized that the communicative behaviors of children with Angelman syndrome vary quite widely. For example, some individuals with Angelman syndrome, while unable or unwilling to produce manual signs or gestures themselves, are able to communicate by manipulating their therapists' or caregivers' hands into recognizable signs (Pearson et al., 2019; Summers & Szatmari, 2009). Moreover, when a questionnaire was administered to twenty families of children with Angelman syndrome, it indicated that half of the children used signs; seven of them communicated spontaneously by producing signs (Alvares & Downing, 1998). The investigators concluded that manual communication, either signs or gestures, appeared "to be the preferred expressive modality for most individuals" (p. 21) with Angelman syndrome. In a review of the expressive communication skills of 300 persons with Angelman syndrome in the United States who were in the early developmental stages of communication (Quinn & Rowland, 2017), 40% of the participants used pointing gestures and 26% used manual signs. Most of these participants communicated to get or obtain

something, to refuse something, or for social interaction purposes; many fewer communicated to exchange information (Quinn & Rowland, 2017). The authors, however, noted that their study did not include data from higher-functioning individuals with Angelman syndrome and thus they could not provide any insight into the use and purposes of gestures or manual signs by persons who were more developmentally advanced. Finally, it should be noted that the utilization of speech-generating devices to facilitate the communication of children with Angelman syndrome also has been reported to be a frequently used approach (Calculator, 2013b).

Some of the wide variability in communication development outcomes seen across participants in different studies may be attributable to the specific genetic mechanisms responsible for the various forms of Angelman syndrome. Those children who did not have the maternal chromosomal deletion form of Angelman syndrome were found to have better communication skills, including the use and understanding of spoken language, manual signs, and gestures (Calculator, 2013a; Jolleff et al., 2006; Pearson et al., 2019; Quinn & Rowland, 2017). Moreover, in general, those children with a severe level of intellectual disability as opposed to those with a profound level, who lived at home rather than at a residential facility, and who had no epilepsy, were the children who engaged more often in successful communication (Didden et al., 2009).

Complicating Factors

Although many intervention programs for young children and students with Down syndrome and other forms of intellectual disability reported considerable success in sign learning (Abrahamsen et al., 1991; Blischak, Loncke, & Waller, 1997; Kiernan et al., 1982; Romski & Sevcik, 1997; Toth, 2009), youngsters in a number of other programs failed to make substantial progress. The results of two longitudinal studies of sign language learning in students with a severe or profound intellectual disability underscored the limited progress some participants made. In one study, the students' signing skills were assessed after a mean training duration of nearly three years (Bryen, Goldman, & Quinlisk-Gill, 1988). These youngsters imitated an average of 9.2 signs and spontaneously used an average of only 4.2 signs. In the second study (Kahn, 1996),

manual signs were taught to thirty-four children over a four-year period. Twenty of them failed to use a single sign spontaneously or independently. Although the remaining children were more successful (six formed sign combinations), the finding that the majority made very little progress learning to sign should make one cautious about expecting significantly positive outcomes in some children with a severe or profound intellectual disability.

One explanation advanced for the limited progress in spontaneous signing manifested by some persons with an intellectual disability was the "dismally limited" sign usage of staff members (Bryen & McGinley, 1991). Staff members at a community residence for individuals with intellectual disabilities were found to have sign vocabularies only slightly larger than the residents and to rarely interact with them through signs. These sign interactions also tended to occur in limited settings, rather than being incorporated in a naturalistic way throughout the entire day. Furthermore, the sign vocabulary used was not especially meaningful or tailored to the particular interests of the children, thereby limiting their motivation to use the signs (Bryen & McGinley, 1991). A more supportive signing environment, together with a simplified form of signing, might have enhanced the residents' sign-communication skills. Positive links have been established between the use of signs by teachers and staff members and higher signing levels by individuals with disabilities in school, day care, and group home settings (Grove & McDougall, 1991; Rombouts, Maes, & Zink, 2017a, 2017b, 2017c, 2018a, 2018b; Rombouts et al., 2019).

Even with an environment that is more supportive of signing and that employs manual signs that are easier to form, some individuals with an intellectual disability may never make substantial progress in signing. These persons might benefit from other augmentative and alternative communication systems (some of which are discussed in Chapter 5). Deciding which system to use will likely require considerable care. For example, one might intuitively believe that learning to point to pictures on a communication board or computer screen to indicate items would be an easier task than learning to produce signs to identify those same items. Yet, when a pair of studies (Sundberg & Sundberg, 1990; Wraikat, Sundberg, & Michael, 1991) systematically probed the use of manual signs and pointing with minimally verbal adults who had an intellectual

disability, the clear majority of the adults were more successful in acquiring and using signs. It should be noted that the participants in these studies did not have discernible motor impairments that might have made their production of signs more difficult. Moreover, dynamic or moving stimuli may convey more information than static stimuli, such as photographs, thus facilitating the performance of persons with intellectual disabilities (see Moore, 2001).

Even among those persons who are quite successful in acquiring large expressive sign vocabularies, their sign usage typically remains relatively basic (Grove, 2019a; Grove & Dockrell, 2000). In particular, signing youngsters appear to experience a good deal of difficulty in making the transition from one- or two-sign utterances to mastering syntactic rules. Although a lack of fluent sign language input by their teachers, caregivers, and fellow students may account for some of this limited sign complexity, the youngsters' cognitive, language, and motor impairments probably play important roles as well. Despite these obstacles, however, the majority of the ten children in the Grove and Dockrell (2000) study made spontaneous, meaning-based modifications to their signs; most such changes were made on iconic verbs. Thus, it appears that persons with intellectual disabilities are capable of making creative changes to their signs even without prior prompting or modeling by others. It is therefore important for teachers and caregivers to watch out for, identify, and capitalize upon the use of such sign modifications as a way to build the children's nascent syntactic skills.

In recent years, investigators have deliberately made an effort to increase the complexity of the meanings that children with intellectual disabilities are capable of expressing through manual signs. These efforts have focused on getting children with moderate and severe intellectual disabilities and poor speech intelligibility to modify their signs to express more complex meanings. As examples, a sign's direction of movement might be changed to indicate who is the recipient of an action, a sign's width might be increased or decreased to indicate an object's relative size, or a sign might be repeated to indicate plurality. By learning these and other changes or modifications in how signs may be formed, a number of children with intellectual disabilities have been shown to be able to convey more complex meanings through signs (Molteni et al., 2010; Rudd, Grove, & Pring, 2007). Furthermore, these

interventions can take advantage of modifications that the children are already making (Grove, 2019a; Rudd et al., 2007).

Finally, because many individuals with cognitive impairments have multiple disabilities, analysis of the usefulness of or progress in manual sign intervention of such persons can be quite complicated (Bonvillian & Nelson, 1978). Various medical factors and additional disabilities, although not directly related to a particular individual's level of cognitive functioning, may make the task of signing much more difficult. Teachers and caregivers may need to evaluate how much to emphasize signing as a communication skill and how much to focus on other methods with a particular individual. At the same time, caregivers should give serious consideration to using (or at least trying out or experimenting with) a sign-communication system that is based on signs that are more iconic and that have been modified to make their handshapes easier to form and their movements easier to remember. Systems such as Amer-Ind and the Simplified Sign System may produce better results with regard to sign comprehension, retention, and production than full and genuine sign languages or other sign systems.

Cerebral Palsy

Cerebral palsy occurs when children experience damage to the nervous system before, during, or just after birth. Long believed to be the consequence of an inadequate supply of oxygen during the birth process, in recent years there has been a major change in our understanding of the causes of cerebral palsy. Today, in preterm (premature) infants, cerebral palsy is seen as primarily the product of a cerebral hemorrhage (extensive bleeding from the rupture of a blood vessel in the brain) or of an injury to the white matter of the brain. With advances in medical care in recent decades, there has been an increase in survival rates after preterm births; this increase in survival rates has also resulted in an increase in the incidence of cerebral palsy (Krägeloh-Mann & Cans, 2009). The majority of cases of cerebral palsy, however, are the result of full-term pregnancies. In full-term infants, cerebral palsy is believed to be the product of a brain malformation during intrauterine development (Pellegrino, 2007). A disruption of the supply of oxygen to the brain during the birth process accounts for only a minority of the cases of

cerebral palsy (Pellegrino, 2007). Although a number of children with cerebral palsy have some degree of intellectual impairment, many others have unimpaired intellects and a proportion fall into the gifted range (Stadskleiv et al., 2018).

As a result of abnormalities in their developing brains, children with cerebral palsy have disorders of posture and movement. These disorders of posture and movement, moreover, are both non-progressive (i.e., not increasing in severity or extent) and permanent. In addition to difficulties in their execution of motor movements, individuals with cerebral palsy also show deficits in their planning of such movements (Steenbergen & Gordon, 2006). The motor speech problems often evident in children with cerebral palsy (Pirila et al., 2007) are probably the outcome of disturbances or difficulties in their neuromuscular control of the speech mechanism. These neuromotor impairments may prevent typical spoken language development. This atypical spoken language development often is evident early, as infants with cerebral palsy may show delayed babbling and restricted phonetic repertoires (Levin, 1999). In general, those children with more severe gross motor impairments also had poorer communication skills (Coleman et al., 2013).

There are four main types of cerebral palsy: spastic, dyskinetic, ataxic, and mixed (National Center on Birth Defects and Developmental Disabilities, 2019). Spastic cerebral palsy, the most common form of cerebral palsy, is characterized by increased muscle tone and stiff muscles. It is subdivided into unilateral (also known as spastic hemiplegia or hemiparesis) and bilateral forms that include diplegia and quadriplegia (Anderson et al., 2008). Those persons with the most severe form of spastic cerebral palsy, quadriplegia, often have intellectual disabilities, seizures, vision problems, hearing difficulties, and/or issues with the production of speech. Dyskinetic cerebral palsy (also known as athetoid, dystonic, or choreoathetoid cerebral palsy) involves uncontrollable movements of parts of the body; muscle tone in persons with this subtype can alternate between too tight and too loose. In the Anderson (2008) study, most persons with dyskinetic cerebral palsy had severely impaired speech or no speech and 42% had epilepsy. Ataxic cerebral palsy causes problems in balance and coordination, having an effect on the rate of an individual's movement as well as his or her control of fine motor skills. Persons with mixed

cerebral palsy experience symptoms of a combination of types (NCBDDD, 2019).

Many children with cerebral palsy have intact or relatively intact cognitive and receptive language abilities, but, as a result of their neuromuscular deficits, are unable to effectively communicate orally. Programs for these children frequently are able to take advantage of their ability to understand spoken language. Other children with cerebral palsy may have substantial hearing loss, vision problems, seizures, or cognitive impairments (Andersen et al., 2008; Bottos et al., 1999; Chan et al., 2005; Himmelmann et al., 2006; Pellegrino, 2007; Reid et al., 2011; Stadskleiv et al., 2018; Zhang, Oskoui, & Shevell, 2015). Among these additional impairments are a number of children who are also diagnosed as having autism spectrum disorder (Kilincaslan & Mukaddes, 2009). These additional disabilities may inhibit the use of communication programs based on the children's understanding of spoken language alone.

In the Andersen study (2008), Norwegian children born with cerebral palsy during a three-year period were examined extensively. This investigation represented an effort to provide an account of the varying abilities and different impairments associated with cerebral palsy in a national cohort. Of the children studied in-depth, 28% had severely impaired or no spoken language. Correspondingly, it should be pointed out that 72% of the participating children were assessed as having either normal speech or impaired speech that was still understandable. These findings indicate that while most children with cerebral palsy apparently will be able to rely primarily on spoken language to communicate, a sizeable minority will likely need a form of alternative or augmentative communication to interact effectively.

The Norwegian study (Andersen et al., 2008) provided information on a number of other impairments associated with cerebral palsy as well. Of those children whose cognitive development was assessed, 31% evidenced intellectual disability as determined by scores below 70 on IQ tests. In addition, 5% of the children examined had severely impaired vision and 4% had severely impaired hearing.[14] Finally, 35% of

14 A group of researchers (Reid et al., 2011) performed an international literature review of fourteen studies that included data on hearing loss in persons with cerebral palsy in Australia, Finland, Iceland, Ireland, Norway, Quebec, the U.K., and the United States. They found that the mean percentage of persons having cerebral palsy and

the children showed severely impaired fine motor functioning of their hands. When examined for typology, 33% of the Norwegian children in the study had spastic unilateral CP, 49% had spastic bilateral CP, 6% had dyskinetic CP, 5% had ataxic CP, and 7% of the children were not classified (Andersen et al., 2008). The authors reported that the distribution of the various subtypes of cerebral palsy in Norway was generally consistent with that found in Sweden (Himmelmann et al., 2006), Australia (Howard et al., 2005), Hong Kong (Chan et al., 2005), and Italy (Bottos et al., 1999).

In Norway, greater impairments in gross and fine motor functions were observed in spastic bilateral and dyskinetic populations (Andersen et al., 2008; see also Stadskleiv et al., 2018). The majority of the dyskinetic population and 35% of the spastic bilateral population had severely impaired or no speech. Intellectual disability was seen in significant numbers in spastic bilateral, dyskinetic, and ataxic subtypes but less so in the spastic unilateral subtype (Andersen et al., 2008; see also Stadskleiv et al., 2018). However, recent researchers note that it is important to adapt the response mode on tests of cognitive ability for persons with severe speech and motor disorders to include eye gaze (Stadskleiv et al., 2018). Previous determinations that did not allow for this alternative response mode (i.e., those dependent on verbal responses or pointing with one hand) may have underestimated the actual level of intelligence in such individuals.

Taken together, these findings draw attention to the wide range of disabilities often present in a population of children with cerebral palsy. This wide range in impairments also would appear to make it unlikely that a single form of augmentative and alternative communication would meet the needs or abilities of all children with cerebral palsy with spoken language impairments. Indeed, in one study of fourteen

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severe hearing loss in these studies was 3%. The same researchers also recorded a similar level of severe-profound hearing loss in their own study of 685 children with cerebral palsy born between 1999 and 2004 in Australia (Reid et al., 2011). Of the forty-eight children with hearing loss in that population, most had sensorineural or mixed sensorineural/conductive hearing loss, although the vast majority of them were not due to genetic causes (unlike the wider population of persons with sensorineural hearing loss). In fact, no cause was identified for half (twenty-four) of the children. In addition, many of the Australian children with hearing impairment were also identified as having quadriplegia, serious motor problems, intellectual disability, visual impairment, and/or epilepsy (Reid et al., 2011).

children with cerebral palsy who used augmentative and alternative communication systems, eight relied primarily on Blissymbols (a form of pictographic line drawings), five primarily on manual signs, and one primarily on spoken language, with all the children using more than one system to communicate depending on the situation (Sundqvist & Rönnberg, 2010; see also Sandberg & Dahlgren, 2012). In another recent report (Watson & Pennington, 2015), the Picture Exchange Communication System or PECS (Bondy & Frost, 2002; see Chapter 5) also was identified by speech-language pathologists as a communication intervention approach that they used frequently in their interactions with children with cerebral palsy.

As noted earlier in this chapter, some children with cerebral palsy and an intellectual disability who failed to make progress learning to speak were able to learn to communicate through mimetic gestures (Levett, 1969, 1971). Those individuals with more severe motor impairments, however, may be unable to learn to communicate primarily through a sign or gestural system. These youngsters may be better served by learning to use a communication board or a system that relies on hand pointing or eye placement. These systems require only limited motor abilities to be effective. It should be noted that in a survey of 181 children with cerebral palsy in Hong Kong (Chan et al., 2005), 36 were rated as nonverbal. Of this nonverbal subgroup, six used communication books or boards and five used manual signs; the others communicated through simple gestures, vocalizations, and crying. It is possible that the provision of better and more consistent intervention support to parents could help the latter group of children to use one or more augmentative and alternative communication methods.

There are few systematic, large-scale studies of the relative success of using different non-oral programs with persons with cerebral palsy. This situation may seem somewhat surprising in light of the relatively high incidence of cerebral palsy — estimated in the U.S. (and in other developed countries) at about 1 in 500 children (Bottos et al., 1999; Himmelmann et al., 2006; Howard et al., 2005; Pakula, Van Naarden Braun, & Yeargin-Allsopp, 2009; Winter et al., 2002) — and the substantial frequency of speech problems in these children (Yorkston et al., 1999; Zhang et al., 2015). An important reason behind this dearth of large-scale studies is that most children with cerebral palsy have associated

conditions or impairments that make systematic comparisons difficult to conduct — various types of cerebral palsy present with different levels of cognitive ability and distributions of motor skills. Regardless, a certain pattern of placement in communication intervention programs seems to have emerged for children who have not acquired adequate spoken language skills. Those children with more severe motor impairments and milder cognitive impairments typically were placed in programs that required only limited motor skills (e.g., programs utilizing communication boards that included printed words, letters, or pictographic line drawings such as Blissymbols). Those children with more severe cognitive impairments, but more intact motor abilities, often were placed in programs that utilized signs (Kiernan et al., 1982; Udwin & Yule, 1990). Hearing-impaired children with cerebral palsy also may be placed in a program that employs manual signs and graphic symbols (Hooper, Connell, & Flett, 1987).

One of the few systematic studies of sign acquisition in children with cerebral palsy (Udwin & Yule, 1990) followed twenty children in Great Britain as they were taught signs from the Makaton Vocabulary. This study also underscored some of the limitations of many sign-communication training and teaching programs. After 10.5 months of sign instruction, the children learned to produce an average of 28.2 different signs and to understand an average of 34.4 signs. These relatively substantial average scores, however, masked the finding that there were wide individual differences in the number of signs learned; the least able signer, for example, acquired only a single sign. Fourteen of the children continued in the sign-training program for eighteen more months and their sign vocabularies showed additional growth. These children produced an average of 65.1 different signs and understood an average of 72.1 signs. Thus, for most of the participants, increased duration in sign instruction was positively related to vocabulary size.

Although the children's acquisition of a core sign vocabulary represented an improvement in their language and communication skills, it should be recognized that these numbers contrast markedly with the thousands of words that children without disabling conditions acquire in their childhoods. Furthermore, most of the sign productions of the children with cerebral palsy were composed of only a single sign; only about 12% of their sign productions were multi-sign combinations.

In their effort to understand the sign-learning environments of children with cerebral palsy, Udwin and Yule (1991) examined the extent to which the children were exposed to signs. They observed that the children received between one hour and one-and-a-half hours of formal sign instruction per week. Exposure to signs outside of formal instruction, however, was quite limited. Relatively few of the children's teachers took advantage of opportunities to use signs outside of the sign-training sessions. Exposure to signs similarly was quite inconsistent in most of the children's homes. This occurred even when the parents had received training and instruction in the use of the Makaton vocabulary. This lack of sign exposure outside of the formal teaching setting may not only have restricted the children's sign learning but also adversely affected their spontaneous use of signs.

Although most individuals with impaired spoken language skills eventually make greater progress with signs when signs are introduced in early childhood, there may still be benefits to introducing signs at a later age. Tavares and Peixoto (2003) reported that adolescents with cerebral palsy often were able to make progress in learning to sign despite not being shown how to communicate with manual signs until late childhood or adolescence. The acquisition of signs, moreover, enabled these youngsters to become more independent through their more effective communicative interactions.

Another study into the use of signs to promote language development with similarly-aged individuals with cerebral palsy was conducted in the U.K. in the 1970s (Fenn & Rowe, 1975). Seven male students at the Meldreth Manor School in Royston, Hertfordshire who were between the ages of ten and thirteen years old were taught signs from the Paget-Gorman Sign System. Six of the boys had athetoid (dyskinetic) cerebral palsy (four were classified as severe, one moderate, and one mild) and the other boy had ataxic cerebral palsy. In addition, five of the boys were severely deaf and the remaining two had some degree of hearing impairment. Since earlier attempts to teach other students syntax through use of fully signed sentences were ineffectual (most students only used single signs), the authors decided to adopt a more limited or "telegraphic [approach] in which only the essential information in a sentence is signed in the early stages" (Fenn & Rowe, 1975, p. 4). This early key word signing approach initially focused on nouns and then

expanded to include adjectives and verbs in a phrasal structure. The signs were taught to the seven students in naturalistic settings or situations (a milieu or incidental teaching approach) and were relevant to the boys' experiences. Furthermore, the researchers made sure that all of the staff members at the school were taught and regularly trained on the use of the signs, although they conceded that they could not guarantee the level of general sign exposure that the boys received. When the boys were assessed on their comprehension of simple sentences six months later, most demonstrated knowledge of a variety of lexical relations, although their word order was inconsistent (Fenn & Rowe, 1975). In addition, they were able to spontaneously combine signs and had even started to sign to one another. Thus, it appears that the researchers were quite successful in increasing sign usage and lexical knowledge in this group of students.

Finally, individuals with cerebral palsy or speech disorders who have at least some useful spoken language skills might wish to consider combining iconic gestures with their speech when they communicate. We say this for two reasons. One is that iconic gestures themselves often are an effective way to communicate and may be easily understood by communication partners and also by persons in the environment who are not familiar with the individual or with signing (Powell & Clibbens, 1994). The other reason is that when iconic gestures accompany spoken language, the speech of persons with cerebral palsy often is more intelligible (Hustad & Garcia, 2005), as is the speech of persons with Down syndrome (Powell & Clibbens, 1994). Greatly enhanced intelligibility of communication also is evident when signs are combined with speech in individuals with Cri du chat syndrome (Erlenkamp & Kristoffersen, 2010). Individuals with Cri du chat syndrome, a rare genetic disorder, have substantial intellectual disability and show either markedly delayed expressive language or fail to develop any recognizable spoken language. This increase in intelligibility when spoken language is accompanied by iconic gestures may be a result of the speakers slowing down their rate of articulation and their overall rate of speaking.

Recommendations for Enhancing the Sign-Learning Environment[15]

When planning for the adoption of communication intervention programs with children with disabilities, it is important to first be aware of and, if possible, proactively address any overarching concerns or negative attitudes that may impact the children's general educational environment. As the education of persons with disabilities does not occur in a vacuum, but instead exists within an evolving matrix of wider legal, political, social, and other environmental variables, it is important to be aware that these factors can impact the decision-making processes of teachers, staff, and caregivers. Furthermore, those educators and advocates who view the inclusion of persons with disabilities through more of a human rights model or social diversity lens understand the importance of addressing structural and systemic barriers (Degener, 2016; Guralnick, 2017; Light & McNaughton, 2015). Teachers' and caregivers' attitudes are influenced by the political atmosphere with regard to official educational policy (e.g., whether there are laws requiring integration of special students into mainstream settings), the stance taken by school administrators and leaders toward inclusion, and the level of ongoing support provided to them in the form of resource materials, equipment, training, and personnel (Avramidis & Norwich, 2002; Budiyanto et al., 2018; Goldbart & Marshall, 2004; Light & McNaughton, 2015; Singh et al., 2017). In general, studies have shown that the more experience a teacher has with children with disabilities, the better and more positive his or her attitude toward their inclusion in mainstream settings (Avramidis & Norwich, 2002). Likewise, the more experience that teachers and staff members have with a particular communication intervention program, the greater their positivity toward it and the greater the chance of its successful implementation (Cologon & Mevawalla, 2018).

15 In Chapter 9, we discuss various teaching or training approaches that we believe will foster the individual sign learner's acquisition and use of Simplified Signs. Here, we comment on findings about the use of signs by teachers and staff members in educational and residential settings and by family members at home. These findings make it clear that if one wishes to provide a highly effective sign-learning environment, then an effort also needs to be made to facilitate sign acquisition and usage by those persons who care for and interact with the principal sign learner.

If the decision is made to implement a sign intervention program for non-speaking individuals with an intellectual disability, cerebral palsy, autism spectrum disorder, or aphasia, then an effort also should be made to facilitate the sign learning and usage of those persons caring for and interacting with them (Budiyanto et al., 2018; Cologon & Mevawalla, 2018; Dolly & Noble, 2018; Glacken et al., 2019; Grove & McDougall, 1991; Kent-Walsh et al., 2015; Launonen, 2019b; Light & McNaughton, 2015; Mackenzie, Cologon, & Fenech, 2016; Rombouts et al., 2019; Sheehy & Duffy, 2009; Woll & Barnett, 1998). All too often, programs have focused almost entirely on the sign learning of the non-speaking participants and their language teachers, while neglecting the signing abilities of all of the other persons with whom the participants come into contact (Bryen et al., 1988). When a signing program is implemented on a wider scale within a class or school, signing is often viewed with much less stigmatization than if signing is only used by a few people in limited contexts (Brereton, 2008; Budiyanto et al., 2018; Cologon & Mevawalla, 2018; Mistry & Barnes, 2013; Woll & Barnett, 1998).

This type of inclusive educational model, in which the needs of persons with disabilities are considered and then enacted on a broad scale to the benefit of everyone (not just those persons with disabilities), is consistent with the concept of universal design for learning (Meyer & Rose, 2000; Spratt & Florian, 2015). In this model, teachers view each and every student as an individual and take his/her needs into account when designing lesson plans. Indeed, it is a recognition that teachers already make adaptations for their students, regardless of whether labels are applied to them or not (Mackenzie et al., 2016; Spratt & Florian, 2015). Changes are also incorporated into the curriculum materials to support students who learn better through media such as illustrations, movies, games, audio, and software (Meyer & Rose, 2000). Such an approach may also include more collaborative efforts among children in a classroom, rather than focusing solely on individual work or projects (Spratt & Florian, 2015). A further consideration is that sign-communication programs often have utilized only a small portion of a participant's day for sign instruction and usage rather than embedding signing throughout the entire day. Although this approach is quite typical, it is not the optimal way to enhance signing skills or to maximize progress.

A range of programs for non-speaking children have been examined for their effectiveness in increasing the children's manual signing (Schepis et al., 1982). Those programs that encouraged caregivers to increase the amount of their sign communication throughout the day and in different situations tended to have children who signed more and who engaged in more spontaneous sign interactions (Dodd & Gorey, 2014; Launonen, 2019b; Rombouts et al., 2017a, 2017b). For sign intervention programs to be optimally successful, individuals should be immersed in an environment where most persons consistently rely on signs to communicate (Rombouts et al., 2019; Woll & Barnett, 1998). Because of the importance of family members in caring for and interacting with individuals with disabilities, it would be a good idea to include these family members in the decision-making process about which communication intervention systems to employ and how to implement them (Goldbart & Marshall, 2004; Granlund et al., 2008; Mandak et al., 2017). Regardless of which augmentative and alternative communication approach is selected for a child's instruction, increasing adult input at home is related to greater vocabulary growth by the child (Brady et al., 2013; Launonen, 2019b).

There seem to be several ways for families and institutions to enhance non-speaking individuals' sign language skills. For those who live at home, it would be extremely helpful if their parents, siblings, and other family members learned to sign and then used signs when interacting with them (Glacken et al., 2019; Launonen, 2019b; Smith, Romski, & Sevcik, 2013). The use of signs by family members would give these non-speaking individuals much more practice signing, as well as the opportunity to use signs outside of the school setting. This extension of sign usage beyond the educational setting is important because it will reinforce a child's spontaneous efforts at sign communication across a variety of environments. Involvement of family members in signing likely would also foster closer ties between the non-speaking children and their families and might help alleviate the frustration these children encounter when they are not able to communicate effectively with others (Glacken et al., 2019; Goldbart & Marshall, 2004; Grinnell, Detamore, & Lipke, 1976; Marshall & Goldbart, 2008). Furthermore, by embedding communication interventions throughout the day in natural settings, not only will the children make progress in their communication skills, but

the level of parental stress typically will decline as well (Glacken et al., 2019; Guralnick, 2017; Koegel, Bimbela, & Schreibman, 1996; Launonen, 2019b; Singh et al., 2017).

The signing skills of many staff members at institutions or programs for non-speaking children should be improved as well. In many instances, it is only those teachers and language therapists who have direct and frequent contact with the children who learn signs. Other staff members continue to interact among themselves and with these youngsters exclusively in spoken language. Such a situation not only fails to take advantage of opportunities to enhance a sign learner's communication skills, but also may unintentionally convey the impression that signing is quite limited in its usefulness. In one of the early studies that examined the impact of a full-time signing environment, non-speaking participants with an intellectual disability showed rapid mastery of signing skills (Kopchick, Rombach, & Smilovitz, 1975).

Likewise, when support staff in a facility for adults with intellectual disabilities used key word signing in their communicative interactions in an immersion approach, there was a significant increase in sign usage (Grove & Walker, 1990; Meuris, Maes, & Zink, 2015; Schlosser & Sigafoos, 2006). Key word signing confers an additional benefit: it provides information to the learner in more than one modality and thus increases the chance that the individual will be able to understand the communication (Loncke et al., 2006). Furthermore, speaking and signing at the same time typically slows down the rate of speech, thus providing more time for persons with communication disabilities to comprehend the message (Loncke et al., 2012). These characteristics of speaking and signing the key words at the same time may be especially helpful to persons with multiple disabilities such as intellectual disability, visual impairment, hearing impairment, or autism. If such an individual misses some of the information contained in one modality (e.g., the auditory input), he or she may be able to pick up the same information from the other modality (e.g., the signed input).

Moreover, staff members in residential settings appear to be able to acquire a small number of useful signs each week without an undue expenditure of time or funds (Spragale & Micucci, 1990). In fact, if deliberately trained to combine signs, both teachers and staff members can successfully learn and model multi-sign utterances for

students, thereby increasing the likelihood that the students themselves will combine signs (Dolly & Noble, 2018; Grove, 2019a). Once such communication partners learn how to accurately form a core vocabulary of useful signs, providing these individuals with some form of portable prompt system (e.g., reference card) as a memory aid is likely to prove helpful to them (Chadwick & Jolliffe, 2008). Such a portable prompt system or reference card probably should include a picture or drawing of each sign in the core vocabulary, each sign's translation or language equivalent, and a brief description of how each sign is made.

Even with some minimal training in signing, however, many staff members may be reluctant to use those signs because of a lack of confidence, the increased cognitive effort required to remember and produce the signs in the early stages of their training, or the perception that signing is only useful when spoken language communication fails (Rombouts et al., 2017a). Such attitudes and perceptions should be addressed during staff training sessions by stressing the importance of having staff model sign use throughout the child's environment not only so that the child can learn the signs, but also so that he or she can maintain sign use over longer periods of time. Furthermore, staff sign training, much like the sign training of persons with disabilities, should not be limited to discrete teaching sessions but instead should be incorporated in natural settings throughout the day with appropriate feedback from more experienced and trained signers and with open access to teaching materials (Dolly & Noble, 2018; Kent-Walsh et al., 2015; Rombouts et al., 2017a). Consistently reinforcing the use of signs at various points in the day, including during often-neglected times such as meals and non-communicative (i.e., crafts, play) activities (Grove & McDougall, 1991; Rombouts et al., 2018a, 2018b) helps to establish signing as a natural habit for everyone involved. Overall, when staff members at institutions commit to providing a more complete sign-communication environment, and when they receive consistent training and positive reinforcement to do so, they appear to positively influence non-speaking individuals' sign mastery (Grove & McDougall, 1991; Guralnick, 2017; Kent-Walsh et al., 2015; Mellon, 2001; Rombouts et al., 2019; Wooderson, Cuskelly, & Meyer, 2014).

Although there have been a number of attempts to create sign intervention programs for non-speaking children with an intellectual

disability, the findings of a systematic review showed that only a minority of the programs significantly increased the children's competence in communicating with others (Bryen & Joyce, 1985). Communicative competence was defined as the ability to use signs to effectively convey one's needs, rather than the ability to produce signs out of context. The investigators tried to determine which sign intervention programs led youngsters to use signs to enhance their interactions with others across a range of settings, not just in the classroom. Two differences in the context of sign training and teaching were shown to be related to whether programs were successful or not in fostering communicative competence: (1) successful programs most often were those that used signs throughout much of the children's environment as opposed to those programs that relied on isolated sign-training sessions, and (2) successful programs also emphasized spontaneous sign usage as one of their goals. In fact, the importance placed on spontaneous signing was highly related to the participants' retention and use of signs (Bryen & Joyce, 1985).

In addition, teachers, staff, and caregivers should help promote the use of signs between peers in classrooms and in other settings. Grove and McDougall (1991) found that much of the sign activity they observed in their study of signing by children with various disabilities was directed toward adults; many fewer signs were directed at other children in the classroom. The researchers suggested that direct intervention techniques, including teaching non-disabled peers to sign, may help to promote and support more communicative activity both in the classroom and during other school activities and playtime (Grove & McDougall, 1991). Schools that promote the learning of signs by all teachers, staff, and children have a significant positive effect on the children's sign use (Bryen & Joyce, 1985). This type of environment also promotes signing by persons with autism who are educated in inclusive, mainstream settings (Mackenzie et al., 2016).

One of the approaches related to increased signing and communicative competence is called an incidental or milieu[16] teaching program. This approach utilizes natural interactions between caregivers and non-speaking participants throughout the day for instructional purposes (Launonen 1996, 1998, 2003, 2019b; Light & McNaughton, 2015; Mancil,

16 The word *milieu* refers to the participant's natural environment.

2009; Schepis et al., 1982). Communication training focuses on what the participant is paying attention to and likely is interested in, as well as modeling correct communication at the appropriate level (Wright et al., 2013). With this approach, many participants engage in markedly more spontaneous signing and rely less on prompting from their teachers or caregivers. Also, when staff are more responsive to participants' sign communications (e.g., by imitating or repeating the signs that the participants produce), persons with disabilities have a greater likelihood of producing novel or spontaneous signs (Broberg, Ferm, & Thunberg, 2012; Dodd & Gorey, 2014; Rombouts et al., 2017b, 2017c, 2018b). It should be noted that the sustained interactions in sign on the part of caregivers and teachers or therapists often are critical in maintaining the participants' use of signs. Moreover, teaching parents to use naturalistic language intervention strategies (enhanced milieu teaching or EMT) with their preschool children with intellectual disabilities typically results in greater increases in language and communication skills than if only the therapists are trained (Kaiser & Roberts, 2013; Launonen, 2019b). Also, the effectiveness of parents' teaching of words and signs through EMT evidently can be improved if the parents are provided coaching and feedback from trained therapists (Glacken et al., 2019; Wright & Kaiser, 2017).

Although probably not all non-speaking persons can acquire manual signs without direct teaching, at least some individuals evidently can learn signs primarily through exposure to others' signing (Valentino & Shillingsburg, 2011). In future research, investigators might wisely incorporate an incidental or milieu teaching approach into their methods and try to maximize the opportunities for non-speaking individuals to learn that way. In addition, many young children with intellectual disabilities, including Down syndrome, benefit more in terms of vocabulary growth when milieu communication teaching occurs at a higher rather than lower frequency each week (Yoder et al., 2014; see also Guralnick, 2017).

Another approach likely to foster increased signing in language-limited individuals is to work with parents and other caregivers to enhance their responsiveness to the non-speaking or minimally verbal person's efforts at communication. In such an approach, parents would try to follow their children's leads and react to the children's

acts of communication rather than direct the communication process themselves (Broberg et al., 2012; Fey et al., 2006; Girolametto, Sussman, & Weitzman, 2007; Guralnick, 2017; Mahoney et al., 2006; Ruble et al., 2008; Trivette, 2007; Van keer et al., 2017). The parents' behavior would thus be largely contingent on and responsive to their children's communicative acts rather than the other way around. One tool for measuring the communication of parents when interacting with their children who use signs or other augmentative and alternative communication techniques is the Responsive Augmentative and Alternative Communication Style (RAACS) scale (Broberg et al., 2012). Communicative strategies measured by this instrument include attending to and confirming the child's communication, adjusting physically to the child, giving the child space and time to communicate, clarifying one's own communication, focusing on the child's topic of interest, expanding upon the child's communicative efforts, using AAC, adapting to and engaging in the situation, and adjusting to the child's level of communication (Broberg et al., 2012, p. 249). Important outcomes of this responsive approach would be an increase in the children's initiation of engagements or social interactions, as well as improvements by young children with Down syndrome in their level of developmental functioning (Karaaslan & Mahoney, 2013).

Further examination of the efficacy of different sign intervention programs found that successful learning of a sign-communication system was related to several additional factors in the environment (Avramidis & Norwich, 2002; Bryen & Joyce, 1986; Budiyanto et al., 2018; Cologon & Mevawalla, 2018; Glacken et al., 2019; Goldbart & Marshall, 2004; Grove & McDougall, 1991; Kent-Walsh et al., 2015; Loeding, Zangari, & Lloyd, 1990; Marshall & Goldbart, 2008; Rombouts et al., 2017a, 2017b, 2017c, 2018a, 2018b; Sheehy & Duffy, 2009; Singh et al., 2017; Woll & Barnett, 1998). Those factors included the attitudes of teachers, caregivers, and parents toward the use of manual sign communication, in-service training in the use of a particular sign system, and the level of caregiver competence in a sign system. One interview study that elicited the thoughts of eighteen parents about using key word signing (Lámh) with their children occurred in Ireland (Glacken et al., 2019). Many of the parents commented on the process they went through to understand and accept the potential of using Lámh with their children, noting

the importance that healthcare professionals played in allaying their concerns. Parents appreciated the tailored nature of their initial training in the system, but also stressed the need to have continued access to ongoing training, including supporting materials online, in order to keep up with their developing children's vocabulary needs (Glacken et al., 2019). Frustrations were also expressed by parents of children who used various augmentative and alternative communication (AAC) techniques, including signs, in the U.K. and in Malaysia (Goldbart & Marshall, 2004; Marshall & Goldbart, 2008; Singh et al., 2017). In these interview studies, the parents expressed concerns about their children's social inclusion, societal attitudes toward AAC, financing of the devices they used, the various roles the parents had to play, and the many demands placed on them. They also noted the lack of support from other members of the family, insufficient assistance from some teachers, and not receiving enough information or resource materials about AAC from professionals (Goldbart & Marshall, 2004; Marshall & Goldbart, 2008; Singh et al., 2017).

Taken together, these findings about the importance of the involvement of instructional staff and family members and the effectiveness of certain sign-training approaches make clear that to be maximally beneficial, a sign-communication program needs to focus on enhancing aspects of the settings in which sign teaching and use will take place. Parents, teachers, staff, and other caregivers should also be supportive of signing (or other means of augmentative and alternative communication) in the wider environment (i.e., at stores, parks, sporting events, medical offices, etc.) or with persons with whom the child comes into contact on a less regular basis (Collier, McGhie-Richmond, & Self, 2010; Light & McNaughton, 2015). Beginning the program of sign intervention early in children's development also is associated with considerably greater long-term progress in communication skills (Branson & Demchak, 2009; Clibbens, 2001; Launonen, 2019b; Millar et al., 2006). Furthermore, even when multimodal language intervention programs are effective in enhancing the communication skills of young children with intellectual disabilities, these programs may need to be maintained for a period of years to ensure these children's continued progress (van der Schuit et al., 2011a).

An additional factor that has not yet received much attention is the impact of the attitudes of a signer's peers toward the use of signs.

Whereas multiple studies have addressed the attitudes and concerns of teachers, support staff, professionals, and other adults, a recent study (Bowles & Frizelle, 2016) focused on young children's attitudes toward signing in a mainstream school setting. In this study, investigators interviewed eight children (four from one school, four from another school) who had a classmate with Down syndrome and who had all been taught Lámh. Each of the children was asked various questions about their knowledge of Lámh, including where the signs were used, who used them, and how they felt about the signs. The researchers found that all of the peers had positive attitudes toward signing and also recognized the importance of signing for the person who had Down syndrome (see also Glacken et al., 2019). Thus, it seems that the use of key word signing was not stigmatized in the eyes of the children. The children did, however, express concerns about remembering all of the signs, having a hard time making some of the signs, and being able to use the signs in unstructured settings. In response to these concerns, the authors suggested that teachers focus on a smaller group of high-frequency signs and take a more consistent approach to teaching them (Bowles & Frizelle, 2016). It is also possible that teaching signs that are more iconic and easily formed would have had an impact on these typically developing children's recall abilities.

Although a limited signing environment may constrain the children's development of signing skills, it was not the problem mentioned most frequently by the teachers and language therapists of students with neuromotor disabilities. Rather, these staff members underlined their difficulties in interpreting their students' signing (Grove, 1990). One resolution to this problem might be for the teachers and therapists to accept consistent approximations of the signs. Indeed, one student's rudimentary sign approximations were more easily understood than his indistinct vocalizations (Grove, 1990). Another possible strategy would be to use a sign system that was formationally easier to produce by individuals with motor impairments, such as Amer-Ind or the Simplified Sign System.

Finally, it should be noted that the effectiveness of particular language intervention programs may vary depending on the etiology of the children's intellectual disability and on their levels of communicative abilities (Yoder & Warren, 2002). That is, particular intervention

approaches may be more successful with children at different levels of communicative functioning or with children in certain diagnostic categories (e.g., Down syndrome). In the future, it may be possible for clinicians to confidently recommend a particular intervention program based on an individual's background characteristics and current level of communicative functioning. Alternatively, one may adopt a more holistic approach that maximizes an individual's exposure to multiple forms of input (e.g., speech, sign, symbols, speech-generating devices, etc.) that can all serve as models for his or her communicative development. In such an approach, all strategies would be considered viable and useful options unless specific evidence to the contrary arises for that individual; an ineffective strategy could then be discontinued or de-emphasized in favor of strategies that are more beneficial to that individual. It is also vitally important to consider the preferences of the individuals with developmental disabilities when trying to determine which augmentative and alternative communication options to pursue with them (van der Meer et al., 2011). A user's choice gives that person power in making decisions that affect his or her life and provides him or her with an opportunity to exercise autonomy and control over aspects of the surrounding environment (Light & McNaughton, 2015).

Selecting Signs

If a decision is made to implement a sign intervention program for a non-speaking individual with an intellectual disability or cerebral palsy, then care should be exercised in selecting those signs to be taught. Because some such individuals have pronounced motor difficulties, the signs selected should be relatively easy to form (Dennis et al., 1982). This means that they should consist of a single distinct movement and a basic or formationally simple handshape. Repetition of a particular sign movement typically has little or no impact on that sign's learning. If possible, the signs selected also should touch or make contact with the signer's body or other hand. If, in contrast, the selected signs are more difficult to form, then much more time and effort likely may need to be devoted to teaching the individual to produce recognizable signs. Such an outcome probably would prove frustrating for both teacher and learner, and slow the learner's development of communication skills.

Regardless, it should be acknowledged that systematic studies that probe the interrelationships between sign formational parameters and sign learning in persons with disabilities have rarely been conducted.

Signs taught also should be highly iconic, if possible. Highly iconic signs typically are learned and remembered more easily than signs that do not resemble their concepts (arbitrary signs). Signs high in translucency also are more readily acquired than arbitrary signs. Therefore, signs to be taught should be clearly iconic or high in sign translucency. If it is not possible to find or create a highly iconic or translucent sign for a certain concept, then use the best sign available and facilitate its acquisition by providing an explanation of the relationship between that sign and the concept for which it stands.

Although all sign languages used by Deaf persons have some highly iconic signs, these signs constitute a minority (generally one-third) of the lexicons of those languages (Boyes Braem, 1986; Lloyd et al., 1985). The sign-communication system developed by the Indigenous peoples of North America, Plains Indian Sign Language, evidently contains a larger proportion of highly iconic signs than Deaf sign languages. Unfortunately, many of the signs developed and used by Native Americans for intertribal communication and trade do not appear to be useful in a contemporary classroom setting. Furthermore, some of the signs in Deaf sign languages and Plains Indian Sign Language are relatively complex formationally. Since neither Deaf persons nor Native Americans typically have had difficulty motorically producing signs, this formational complexity was not a problem. Sign formational complexity, however, does factor into the sign-learning success of some individuals with an intellectual disability and/or with cerebral palsy.

Another factor that teachers or caregivers should keep in mind when selecting which signs will be taught is whether a particular sign might be potentially useful to the learner. If a sign does not serve a purpose or is not functionally relevant in some way to the learner, then it is unlikely to be used except in sign-learning sessions.

We believe that the signs that we have developed for the Simplified Sign System help overcome many of the memory and formational difficulties involved in learning to communicate through signs. Simplified Signs are relatively easy to form, typically are high in iconicity or translucency, and frequently will be useful in modern-day situations.

For these reasons, we feel that signs from the Simplified Sign System will be helpful additions to the educational and training programs of many persons with an intellectual disability or with cerebral palsy. These same characteristics also make them easier to learn and remember by young typically developing children (discussed in Chapters 3 and 7), individuals with autism (discussed next in Chapter 5), and individuals with aphasia (discussed in Chapter 6).