

Volume 1: Principles,
Background, and Application

Simplified Signs

A Manual Sign-Communication
System for Special Populations



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John D. Bonvillian, Nicole Kissane Lee, Tracy T. Dooley and Filip T. Loncke, *Simplified Signs: A Manual Sign-Communication System for Special Populations, Volume 1*. Cambridge, UK: Open Book Publishers, 2020, <https://doi.org/10.11647/OBP.0205>

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ISBN Paperback: 978-1-78374-923-2

ISBN Hardback: 978-1-78374-924-9

ISBN Digital (PDF): 978-1-78374-925-6

ISBN Digital ebook (epub): 978-1-78374-926-3

ISBN Digital ebook (mobi): 978-1-78374-927-0

ISBN XML: 978-1-78374-928-7

DOI: 10.11647/OBP.0205

Cover Image and design by Anna Gatti.

6. Sign-Communication Intervention in Adults and Children with Aphasia

In the previous two chapters, the research focus has primarily been on the sign acquisition of non-speaking or minimally verbal children. A number of these individuals learn to communicate effectively, often for the first time, through the use of manual signs. Furthermore, while gaining proficiency in sign communication, a substantial proportion of these children are also able to acquire some spoken language skills. In the present chapter, our principal focus changes to the acquisition and use of manual signs by individuals who were once fluent spoken language users. These persons, typically as a result of a stroke or brain injury, experience severe losses of language functions, motor abilities, or both. Like non-speaking children, some of these individuals are able to learn to communicate effectively through the use of manual signs or gestures.

Manual signs have also been used by therapists to foster their clients' spoken language skills through the pairing of their clients' manual sign production with their efforts to produce recognizable words. In some instances, real improvements in speech intelligibility and articulation have been reported. Although manual sign-training and teaching programs have been shown to increase the communication abilities of many adults who have suffered extensive language losses, much remains to be learned about these individuals' sign acquisition. Many more research studies need to be conducted before we can determine how the location and severity of brain damage affect sign acquisition, how signs may best facilitate speech recovery, and which signs are more readily learned and why. Studies of deaf persons who have suffered strokes

that resulted in aphasia also provide a fascinating look at the distinction between these individuals' signing abilities and their gestural abilities.

It is important to note that children are not immune to strokes, head injuries, or brain trauma that result in loss of expressive and/or receptive language abilities. Furthermore, a number of children who have not suffered brain trauma may still be noticeably impaired in their spoken language development despite hearing levels and nonverbal cognitive abilities in the normal range. Many of these children have substantial and long-lasting vocabulary deficits (Rice & Hoffman, 2015), with such deficits raising concerns about the children's resulting success in learning to read and eventual educational attainment. Teaching signs to hearing children with Landau-Kleffner syndrome (acquired epileptic aphasia), a developmental language disorder (DLD), or childhood apraxia of speech may prove to be a useful strategy in improving their overall communication skills while also encouraging their development of speech skills. Finally, deaf children may be impaired in their sign language development despite normal cognitive abilities, consistent input from fluent sign language models, and the absence of other factors such as autism, head trauma, or stroke. The identification of deaf children with delayed or atypical sign language development is a relatively new expansion of the literature on developmental language disorder and presents unique challenges for families and educators.

Introduction to Aphasia and Apraxia

Individuals with aphasia, or loss of language ability, constitute another population with serious communication difficulties (Beukelman & Mirenda, 2013; Davis, 2007; Kertesz, 1979). Aphasia (or dysphasia)¹

1 Technically, *aphasia* refers to a comprehensive loss of language and *dysphasia* refers to partial disruptions of language abilities. However, in many fields, the terms *aphasia* and *dysphasia* are used interchangeably to refer to losses of language ability of any degree. Furthermore, usage of these terms varies by geographical location. In the United States, the preferred term often is *aphasia*, whereas in other countries, the term *dysphasia* is more prevalent. In this text, we consider *aphasia* and *dysphasia* to generally be synonymous. For practical purposes, however, we use *aphasia* to refer to acquired language losses that are the result of strokes, head injuries, tumors, infections, and the like. In contrast, we use *developmental dysphasia* or *developmental language disorder* to refer to language problems that are present in children from an early age and which are not attributable to a specific trauma.

is primarily a language disorder that results from damage to areas of the brain responsible for various language functions. This damage can affect both the production of language (that is, *expressive language skills*) and its understanding (*receptive language skills*), as well as impairing the ability to read (*dyslexia*) or write (*dysgraphia*). Aphasia is often the product of a cerebrovascular accident or stroke, serious brain injury, brain infection, or brain tumor. Although aphasias are more common in older than younger individuals, children and adolescents may also lose all or portions of their language abilities.

Strokes are the leading cause of long-term disability among adults worldwide (Ward & Cohen, 2004). Strokes involve the relatively sudden loss of blood circulation to an area of the brain; this loss of blood circulation in turn results in impairment or loss of function performed by the brain area affected (Caplan, 1995; Kljajevic, 2012). In most instances, the cause of a stroke is a clot that blocks a blood vessel in the brain; this is known as an ischemic stroke. A less common form of stroke occurs when a blood vessel breaks and there is a discharge of blood into the brain; this is known as a hemorrhagic stroke. In the United States, there are over three quarters of a million new cases of cerebrovascular accident or stroke each year. Of those individuals who experience an acute stroke, a significant proportion (21-38%) suffer extensive language loss or aphasia (Geschwind, 1979; Laska et al., 2001; Pedersen et al., 1995). In addition to their language loss, persons with aphasia may suffer impairments in other areas of cognitive functioning, such as attention and executive function (Sandberg, 2017). Because advancements in medical care are both prolonging the average life span and improving the survival rates after strokes, there are increasing numbers of individuals with aphasia who become candidates for language therapy (Howard & Hatfield, 1987). A recent estimate is that aphasia affects about one million persons living in the U.S. (National Institute of Neurological Disorders and Stroke, 2019).

Another leading cause of disability among adults is traumatic brain injury (TBI). These serious injuries frequently are the product of an automobile accident, fall, or assault. Those individuals who suffer traumatic brain injuries are likely to experience impairments in their motor, cognitive, perceptual, communicative, and social abilities (Rispoli, Machalicek, & Lang, 2010). Individuals with acquired language

impairment or aphasia after TBIs frequently make more extensive use of gestures, typically pointing and iconic gestures, when compared with healthy adults (Kim et al., 2015). Although the use of gestures may help such aphasic individuals convey information and enhance their communication, their loss of spoken language abilities may result in social isolation.

For some years, treatment programs for persons with aphasia, especially those with chronic aphasia, frequently were viewed as relatively ineffective. More recently, however, there has been a change in perspective about treatment outcomes and the optimal course of therapeutic intervention for persons with aphasia. This change was based on findings from investigations that showed that intense aphasia treatment over a short duration often resulted in substantial treatment gains and proved more effective than the same number of hours of treatment spread over a longer period (Bhogal, Teasell, & Speechley, 2003; Hillis, 2007). Greater treatment progress also was evident in those persons whose language therapy hours and frequency of language therapy were maximized (Pulvermüller & Berthier, 2008). These findings about the benefits of intensive language therapy held both for those persons whose language loss was of recent origin and for persons with chronic aphasia.

Many patients evidence substantial recovery from stroke-caused aphasia in the first three months after onset, with some persons continuing to show improvements in verbal communication over the next three months (Bakheit et al., 2007; El Hachioui et al., 2013). However, recovery often reaches a plateau about six months after stroke. In their course of language recovery, patients typically recover their semantic and syntactic skills before they recover their phonological skills (El Hachioui et al., 2013). This pattern of a longer recovery period for phonology, as opposed to semantics and syntax, apparently indicates that various components of language are often differentially affected in aphasia.

Additional patients, especially those with a severe aphasia, fail to reacquire most of their speech skills, even after intensive and prolonged speech therapy. Some of these latter individuals may be able to acquire needed communication skills through the use of manual signs or other augmentative and alternative communication intervention strategies

(Hux, Weissling, & Wallace, 2008). Yet, many such individuals, including those with severe, chronic aphasia, evidently are reluctant to embrace any augmentative and alternative communicative strategy out of fear that it might interfere with the return of their natural speech skills (Beukelman et al., 2007).

Persons who become aphasic may have serious motor or visual-processing difficulties, along with their language-processing disturbances. In general, however, visual and gestural skills are not as impaired as spoken language skills in persons with aphasia (Porch, 1970, cited in Kenin & Swisher, 1972; see also Cocks et al., 2009). This pattern may help explain why many individuals with aphasia make more frequent use of gestures, especially iconic gestures, in their communication than do neurologically healthy comparison group members (Kong et al., 2015; Pritchard et al., 2015). Many persons with aphasia experience muscular weakness (or hemiparesis) on one side of their bodies. If the impairment is quite severe and the side of the body is paralyzed, then the term hemiplegia is used (Patterson & Chapey, 2008). In the large majority of cases it is the right side of the body that is affected. In addition, some individuals may experience temporary or lasting paralysis on both sides of their bodies. Clearly, persons with lasting, bilateral paralysis would not be good candidates for a sign-communication system where movement of at least one arm is essential. Before starting a sign-communication intervention with such persons, control of movement of at least one arm would need to be re-established.² Furthermore, the visual problems experienced by certain individuals with aphasia often involve a cut in their visual fields (Davis, 2007), frequently on the right side. As a result, manual signs made in these persons' right visual fields would be largely inaccessible

2 Certain investigators have been examining the use of motor imagery as a way to improve the motor abilities of individuals who have suffered motor impairments after strokes (Hwang et al., 2010; Sharma, Pomeroy, & Baron, 2006). In this approach, patients form visual images of themselves successfully performing motor functions or movements without overtly performing these actions. It is possible that motor imagery may be a useful initial strategy in rehabilitating motor control in persons with bilateral paralysis or impairment. If use of this approach is successful in re-establishing control of movement in at least one arm, then these persons may become candidates for learning and using manual sign communication. Because manual signs are, to a considerable extent, motor actions, it might be possible to incorporate the learning of signs into the initial application of this motor imagery rehabilitation strategy (rather than after).

to them. If an individual has such a difficulty, then signs should be positioned to avoid these problems or another form of communication should be considered.

Over the last few decades, two contrasting representations of the relationships between gesture and speech have emerged from the research literature. In one, gesture and speech were viewed as products of a single bimodal process. If this approach were to be empirically verified in all or most individuals, then it would suggest that the use of manual gestures to compensate for spoken language losses from aphasia probably would be limited at best. That is, communication in both the speech and gestural channels would be impaired. The other major depiction of speech-gesture relationships has viewed spoken language and manual gestures as two highly coordinated but largely independent processes. In their test of these two approaches, Hogrefe et al. (2013) examined the use of gestures in adults with varying degrees of aphasia. More specifically, the participants were instructed to retell video clips they had seen: first, without narrative instruction (the patients typically used speech and gestures) and, subsequently, to do so silently through manual gestures (without speech). Because the comprehensibility of the gestures produced by a number of the aphasic participants was significantly enhanced in the silent condition, the investigators interpreted this finding as supporting the position that speech and manual gesture are largely separate communication channels. They also advanced the view that persons with aphasia could compensate, in part, for their spoken language impairments through the use of gestural communication (Hogrefe et al., 2013; see also Ahlsén, 1991; Béland & Ska, 1992; de Beer et al., 2017; de Ruiter, 2006; de Ruiter & de Beer, 2013; Goodwin, 2000, 2006; and Herrmann et al., 1988).

Although the comprehensibility of the gestures produced by many of the aphasic participants was found by Hogrefe et al. (2013) to be significantly enhanced in their silent condition, this should not be interpreted to mean that aphasic patients should communicate in the gestural mode alone. More specifically, listener comprehension has been shown to be greater when the speech of persons with aphasia is combined with pantomimic gestures than when efforts to communicate are made in speech or gesture alone (de Beer et al., 2017; Rose, Mok, & Sekine, 2017). It is also important to note that a person with aphasia

may convey additional information through the gestural modality than is present in his or her speech (de Beer et al., 2017). In other words, gestures that people produce with their speech do not always provide redundant information — sometimes, the gestures augment or add new informational content to a spoken utterance (Bangerter, 2004; Beattie & Shovelton, 2011; Melinger & Levelt, 2004).

For most hearing patients with severe aphasia, the principal emphasis of their language therapy will be on restoring their spoken language skills. But if patients fail to show real improvements in their speech skills over time, then therapists should strongly consider embarking on a program of teaching communicative gestures to these patients. For instance, in one study, although the clear majority of the participants with severe aphasia acquired more vocabulary items through therapy using spoken and written words, a distinct minority learned many more vocabulary items through gesture communication therapy (Marshall et al., 2012).

Not only may some patients with aphasia benefit from learning gestures, but their therapists and caregivers may also wish to acquire a vocabulary of representative or iconic gestures to accompany their speech to their patients. We say this in light of findings from a recent study of co-speech gestural input (Eggenberger et al., 2016). In this study, if gestures were combined with spoken language input to patients with aphasia, then it was important that these co-speech gestures be congruent with (i.e., closely related to or highly similar in meaning) or match the principal content of the vocal utterances. More specifically, when gestures congruent with speech were used, the patients' comprehension of the input increased. In contrast, when gestures were not congruent with the speech input, then the aphasic patients' comprehension decreased significantly. This approach of using co-speech gestures congruent with the meaning of the spoken language input will likely make communicative interactions with aphasic patients more successful.

Finally, it should be noted that the study of aphasia, in addition to being central to a major and growing area of language and communication therapy, has contributed much to our understanding of the neurological bases of language. By pinpointing the location in the brain of a stroke or other lesion, investigators have been able to determine areas of the

brain related to specific language functions. Depending on the precise location of the lesion and the severity of the damage, different language and motor processes may be affected. Not only do the lesions of hearing persons with aphasia provide useful information, but the lesions of deaf persons with aphasia who use signed languages also provide insight into the brain's neurological organization with regard to language.

In some cases, Deaf signers may experience brain injuries that severely and adversely affect their signing. This loss of language ability, or sign language aphasia, may occur when a signer suffers a stroke or cerebrovascular accident, typically in the left hemisphere of the brain. In such an instance, a signer often also loses the use of his or her right (or contralateral) arm. Although the use of the left arm may not be physically impaired, the damage to the brain's left hemisphere may constrain that Deaf person from producing useful sign utterances (Marshall et al., 2005). Systematic examinations of Deaf signers who have suffered aphasias have shown that the brain structures that control sign production and comprehension are highly similar to those involved in spoken language production and comprehension in hearing persons (Corina et al., 1992; Emmorey, 2002, 2003b; Hickok, Love-Geffen, & Klima, 2002; MacSweeney et al., 2009; Marshall et al., 2004; Poizner, Klima, & Bellugi, 1987; Sarno, Swisher, & Sarno, 1969). Furthermore, this seems to be true even when a deaf signer shows atypical brain lateralization (i.e., right hemisphere dominance for language). In a study of a left-handed deaf signer who had suffered a right hemisphere stroke and had sign language aphasia, the researchers found that the pattern of strengths and deficits in this deaf man's production and understanding of sign language very closely mirrored the pattern of strengths and deficits observed in hearing persons' production and understanding of spoken language (Pickell et al., 2005). Such a result implies that right hemisphere damage in persons with atypical brain lateralization for language may produce deficits similar to those exhibited by neurotypical persons who experience a left hemisphere stroke.

Improvement in the signing skills of Deaf persons with aphasia often depends on recovery or improvement of damaged brain functions. Many studies, however, have found that deaf persons who suffer brain damage and have impairments in the production of linguistically constrained signs may not have deficits in the production of gestures (Corina et

al., 1992; Hickok et al., 2002; Marshall et al., 2004). That is, some deaf people with aphasia have difficulty producing signs from their native sign language within the phonological constraints imposed by those signs' particular handshapes, locations, movements, and orientations. In contrast, they may not have as much difficulty producing wider-ranging gestures or pantomimic enactments. Deaf persons may thus be able to access gestural abilities that are at least somewhat disassociated from their signing abilities despite the fact that both gestures and signs use the same visual-manual modality. Comparisons of the similarities and distinctions in linguistic processing in different modalities (e.g., speech, sign, and gestures) by normal and aphasic hearing persons and by normal and aphasic deaf persons may well illuminate further aspects of neural functioning that would otherwise remain hidden (Marshall et al., 2004, 2005).

Apraxia

A number of individuals who are severely aphasic also are identified as apraxic or dyspraxic³ (Albert et al., 1981; Kertesz, 1979; Papagno, Della Sala, & Basso, 1993; Weiss et al., 2016). That is, many persons with severe aphasia experience significant difficulty in accurately and purposefully controlling their manual or oral-respiratory movements, even in the absence of motor paralysis. More specifically, in the Weiss et al. (2016) study, approximately two-thirds of their aphasic patients also had apraxia. Although apraxia commonly co-occurs with aphasia, it may also occur when no language deficit is present. This pattern, however, is relatively rare; Weiss et al. (2016) reported that only 4% of their patients were identified as apraxic without co-occurring symptoms of aphasia.

The lack of a strong correlation between severity of apraxia and severity of aphasia often is viewed as indicating that there is no causative relationship between the two (Albert et al., 1981). At the same time, it should be recognized that both language and purposeful motor movements (that is, *praxis*) are evidently vulnerable to injury in nearly the same areas of the brain, typically in the left hemisphere (Stamenova, Roy, & Black, 2010; Tartter, 1998). Most likely, the neural networks that

3 See Chapter 5, Footnote 10 for a discussion of the terms *apraxia* and *dyspraxia*.

support language and praxis are partly overlapping (Papagno et al., 1993). There is also evidence of a cerebellar role in verbal and manual apraxia, as the cerebellum is involved in the coordination and sequencing of complex motor movements (Paquier & Mariën, 2005).

It should be noted that not only may language and purposeful motor movement abilities be independently impaired by brain injury, but the movements that underlie speech and the use of the hands and limbs may be independently affected as well (Albert et al., 1981; Falchook et al., 2014). While language and purposeful motor movements may be independently impaired by brain injury, the loss of language skills may influence a patient's capacity to select purposeful actions (Falchook et al., 2014). Moreover, in one recent study, language impairment was strongly associated with the aphasic participants' deficits in the generation of pantomimes of tool use whereas other measures of apraxia were not similarly adversely affected (Goldenberg & Randerath, 2015). The investigators advanced the view that underlying this impairment in both pantomime of tool use and linguistic abilities was probably the participants' loss of access to their semantic memories or knowledge.

The various forms of apraxia also may differentially affect the usefulness of certain language and communication intervention programs. Those individuals with a severe oral-motor apraxia may find acquiring spoken language skills very difficult.⁴ Correspondingly, because losses in motor planning and production skills involving the hands may negatively affect an individual's ability to acquire and use signs, learning a manual communication system may prove an inordinately difficult task for some persons, such as those with a limb apraxia.⁵ In addition, when persons with more severe apraxia produce manual gestures, the meanings of these gestures may not be understood by others; that is, these gestures may be quite low in comprehensibility (Hogrefe et al., 2012). For aphasic individuals with severe apraxia, a less motorically demanding communication system, such as a communication board,

4 An oral apraxia is when an individual experiences difficulty performing, on request, such tasks as sticking out one's tongue or biting one's lip. Apraxia of speech is evident in impaired speaking skills such as imprecise articulation, slow overall rate of production, and errors of stress assignment. Apraxia of speech is believed to be the product of a disturbance in the planning or programming of movements for speech.

5 Limb apraxia is when an individual experiences difficulty performing, on request, such motor or gestural tasks as making a fist, waving good-bye, or throwing a ball.

picture cards, or speech-generating device may be a more beneficial approach.⁶ Nevertheless, some aphasic individuals with moderate to severe limb apraxia are able to acquire a vocabulary of manual signs and to combine signs into short sign utterances (Coelho & Duffy, 1990). Furthermore, the signs of an individual with aphasia and apraxia may be more recognizable to their communication partners (and thus more functionally successful) than their spoken language utterances (de Beer et al., 2017; Goodwin 2000, 2006; Herrmann et al., 1988).

Sign-Communication Training Outcomes

Although the literature on sign-communication training and teaching in non-speaking populations has grown markedly over the last few decades, only a relatively small proportion of these studies have examined the sign-learning abilities of adults with aphasia. These studies show that some individuals who have lost their ability to speak may still be able to acquire a number of communicative signs (Christopoulou & Bonvillian, 1985; Peterson & Kirshner, 1981; Rose, 2006). Many of these studies, however, were primarily exploratory in nature, involved only a few participants, and failed to include detailed descriptions of participants' language and motor impairments. As a result, it remains difficult to draw firm conclusions about the efficacy of sign-communication training and teaching with adults with aphasia. This situation is somewhat perplexing in that there have been repeated observations, some dating back to the late nineteenth and early twentieth centuries (e.g., Seton, 1918), that adults with severe spoken language impairments might be taught to communicate effectively through the use of manual signs.

Unlike children with a severe or profound intellectual disability who were taught to sign, hearing adults with aphasia typically were fluent users of a spoken language for many years before their loss. Depending on the type and severity of their aphasia, these individuals may retain substantial receptive language skills (the ability to understand language). If a particular person has at least some receptive spoken language skills, it may be possible to explain the meanings of signs and how they are formed, which in turn may facilitate the learning

6 For more information on such systems, see the "Other Non-Oral Approaches" section in Chapter 5.

of those signs. We say this because some manual signs may be more easily learned and remembered if the relationships between those signs and what they stand for (their referents) can be readily discerned once the meanings of the signs have been provided.⁷ In the paragraphs that follow, we review a small number of investigations that have examined manual sign acquisition in hearing individuals with aphasia.

As part of their investigation into the usefulness of sign-communication interventions, Eagleson, Vaughn, and Knudson (1970) developed a manual system that was designed to help persons with expressive aphasia communicate their self-care needs. In constructing this system, the investigators borrowed a relatively small number of signs from the sign languages used by Deaf persons and from the sign system used by Native Americans. These signs were then taught to a fifty-five-year-old man with a predominantly expressive aphasia; that is, he could understand considerable speech, but produced very little. His success in communicating manually appeared to encourage him to communicate verbally as well. Although Eagleson et al.'s efforts represent an early attempt to design a manual communication system for a hearing (albeit non-speaking) individual, the very limited size of the lexicon seriously constrained its usefulness with other persons.

In 1975, Holmes reported success in teaching a manual sign vocabulary to a sixty-year-old man diagnosed with Wernicke's aphasia. People with Wernicke's aphasia often produce speech that is markedly lacking in specific content or references because they experience difficulty in using meaningful content words such as nouns, verbs, adjectives, and adverbs. Over a relatively brief training period, this man acquired a lexicon of 120 signs from the Paget-Gorman sign system (a communication system devised in Great Britain to render English manually). Most of the signs this man learned were nouns, and he used many of those signs to refer to objects that he was unable to name orally. This outcome demonstrates that some individuals who are unable to produce specific words orally may retain the capacity to produce those same words manually.

Another early account of an adult with aphasoid characteristics acquiring signs was provided by Bonvillian and Friedman (1978). The forty-nine-year-old man in this case report suffered severe

⁷ This feature of signs is known as translucency; see Chapter 1 for a discussion of translucency, iconicity, and related concepts.

brain and bodily injuries as a result of an accident. He experienced nearly complete loss of his spoken language skills and was partially paralyzed. Several years of speech therapy followed the accident, but when no improvement occurred, it was discontinued. Some years later, over the course of nine months of one-hour-per-week teaching sessions using American Sign Language (ASL) signs, this man made substantial progress in his ability to use signs. He learned to produce 117 different signs and used 79 of those signs spontaneously (without immediate prior prompting or usage by others). Rarely, however, did he spontaneously combine signs; his multi-sign combinations seemed quite effortful. With his increase in communication skills through signs, this person appeared much less frustrated with his daily living situation and was reported by members of the nursing staff to be much easier to care for and interact with.

Some persons suffer extensive damage to their brains resulting in a severe language deficit known as global aphasia. These persons show deficits in both their comprehension and production of language, and typically experience severe movement restriction on the right side of their bodies (right hemiplegia) (Damasio, 2008). The prognosis for recovery of spoken language in these individuals is quite low. However, the results of two studies involving persons with global aphasia indicate that such persons may be able to make significant progress in learning to communicate again through manual signs and gestures. In one study (Moody, 1982), the participant acquired an active vocabulary of over 200 signs from Australasian Sign Language. Two-handed signs were modified into one-handed versions. Although the participant reportedly was able to understand longer utterances, this individual communicated mostly through single-sign utterances. In the second study (Baratz, 1985), the participant made gradual progress in learning to communicate over a twenty-month training period. He first learned to produce pantomimic gestures through therapeutic drills and then began to generate his own pantomimic gestures. In the ensuing months, the participant increased his communicative repertoire by learning signs from Amer-Ind and then from ASL. He also frequently combined gestures and signs, but he showed no evidence of acquiring syntactical rules. Taken together, these two studies show that at least some individuals with global aphasia may be able to make considerable progress in learning to communicate

again when they participate in a program of manual sign and gestural communication.

Amer-Ind

Over the past several decades, Amer-Ind (derived from a Native American sign language variously known as Plains Indian Sign Language, North American Indian Sign Language, or American Indian Hand Talk) has become a widely used sign-communication system both for individuals with aphasia and for those with an intellectual disability. Amer-Ind was initially devised by Madge Skelly (Skelly, 1979; Skelly et al., 1974) and her colleagues to help meet the communication needs of patients who had undergone such surgical procedures as a glossectomy (removal of the tongue) or laryngectomy (removal of the larynx, which holds the vocal cords) as part of their cancer treatment. After Amer-Ind proved successful with these individuals, it was adapted for use with other groups of non-speaking persons.

The most extensive literature on the use of signs by individuals with aphasia or other severe communication disorders was compiled by Madge Skelly (1979). In this report, Skelly summarized the results of seven Amer-Ind training programs; altogether, 181 individuals participated. The report indicated that most of the participants were able to learn at least a limited number of signs and gestures, and that this enabled them to communicate their basic needs. Although one-half of them also acquired some speech skills, progress in this domain typically was much poorer. Unfortunately, wide differences across the various Amer-Ind training studies in treatment methods, duration of training, and characteristics of the participants make it difficult to reach more specific conclusions based on the report of the training studies' outcomes. For example, because no attempt was made to differentiate the various types of aphasia involved, it is not possible to predict the likely efficacy of sign-communication training for individuals presenting with different types of aphasia.

Two additional case studies of the acquisition of Amer-Ind signs and ASL signs (Heilman et al., 1979; Kirshner & Webb, 1981) have shown that at least some individuals with aphasia are able to combine signs. In both these cases, the participants acquired over one hundred different signs

and learned to produce short sign sequences. This ability to sequence or combine signs enabled the participants to transmit more complex messages than would have been possible using only single signs. This seems to indicate that at least some of the participants' syntactic skills were still present, even with the loss of speech.

Skelly and her colleagues used several criteria in selecting signs from the Plains Indian Sign Language lexicon to constitute the Amer-Ind vocabulary (Skelly, 1979). Each sign was chosen because it was deemed to be readily understood by the inexperienced viewer, of some practical present-day value, and relatively easy to produce. These are some of the same criteria used in selecting and developing signs for the Simplified Sign System. Some Amer-Ind signs subsequently were modified to make them easier to produce. In particular, a single-hand version was developed for use with the left hand by right hemiplegic (paralyzed) patients (Skelly et al., 1975). In addition, a small number of signs were created to help meet the needs of persons using modern technology. Altogether, 236 distinct signs make up the Amer-Ind core vocabulary.

Since publication of Skelly's book in 1979, investigators working with individuals with aphasia increasingly have opted to use Amer-Ind signs instead of those from a sign language used by Deaf persons. One reason frequently given for selecting Amer-Ind is that many of its signs are highly iconic or pantomimic. Persons unfamiliar with the Amer-Ind system typically are able to accurately guess the meanings of about half of the Amer-Ind signs they see (Campbell & Jackson, 1995; Daniloff, Lloyd, & Fristoe, 1983; Vanderheiden & Lloyd, 1986). This is a much higher rate of accuracy than what occurs when they are tested on the signs of ASL or other Deaf sign languages (in 1985, Lloyd, Loeding, and Doherty estimated that only about 10–15% of ASL signs were highly iconic or pantomimic). The highly iconic nature of many Amer-Ind signs may help explain the finding that these signs typically are more easily learned than ASL signs for the same word or concept (Fritelli & Daniloff, 1982). This iconic or pantomimic aspect of many Amer-Ind signs may also facilitate their acquisition by those who care for persons with aphasia.

In a related study, investigators examined whether ASL or Amer-Ind signs were more often recognized and more accurately imitated by individuals with aphasia (Daniloff et al., 1986). Amer-Ind signs

were found to be significantly easier both to recognize and to imitate. The investigators suggested that this outcome was largely the product of the greater motor coordination involved in the production of ASL signs than in the formation of Amer-Ind signs. Recall that in ASL, individual signs may have more than one movement (Stokoe et al., 1965). When examining which signs individuals with severe aphasia learned (Coelho & Duffy, 1986), motor complexity was found to have an impact on sign learning. The motor complexity of a sign is based on the number of movements contained in the sign, the particular location, handshape, and movement parameters used in the sign, and the spatial orientation of the sign. Those signs with a low or intermediate level of motor complexity were more frequently acquired than those signs with greater motor complexity.

Finally, it should be noted that there is a significant limitation to the Amer-Ind system. At 236 distinct signs, the overall size of the Amer-Ind lexicon is quite small in comparison with the many thousands of signs present in ASL and other sign languages used by Deaf persons and less than one-fourth the size of the initial Simplified Sign System lexicon. It is important to remember, though, that Amer-Ind is a communication strategy for individuals with moderate to severe language impairments and is not intended to be a full language. Nevertheless, Amer-Ind's limited vocabulary size is a serious constraining factor with regard to its more widespread adoption and use. Clinicians who adopt Amer-Ind for their clients may, if needed, create additional concepts through the process of combining or agglutinating two or more existing signs. For example, the concept *library* is conveyed by adding the sign for SHELTER or HOUSE to the sign for BOOK (Skelly et al., 1974). Although such combinations of signs noticeably increase the potential vocabulary size of Amer-Ind (and could also be used to increase the size of the Simplified Sign System lexicon), this process involves considerably more cognitive and motor skills on the part of the user and may be problematic for individuals with certain language or motor impairments.

Pantomime

Various investigators have suggested that one reason for the success of sign-communication interventions with some persons with aphasia has

been the pantomimic aspect of many manual signs. Certain investigators (Méthé, Huber, & Paradis, 1993; Sarno, 1998), moreover, have advanced the view that the areas in the brain that are involved in the processing of pantomime may have remained relatively intact in individuals with aphasia while their language-processing centers were severely damaged. Other investigators (e.g., Daniloff et al., 1986; Skelly, 1979) have claimed that it was the pantomimic or iconic nature of many manual signs that made them quite readily learned and particularly memorable for aphasic individuals. In light of this strong emphasis on pantomime processing in individuals with aphasia and the pantomimic aspect of many manual signs, we elected to explore this topic in more detail.

Examination of the pantomime abilities of adults with aphasia also has been seen as a way to test the hypothesis that aphasia is primarily a deficit in symbol processing. More specifically, proponents of this central symbolic deficit hypothesis of aphasia (Duffy & Duffy, 1981; Duffy, Duffy, & Pearson, 1975) have seen the language loss experienced by adults with aphasia as reflecting a more general deficit in symbolic representational skills rather than one limited to the domain of language.⁸ According to this approach, if such a central symbolic deficit did exist, then persons with aphasia likely would show noticeably poorer pantomime recognition skills when compared with brain-damaged individuals without aphasia and when compared with same-age individuals with intact abilities. In a study testing this hypothesis, aphasic participants as a group performed more poorly on pantomime recognition tasks than did participants from the other groups, lending some support to the central symbolic deficit hypothesis (Duffy et al., 1975). Additional support for this view came from a study of pantomimic gesture comprehension conducted by Gainotti and Lemmo (1976). These investigators had their research participants first view a simple pantomime and then identify the object to which it was related from among a set of three pictures. Additional pantomimes and sets of pictures were then presented. Nearly two-thirds of the participants with aphasia were depicted as failing to comprehend simple pantomimic gestures. These findings of deficits in pantomime

8 A person with a central symbolic deficit would have difficulty understanding and using various symbol forms such as words, musical notes, and insignia. Pantomimes, because they generally resemble and stand for objects, actions, and properties, could be viewed as symbolic forms as well.

processing often were seen as valid predictors of aphasic individuals' likely success (or lack of it) in intervention programs that relied on manual signs or gestures.

Because the Simplified Sign System we have developed and Amer-Ind both rely heavily on signs that are highly iconic or pantomimic, a substantial deficit in comprehending pantomimic gestures would appear to be a very negative indicator for the use of Simplified Signs or Amer-Ind signs with persons with aphasia. Perusal of Gainotti and Lemmo's results, however, suggests that the picture is not so bleak. Of the fifty-three aphasic individuals they tested, twenty made no errors on the test of gestural comprehension and another ten made only a single error. Although the remaining participants performed relatively poorly, one could argue that the majority were successful in comprehending pantomimic gestures (Christopoulou & Bonvillian, 1985). Indeed, Gainotti (1988) has recognized that deficits in pantomime comprehension skills affect only a percentage, although often a sizeable one, of individuals with aphasia. Gainotti wrote: "that pantomime comprehension disorders are observed only in a subgroup of aphasic patients can be explained by assuming that aphasia is a complex, multicomponent syndrome and that only one (or some) of these components are intimately linked to pantomime recognition impairment" (p. 138).

Another complicating factor that may have affected Gainotti and Lemmo's results was the fact that participants chose from a list of pictures instead of from a collection of real objects. In other words, some individuals may have trouble interpreting two-dimensional pictures and/or relating them to the pantomimic gestures demonstrated by investigators, whereas those same individuals may not have trouble interpreting and relating real objects to pantomimic gestures (Rothi, Mack, & Heilman, 1986). This observation makes analysis of pantomime comprehension results difficult, as one cannot be sure whether a participant had poor pantomime recognition skills, difficulty perceiving two-dimensional pictures, problems relating the two-dimensional, static pictures to moving gestures, or some combination of factors. Perhaps the conclusion one should draw from this study is that some persons with aphasia are relatively good at understanding pantomimic gestures and recognizing their

relationships to two-dimensional pictures, whereas others find some aspect of this task difficult.

In addition to difficulties with pantomime recognition, individuals with aphasia often have been reported to show marked deficits in pantomime expression. In general, those aphasic individuals with more severe verbal deficits typically scored lower on pantomime expression, with scores in this domain significantly correlated with their scores on pantomime recognition (Duffy & Duffy, 1981). These findings initially were interpreted as providing strong support for the view that the verbal deficits and pantomimic deficits present in individuals with aphasia were caused by a central symbolic deficit. Subsequent investigations, however, have revealed that the situation is a more complicated one. In addition to a central symbolic deficit, performance on pantomime recognition tasks evidently is affected by impairments in visual processing areas of the brain, and pantomime expression may be affected by the occurrence of limb apraxia (Duffy & Duffy, 1990). Difficulties in pantomime expression or production, moreover, may rest on aphasic participants' problems in selecting purposeful actions (Falchok et al., 2014) or in semantic processing more generally (Weiss et al., 2016). Aphasic individuals with predominantly phonological-processing impairments might not experience such pantomime production problems. Furthermore, individuals with apraxia show a particular deficit in the processing of sequential pantomimic actions (Weiss et al., 2008). This last finding may indicate that aphasic individuals with apraxia may be more successful in acquiring single-movement pantomimic gestures or iconic signs than they would be for more complex, multi-movement gestures or signs.

Thus far, the studies we have reviewed with regard to assessment of pantomime recognition ability, pantomime expression, and limb apraxia in individuals with aphasia have come from investigations that relied on formal testing of these abilities. Rose and Douglas (2003), however, questioned whether such results from standard tests of these abilities were actually indicative of aphasic individuals' spontaneous gestural performance in natural conversational settings. Rose and Douglas found that the presence of pantomimic deficits and limb apraxia in their participants (as determined from standard assessment tests) was not related to these individuals' production of pantomimic gestures in spontaneous communicative interactions. Apparently,

the demand characteristics of the formal testing situations did not accurately predict performance in more natural settings. Following up on those initial findings, additional studies (Sekine & Rose, 2013; Sekine et al., 2013) examined gesture use in conversational discourse in a large number of individuals with aphasia. The investigators found that their aphasic participants produced a higher proportion of gestures than did members of their comparison group, which consisted of healthy individuals. Moreover, many of the gestures produced by those participants with a Broca's aphasia were clearly iconic and meaning-laden, including pantomimes and number gestures. These findings show that some individuals with aphasia may make frequent use of iconic gestures and pantomime when in more natural communication settings (de Beer et al., 2017).

In a comparative study of a sixty-eight-year-old man with Wernicke's aphasia versus a healthy control group (van Nispen et al., 2014), the investigators noted that the man almost always gestured along with his production of speech (his speech was incomprehensible). This study involved both an object naming task and a story retelling task within two conditions: the use of co-speech gesture (called the verbal condition that enabled gesticulation) and the use of gestures without speech (called the pantomime condition). Naïve viewers were asked to watch silent videos of the aphasic man while he performed each task. After each stimulus, the viewer had to interpret the meaning of the aphasic man's gestures and select from one of two possible options. Results indicated that the man's comprehensibility on the object naming task was greater in the pantomime condition (i.e., no speech, only gestures), and his comprehensibility on the story retelling task was greater in the verbal condition (i.e., using co-speech gestures). In the pantomime condition for object naming, the researchers noted that he used shape gestures for most of the items whereas the control group generally used handling gestures (van Nispen et al., 2014). However, in the verbal condition (co-speech gesture) for object naming, the aphasic man tended to use deictic and handling gestures. These interesting results show that some persons with aphasia may prefer certain types of pantomimic gestures to others and the form or type of gestures they prefer may vary based on whether or not they accompany speech. Indeed, persons with aphasia often use shape or outline gestures to convey meaning when

communicating with others (Cocks et al., 2011, 2013; Mol, Krahmer, & van de Sandt-Koenderman, 2013). Finally, the ability of other people to understand such gestures may be somewhat dependent on the context in which they are used.

Overall, numerous investigations of the nonverbal cognitive abilities of persons with aphasia have shown wide ranges in performance across both the participants tested and the particular abilities examined (Gainotti, 1988). Often, persons with aphasia have significant deficits on tests of pantomime recognition and expression, but many other persons with aphasia perform satisfactorily on these tests. Furthermore, scores indicative of pantomimic deficits obtained from formal tests may not be related to aphasic individuals' production of pantomimic gestures in natural communication settings. In the future, it will be of interest to examine the interrelationships among scores on tests of pantomime recognition and expression, measures of severity of limb apraxia, the incidence of pantomimic gesturing in natural settings, and aphasic individuals' learning of Simplified Signs. How well an individual with aphasia learns signs from the Simplified Sign System might be predicted by his or her scores on one or more of these measures. Such an approach might be used to identify which individuals with aphasia are likely to benefit from sign training and teaching.

Predicting Sign Intervention Outcomes

Overall, the findings reviewed in this chapter indicate that a program that includes communicative gestures or manual sign-communication training and teaching may be a more successful intervention strategy with certain persons with aphasia than more traditional speech-based therapies. This outcome raises the question as to why this may occur. One interpretation is that manual signs may access abilities, such as pantomime and gesture, which may have remained relatively intact in contrast to more severely damaged linguistic centers (Méthé et al., 1993; Sarno, 1998; see also van Nispen et al., 2014). A therapist, through switching the communication mode to a visual and manual one, might effectively bypass an area of particular difficulty for a client, such as apraxia of speech. Moreover, if a person's spoken language difficulties stemmed primarily from problems in the processing of auditory-vocal

input, then the shift to manual signs would likely involve processing in different networks at a perceptual level, thus potentially avoiding an area of difficulty. Because many Amer-Ind (and Simplified Sign System) signs resemble the objects and actions for which they stand, such iconic signs may make only limited demands on an individual's memory and symbol-processing skills (Skelly, 1979). A second possibility that might account for the present findings of manual sign acquisition in some individuals with aphasia is that certain forms of learning or processing may recover more quickly than others. In these individuals, visual- and motor-processing skills may re-emerge faster and more completely than spoken language abilities. Another possible explanation for the success of sign intervention is that a therapist who teaches signs is able to mold and guide a person's hands and arms in the production of signs in a way that would not be possible in teaching speech. Finally, when some persons with aphasia observe the production of manual gestures or signs and then attempt to imitate these gestures, this process may aid the reassembly of damaged or incomplete neural networks, thus facilitating limb rehabilitation (Buccino, Solodkin, & Small, 2006).

Although the studies we have reviewed indicate that some individuals with severe aphasic impairments can make noticeable progress in learning to sign, it is important not to overstate the studies' outcomes. In many instances, the rate of sign acquisition by the participants was slow and the vocabularies attained relatively small in size (Kraat, 1990). The same lesion or injury that caused their initial communicative and language impairments may have adversely affected the persons' learning of manual signs as well. Some investigators have tried to identify which individuals with aphasia would be more likely to benefit from sign-communication training and teaching. The severity of an individual's aphasic impairment has been shown to be an important factor in predicting the outcome of this type of therapy (Coelho, 1990; Coelho & Duffy, 1987). More specifically, the number of signs that a participant acquired and whether that person learned to combine signs were strongly related to the severity of aphasic impairment. Persons with less severe aphasic impairments typically made much more progress learning to sign. In light of these findings, Coelho and Duffy (1987) advanced the view that there may be a threshold level of aphasic severity beyond which sign acquisition

is either very limited or negligible (but see de Ruiter, 2006 and de Ruiter & de Beer, 2013).

Neuro-imaging techniques, which have enabled clinicians to determine the location and extent of the brain damage that caused an individual's language loss, also have the potential to be used to determine which individuals with aphasia would be more likely to benefit from sign interventions. One study that used this approach (Anderson et al., 1992) found that two severely aphasic patients with damage or lesions in the left posterior temporal and parietal regions of the brain were much more successful in learning to communicate with ASL signs and fingerspelling than a severely aphasic patient with damage to most of her left temporal cortex.⁹ This study clearly shows that the location(s) of an individual's brain damage can have profound effects on that person's acquisition and use of manual signs. In light of the great strides that have been made in neuro-imaging techniques in recent decades, it is perplexing that more investigators have not probed the interrelationships between the locations of patients' brain injuries and their success in learning manual signs. If, in the future, systematic records were kept of the location and extent of different individuals' lesions and the outcome of sign-communication programs, then it should be possible to predict which persons would be more likely to benefit from such training.

An additional issue involved in evaluating the usefulness of different communication intervention approaches for persons with aphasia has come to light in another study (Pattee, Von Berg, & Ghezzi, 2006). That issue is participant preference. This study involved a middle-aged woman who had primary progressive aphasia as well as apraxia of speech.¹⁰ This woman was taught both to produce ASL signs and to use a text-to-speech alternative communication (or speech-generating) device. She made progress in both communication approaches. At the end of the study, she was asked to indicate her preferred mode of

9 The parietal lobe is a region of the brain involved with the sense of touch and the experience of one's body in space and movement. The temporal lobe is primarily involved in audition and language. The cortex refers to the outer layers of the cerebrum, the part of the brain responsible for most mental processes.

10 Primary progressive aphasia is a gradual deterioration of language functioning over a period of at least two years while other cognitive abilities remain largely intact. Apraxia of speech is a motor speech disorder that results in impaired speaking or an inability to speak.

communication. Her clear preference across all situations was signing; the alternative communication device just did not feel “normal” to her. As the meanings of most ASL signs are not apparent to most hearing persons this woman may come into contact with, it is possible that the more highly iconic Amer-Ind signs and Simplified Signs would have proved even more effective and been preferred as a communication approach.

A final concern that has been expressed about the outcomes of sign-communication programs for persons with aphasia is that these programs focused primarily on the acquisition of sign vocabulary within a discrete training setting. Although the participants in these programs typically acquired a number of signs, the results were not shown to generalize to functional use outside of the training settings (Jacobs et al., 2004). To overcome this limitation, sign-communication programs in the future should be designed to extend the training and teaching to a variety of settings, to include a number of communication partners, and to incorporate signing into the day’s naturally occurring routines.¹¹ If these procedures are followed, it is likely that the sign usage of persons with aphasia will be both more spontaneous and functionally useful.

Sign Facilitation of Spoken Language

For some individuals with aphasia, manual signs may constitute an effective alternative to speech as a primary means of communication (Rose, 2006). Manual signs, however, apparently can play another important role in aphasia therapy as a facilitator of spoken language (Rao, 2001). In some of the studies that examined the use of sign communication with persons with aphasia, oral language skills were reported to have improved along with sign-communication skills. This pattern occurred primarily when a therapist combined signed input with spoken words (Hoodin & Thompson, 1983; Kearns, Simmons, & Sisterhen, 1982). Some individuals with aphasia evidently benefit from

11 For more information on these approaches to facilitating sign use, see the “Recommendations for Enhancing the Sign-Learning Environment” section in Chapter 4 and the “Teaching Generalization and Spontaneous Communication Skills” section in Chapter 5, as well as the subsections “Use Environmental Cues or Contextual Information” and “Ensure a Positive Signing Environment” in Chapter 9 (under the “Guidelines for Using the Simplified Sign System” section).

the multimodal nature of this input (Rao & Horner, 1978; Rose, 2013; Skelly et al., 1974). Therefore, if one therapeutic goal is improved oral language skills, then therapists should strongly consider combining signs and communicative gestures with speech rather than using signs or speech alone.

Facilitation of verbal naming also may occur when nonfluent aphasic patients (that is, patients with hesitant, effortful, abbreviated speech; Broca's aphasia is one type of nonfluent aphasia) are instructed to produce communicative gestures with their more affected or impaired limb as they try to name or label pictures (Hanlon, Brown, & Gerstman, 1990). The more affected limb, usually the right arm and hand, is used because it is controlled by the same general area of the brain that controls speech. By focusing therapeutic intervention on the more affected arm, this limb may show greater improvement in its functioning. Enhanced action or motor functioning with the more affected limb often is associated with improvements in language abilities (Gauthier et al., 2008; Szaflarski et al., 2008). Improved word retrieval may also occur when aphasic participants simply observe others performing actions corresponding to the words to be retrieved (Marangolo et al., 2010) or by preactivation of the motor cortex through standing (Meinzer et al., 2011). This improvement across modalities may rest on the many interconnections between language and action systems in the brain (Pulvermüller & Berthier, 2008). Furthermore, in recent years, manual gestures and speech have come to be viewed by a number of investigators as an integrated system operating both in language production and language comprehension (Goldin-Meadow, 1998; Kelly, Özyürek, & Maris, 2010).

The improved spoken language skills present in some sign-trained individuals may be evidence of successful deblocking or cueing. In the aphasia treatment technique known as deblocking, a disturbed language function is paired with an intact or less impaired communication or language function (Benson & Ardila, 1996). The hope is that this systematic pairing, typically involving both receptive and expressive language tasks, will result in the more intact function having a positive effect on the more impaired function. In sign-communication deblocking therapy, a manual sign is paired with the spoken word for the same concept. For example, after learning an Amer-Ind sign for a particular

concept, a client would be trained to synchronize the appropriate movements of the mouth for the associated word while producing the Amer-Ind sign. A frequent outcome of this pairing of language modalities has been improved verbal expression or speech intelligibility (Code & Gaunt, 1986; Rosenbek, LaPointe, & Wertz, 1989; Skelly et al., 1974). This outcome may rest, in part, on the fact that the areas of the brain involved in speech production are near or adjacent to the areas of the brain involved in manual sign production. In some instances, the activation and use of one brain area apparently has a positive crossover effect on the other. (For additional discussion of how signing skills may help a person regain or improve spoken language skills, see the “Addressing Concerns about Sign-Communication Training and Teaching” section in Chapter 1 and the “Dispelling Myths” section of Chapter 5.)

In the aphasia treatment technique known as cueing, emphasis is placed primarily on the use of prompts or prestimulation to facilitate a person’s word retrieval or comprehension. Among the many possible cues that might be employed are pictures, letter tracing, manual signs, printed or written words, pantomime, object visualization, and pointing. Not all cues, however, are equally effective. In one study (Rose & Douglas, 2001), the production of iconic gestures resulted in significantly enhanced word naming abilities in half of the participants, whereas the use of other types of cues, such as pointing and visualization, did not have significant positive effects. In a second study (Pashek, 1997), cued naming was most effective when the participant’s verbal training also included the production of iconic gestures (mostly Amer-Ind signs). In light of these findings and others, Marshall (2006) advanced the view that for gestures to cue words effectively, the gestures need to have “language-like” properties. The transparency of meaning and relatively close correspondence with words often present in Amer-Ind and Simplified Sign System signs may make them good gestural cues for individuals with aphasia.

A recurring observation among investigators who have examined the effects of signs or iconic gestures on the spoken language production of individuals with aphasia is that this treatment approach often is quite effective with some participants while not benefiting others (Rose, 2010). In a pair of studies, Rose and her associates (Lanyon & Rose, 2009; Rose & Douglas, 2001) examined the participant characteristics

that were associated with successful use of iconic gesture production to resolve word retrieval difficulties. In both studies, it was the aphasic participants with predominantly phonological-level impairments who benefitted from using iconic gestures; facilitation effects of iconic gestures were not observed for the other participants. In the future, it will be important both to replicate this finding in additional participants and to try to determine if there are individuals with other forms of aphasic impairments who also would benefit from iconic gesture or sign-communication training and teaching.

What factor or factors might explain the improved spoken language skills of persons with aphasia when words are cued or paired with closely related iconic gestures or manual signs? One possibility is that because words and their corresponding signs (or iconic gestures) share lexical features, the activation provided by the manual or gestural modality may facilitate lexical retrieval of the spoken words (Krauss, Chen, & Gottesman, 2000). Another possibility is that the pairing of words and signs (or iconic gestures) activates related processes at the motor programming level. That is, in some individuals with aphasia, there might be cross-modal activation of the motor programming processes that underlie the subsequent production of spoken words. Of course, neither of these hypothesized processes may prove to be accurate explanations of a person's improved speech skills or both processes may be involved. Regardless, it is clear that improved spoken language skills often result when words and signs (or iconic gestures) are combined.

Finally, a recent investigation has shown that a person's motor system may play an important role in that individual's comprehension of spoken language (Willems et al., 2011). Although studies of the use of signs with persons with aphasia typically have focused on their language production, signed input may also play a role in facilitating their receptive language skills or language comprehension. Many individuals with aphasia have serious deficits in their comprehension or understanding of the spoken language produced by other people. If the communication partners of such individuals were to accompany their speech with signs that have clearly transparent meanings, then this approach might enhance their communicative effectiveness and be easier for persons with aphasia to understand (see Eggenberger et al., 2016). Furthermore, the combining of speech with signs (a process

known as simultaneous communication)¹² may sufficiently slow the communication partners' rate of speaking to make their speech input more intelligible to persons with receptive language difficulties (Hyde & Power, 1991; Wilbur & Petersen, 1998), thus providing the opportunity for the information to be more fully and accurately processed by them.

Acquired Childhood Aphasia and Landau-Kleffner Syndrome

Although we have focused most of our discussion in this chapter on the language loss of adults, children certainly are not immune to brain injuries that result in a language loss or deficit. In most cases, children who experience aphasia as a result of external brain trauma are relatively good candidates to recover or reacquire their spoken language skills (Loonen & Van Dongen, 1990; Martins, 2004; Van Dongen & Loonen, 1977). Not all children, however, are so fortunate. Consider the case report of Johnny (Brookner & Murphy, 1975). According to hospital records, Johnny was a typically developing four-year-old until he fell on a concrete step, striking his head. He failed to reacquire speech, was very aggressive, and repeatedly suffered from seizures. After an eighteen-month stay in the hospital, Johnny was transferred to a state institution for persons with an intellectual disability; he had a diagnosis of global aphasia (substantial damage to all aspects of language) and severe intellectual disability. There, his foster parents observed that many of Johnny's aggressive outbursts were associated with his unsuccessful attempts to communicate. As a result, the foster parents helped craft a very basic gestural communication system for Johnny. The use of this system appeared to alleviate some of his frustration.

At the age of fifteen, Johnny was introduced to sign language signs together with speech input. He made rapid progress manually, acquiring a vocabulary of 160 signs after only nine months. The complexity of his signing increased as well: he began to combine signs after an initial

12 We recommend that teachers and caregivers use a specific form of simultaneous communication known as key word signing when interacting with non-speaking individuals. In this technique, the teacher or caregiver signs the principal, information-bearing words of a sentence at the same time that the corresponding words are uttered. All words in the sentence are spoken, but only the most important ones are signed. Key word signing is discussed in more detail in Chapter 9.

period of using only single signs. Johnny's significantly increased ability to sign also appeared to assist his social development. Soon after joining the sign language program, his social behavior improved and his in-school temper tantrums ceased. While Johnny's sign acquisition is quite impressive, the relatively late onset of the sign-communication training makes one wonder what he might have been able to achieve if this training had started much earlier.

When the cause of a child's loss of language is an internal event such as an infectious disease (e.g., herpes encephalitis, tuberculous meningitis), a tumor, or a progressive disorder, the prospects for rapid reacquisition of speech often are not as good as they are for losses caused by strokes or by external traumas (Loonen & Van Dongen, 1990; Martins, 2004).¹³ Seizure activity also is associated with language loss or impairment in children. In some children who experience seizures, there is a nearly total loss of the ability to comprehend or produce spoken language. These seizures are believed to be localized primarily in cortical areas (outer layers) of the brain involved in speech-sound processing (Castillo et al., 2008). While their spoken language skills are seriously impaired, the nonverbal cognitive skills of most such children remain relatively intact. These children have the ability to learn and a desire to communicate despite serious auditory-processing difficulties.

Landau-Kleffner Syndrome

In acquired epileptic aphasia, also known as verbal auditory agnosia or Landau-Kleffner syndrome, children experience a severe and often prolonged loss of their receptive language skills (Landau & Kleffner, 1957; Pearl, Carrazana, & Holmes, 2001; Rapin et al., 1977; Stefanatos, 2011). Indeed, the children's difficulty in understanding spoken language and their deficits in the auditory processing of other sounds (e.g., environmental noises, music) may convey the impression that they are deaf. Typically, children with Landau-Kleffner syndrome first

13 In her study of acquired childhood aphasia, Martins (2004) reported that all nineteen of her patients who had become aphasic after suffering a stroke recovered their spoken language skills. This rate of recovery is much higher than that for adults. Kertesz (1979, 2000) reported that only around 25% of the sixty-seven adults he studied who became aphasic after suffering strokes regained enough language skills to be considered fully recovered. Another approximate 25% of this group made what Kertesz deemed a "good" outcome or recovery.

show a decline in their language comprehension;¹⁴ this is often followed by difficulties in oral expression, with mutism a frequent outcome (Campos & Guevara, 2007; Chapman, Stormont, & McCathren, 1998; Kaga, 1999; Kuriakose et al., 2012; Pearl et al., 2001; Soprano et al., 1994; Tharpe & Olson, 1994). These children may also show declines or impairments in their reading skills (Sieratzki et al., 2001). As their speech comprehension and production skills deteriorate, some individuals begin to rely more heavily on pointing and gesturing (Paquier, Van Dongen, & Loonen, 1992; Sharma, Sharma, & Yeolekar, 2011). Deficits in the auditory processing of speech sounds tend to persist longer or be more severe than impairments in the processing of environmental sounds, which improve at least somewhat with age (Doherty et al., 1999; Kaga, 1999; Korkman et al., 1998; Sieratzki et al., 2001). Along with their language-processing difficulties, children with Landau-Kleffner syndrome frequently are hyperactive, aggressive, have difficulty following lengthy verbal directions, and experience mood swings and attentional problems (Chapman et al., 1998; Cockerell, Bølling, & Nakken, 2011; Korkman et al., 1998; Kuriakose et al., 2012; Sharma et al., 2011).

The age of onset of Landau-Kleffner syndrome occurs between eighteen months and fourteen years of age (Stefanatos, 2011). About 75% of these cases start when the children are between the ages of three and seven years. In general, the younger the child at syndrome onset, the poorer the prognosis for eventual spoken language development (Bishop, 1985; Chapman et al., 1998; Pearl et al., 2001). As with many forms of language disturbance, the syndrome occurs more frequently in boys than girls (Pearl et al., 2001; Woll & Sieratzki, 2019).¹⁵ The long-term outcomes for individuals with Landau-Kleffner syndrome are quite variable. In one large-scale study (Caraballo et al., 2014), eight of the twenty-nine participants eventually showed complete recovery from their language disturbances, while the remaining twenty-one continued to evidence language and/or cognitive disturbances. These results are in line with other studies that show variable long-term outcomes

14 Some aspects of speech processing (e.g., understanding and production of prosodic features like intonation and syllables) may remain relatively intact in some individuals with Landau-Kleffner syndrome (Doherty et al., 1999; Korkman et al., 1998).

15 For exceptions to these general trends, see Robinson et al., 2001.

(Cockerell et al., 2011; Doherty et al., 1999; Duran et al., 2009; Kaga, 1999; Korkman et al., 1998; Woll & Sieratzki, 2019). Older children affected by Landau-Kleffner syndrome, children experiencing fluctuations in their speech skills, and children undergoing a shorter period of aphasia tend to recover more language functioning (Cockerell et al., 2011; Sharma et al., 2011).

Although most youngsters (about 70–85%) with Landau-Kleffner syndrome experience seizures at some point, these usually stop by the age of fifteen (but see Duran et al., 2009 for exceptions). Furthermore, some individuals do not have seizures but all show EEG abnormalities, some of which may persist (Campos & Guevara, 2007; Kuriakose et al., 2012; Pearl et al., 2001; Sharma et al., 2011; Tharpe & Olson, 1994). In some instances, seizures appear after disturbances in language development are already occurring. In the Carballo et al. (2014) study, two of the participants experienced language disturbances prior to their first seizures, and in seven other cases, their initial seizures occurred at the same time as the onset of their language disturbances. This pattern of language disturbances sometimes preceding, following, or co-occurring with initial seizure activity may indicate that there is a common etiological factor (e.g., autoimmune reaction, encephalitis, meningitis) behind both the language disturbance and the seizures (Campos & Guevara, 2007; Soprano et al., 1994). Another view is that the children's language difficulties may be the product of a special form of epilepsy (Deonna, 2000). Regardless, in the future, investigators may wish to carefully chart each participant's course and pattern of syndrome onset together with the drug regimen (typically anticonvulsants or corticosteroids), surgical interventions or medical therapies (Castillo et al., 2008), and the language therapy programs subsequently employed (Van Slyke, 2002). Although the cessation of seizure activity and/or the resumption of normal EEG patterns may have a positive effect on the reacquisition of both receptive and productive language functions, this effect may be gradual and linguistic deficits often remain (Korkman et al., 1998; Van Slyke, 2002). This outcome is probably the result of lasting damage in the primary auditory cortex (Castillo et al., 2008). If, however, the language functions affected by this damage are able to be assumed by other areas of the brain (perhaps in the unaffected hemisphere) through a

natural reorganization of neural pathways, better outcomes may result (Castillo et al., 2008).

In an important case study (Roulet Perez et al., 2001), a boy with acquired epileptic aphasia was taught to communicate quite effectively through a sign language. This boy began losing his speech comprehension and production skills when he was between the ages of three and four years. At the age of six, he was introduced to the vocabulary of Swiss-French Sign Language and at age seven began attending a school for deaf and for dysphasic students in Switzerland. In the ensuing years, he made rapid progress learning to sign, acquiring a substantial vocabulary and mature grammatical skills. Indeed, when this boy's sign proficiency was compared with that of a same-age congenitally deaf student, there was no clearly discernible difference in signing proficiency between them. This study showed that a youngster with acquired epileptic aphasia was capable of acquiring fluency in a sign language when placed in an environment that emphasized signing.

Although signing was this boy's preferred communication mode during his schooling, he made a great deal of progress in reacquiring speech skills. Progress in oral language development was quite slow at first, but increased with the help of speech therapy and auditory training. The investigators noted that signing did not compete with his spoken language development and may well have hastened his recovery of oral language. Meanwhile, this youngster was able to complete years of schooling while he was regaining his speech skills. While signing can result in significant gains in spoken communication skills, it should be noted that the specific technique of key word signing may not work as well with some persons with Landau-Kleffner syndrome because of auditory interference from the speech input (Woll & Sieratski, 2019). Such individuals may initially benefit more from signed input only and then be transitioned to both speech and signed input. In addition, the educational environment for a child with Landau-Kleffner syndrome should be adapted to that child's particular needs, a variety of language interventions may need to be employed, and adjustments should be made as the child's linguistic situation evolves (Chapman et al., 1998; Kuriakose et al., 2012; Vance, 1991; Van Slyke, 2002).

Other individuals with acquired epileptic aphasia or Landau-Kleffner syndrome in childhood also have learned to communicate

manually, and some have become quite adept in using a sign language or in fingerspelling (Cockerell et al., 2011; Deonna, Peter, & Ziegler, 1989; Deonna et al., 2009; Doherty et al., 1999; Ege & Mouridsen, 1998; Pullens et al., 2015; Rapin et al., 1977; Sieratzki et al., 2001; Tharpe & Olson, 1994; Vance, 1991; Woll & Morgan, 2012; Woll & Sieratski, 1996, 2019). These youngsters' acquisition of sign language skills indicates that the higher language areas in the brain involved in sign language processing were essentially spared, in contrast with those involved in speech processing (Gordon, 2004). In addition, the acquisition of signing skills evidently did not interfere with spoken language recovery in individuals with Landau-Kleffner syndrome, and may have facilitated it (Deonna et al., 2009). Despite the evidence of successful use of manual signs to facilitate the communication of children with Landau-Kleffner syndrome, the implementation of such sign-based programs may still be met with resistance by some family members who worry that learning to sign might impede their children's re-acquisition of speech (Deonna, 2000). Such concerns should be addressed at the time of a child's diagnosis so that parents can understand both the short-term and long-term benefits of sign intervention.

Children's successful use of signs to communicate also can prevent or decrease the behavioral difficulties often associated with the syndrome (Chapman et al., 1998; Deonna, 1991; Tharpe & Olson, 1994). Furthermore, by becoming adept or proficient at using a sign language, these youngsters may be able to make educational progress and to interact socially with members of a signing community. Because students with Landau-Kleffner syndrome can still hear, both family attitudes and legal restrictions may need to be overcome if they are to attend a school for deaf students. If placement in a school for deaf students is not an option, another alternative that should be explored would be to teach these youngsters to communicate through manual signs by utilizing the services of language therapists in local school systems or mainstream settings.

Developmental Language Disorder and Childhood Apraxia of Speech

Some hearing children experience a disorder in language and communication seemingly from birth onward without any clearly discernible cause (e.g., intellectual disability, brain trauma, autism spectrum disorder). These children often initially appear to be developing in a typical manner; it is only when the understanding and production of spoken language becomes important that a deficit becomes evident. Such children historically were diagnosed with developmental dysphasia. In later years, the more frequently used term became specific language impairment (SLI) (Hoff, 2009), although that term itself is in the process of being superseded by the umbrella term developmental language disorder (DLD) (Bishop, 2017).¹⁶ In comparison with typically developing children, children with DLD in most instances acquire early spoken language milestones at later ages (Botting, 2014; Rudolph & Leonard, 2016), and their rate of language acquisition is noticeably slowed.

A small number of children with developmental language disorder respond to environmental sounds and short verbal commands but fail to acquire even the rudiments of expressive spoken language. In light of their ability to process visual information and their relatively intact nonspeech-based cognitive skills, it should not be surprising to learn that some of these children spontaneously create their own gestural or manual sign-communication systems. These systems often begin with pointing and other basic communicative gestures and then progress to a more elaborate system of mime or to manual signs. A similar phenomenon of spontaneous development of a complex gestural communication system has not been reported for non-speaking children with autism spectrum disorder. Although it is not clear why some children with DLD create their own gesture or sign-communication

16 Bishop (2017) provides an analysis of the debate process on the CATALISE (Criteria and Terminology Applied to Language Impairments: Synthesizing the Evidence) project as its participants were trying to reach consensus on the diagnostic terminology to apply to unexplained language problems, and the criteria for distinguishing such problems from other conditions. Also of note in this paper are panelist concerns about the resulting impact of any such determination on the provision or exclusion of intervention services and the allocation of resources to children and families who could benefit from them.

systems and children with autism do not, it is likely that the relatively more intact cognitive, motor, and social interaction abilities of children with developmental dysphasia are important contributing factors.

Caparulo and Cohen (1977) provided a case study account of a young child with developmental dysphasia named Todd who acquired gestural and sign-communication skills. When they first observed him, four-year-old Todd communicated with his mother through a vocabulary of twenty signs, most of which referred to concrete objects. During the eight months he was observed, Todd acquired additional signs and spontaneously began to combine them. This enabled him to convey a range of semantic relations, thus expanding the scope of his communicative abilities. Although Todd's sign-communication skills were far behind those expected of children of Deaf parents of his age, the system he created with his mother clearly expanded his range of communication and facilitated his growth and development.

In a case study of a young boy whose speech was unrecognizable and who also experienced delays in his receptive language skills, the introduction of Signed Norwegian proved extremely helpful (von Tetzchner, 1984a). Signs were taught to him in a formal training session on a daily basis, other signs were taught during play, and he learned some signs through general exposure. The boy often vocalized sounds along with his production of signs; initially, these sounds were difficult to interpret. However, as he learned a sign, the sounds he produced started to resemble the spoken word equivalent. Signing thus provided a means for his parents and teachers to better interpret his vocalizations and provide him with appropriate linguistic feedback (von Tetzchner, 1984a). Shortly after learning to pronounce a spoken word, he typically stopped using the sign for that word. After six months of sign training, the child had improved dramatically on both his receptive and productive speech skills, was able to learn most words without the help of signs, and had noticeable improvements to his temper.

Some success in acquiring a lexicon of manual signs in children with congenital aphasia or developmental dysphasia also has been reported by Phillips (1973). Over a six-week period, she taught seventeen children, ranging in age from six to thirteen years, a vocabulary of signs used in the U.S. In addition to teaching manual signs, Phillips also assessed the children's degree of aphasic impairment. While she

reported that the children were able to acquire some facility in signing, their performance in the manual modality evidently was affected by their general language deficits (their degree of aphasic disturbance). That is, the children's proficiency in sign language was significantly related to their degree of aphasic impairment, with those children with lower levels of aphasic impairment showing greater proficiency in sign communication. This finding indicates that performance in the two language modalities of speech and sign are closely interrelated. A similar pattern of considerable impairment across modalities also was found in a recent study of gestural comprehension and production in children with developmental language disorder (Wray, Norbury, & Alcock, 2016). This finding of a breakdown in both spoken language and gestural communication provides additional support to the view that performance in both communication modalities is highly interrelated.

Although we have largely focused so far in this chapter on cases where language loss has been quite extensive or when little spoken language development has occurred, there are many more instances in which the disturbance in language is less severe. Many children identified with developmental language disorder communicate relatively effectively through speech, but begin to talk at a later age, have smaller vocabularies, exhibit deficits in grammatical and morphosyntactic skills, experience difficulties understanding complex utterances, and continue to show impairments in language relative to other abilities some years later (Bernstein Ratner, 2017; Bishop, 2006; Fey, Long, & Finestack, 2003; Haskill & Tyler, 2007; Tomblin et al., 1997; Tomblin et al., 2003). Most of these children are neither cognitively impaired nor hearing-impaired, have no clear evidence of brain dysfunction, and do not meet the criteria of autism spectrum disorder. Furthermore, the number of children who meet the diagnostic criteria for DLD is quite high, with estimates ranging from 5–7% of the population (Botting, 2014). As with most other language-related syndromes, the incidence is markedly higher among boys than girls (about 3:1).

There are also a large number of children who are identified between two and three years of age as "late talkers." This term is largely a descriptive one as many investigators feel that a diagnosis of developmental language disorder cannot be accurately made at this age. When these late-talking children have been followed

longitudinally, over 75% of them moved into the normal range for vocabulary, grammar, and discourse skills by the time they were in kindergarten (Paul & Roth, 2011). Although these late-talking toddlers clearly improved their language skills with increasing age in comparison with language norms, it should be noted that their language abilities continued to be well below their nonverbal abilities throughout adolescence (Rescorla, 2009).

Some of the children who are quite delayed or late in their development of spoken or expressive language skills also are delayed in their development of receptive language abilities. Those children who experience delays in both expressive and receptive language domains also use gestures less frequently and score lower on measures of symbolic comprehension than do children who have a delay in expressive language skills only (O'Neill & Chiat, 2015). Those children who have delays in the development of both receptive and expressive language abilities have largely been excluded from studies of late talkers. As a consequence, relatively little is known about the course of their language development and what approaches to communication might be more effective in fostering their progress.

Late-talking children and youngsters with developmental language disorder often appear to have patterns of learning different from those of typically developing youngsters. That is, many late-talking children and youngsters with DLD have better visual and spatial learning abilities than learning abilities based on spoken language (Camarata, 2014). These children apparently learn more by watching and doing than by listening. Some of these learning preferences may be rooted in differences in hemispheric processing. When young adults with DLD were tested, the clear majority (about 55%) showed right-hemispheric dominance for language and a sizeable minority (about 27%) showed their language function to be dispersed bilaterally (Whitehouse & Bishop, 2008). In contrast, the overwhelming majority of typically developing young adults show strong left-hemisphere dominance for language. These differing patterns of learning abilities and hemispheric processing among late-talking children and individuals with DLD may, in turn, underlie their selection of different educational and career paths that embrace more analytical activities (e.g., engineering, accounting).

For the large majority of hearing children with developmental language disorder who eventually acquire substantial spoken language skills, manual gestures may help them compensate to some extent for their early expressive spoken language difficulties. This may be seen in the higher proportion of gesture use in the communications of language-impaired children than in typically developing children (Evans, Alibali, & McNeil, 2001; Iverson & Braddock, 2011; see also von Tetzchner, 1984a). In particular, children with DLD tend to produce more iconic or representative gestures to replace words in their communications than do children in comparison groups (Blake et al., 2008). In a study of mother-child shared book reading (Lavelli, Barachetti, & Florit, 2015), children with DLD used more co-speech gestures, especially representative gestures, than did their typically developing age-mates. In addition, the children with DLD were more sensitive to their mothers' use of gestures or gestural cues in these book-reading experiences. Manual gestures also apparently serve to "boot strap language development" in hearing children with developmental language disorder in much the same fashion as gestures aid younger, typically developing children to communicate (Botting et al., 2010, p. 65). In addition, children with DLD appear to access information more effectively when it is conveyed through gesture than when it is conveyed through speech alone (Kirk, Pine, & Ryder, 2011).

Because developmental language disorder apparently transcends language modality and is evident in the signing of some deaf children, an intervention approach that simply focused on switching language input to a child with DLD from speech to sign language might not be effective in establishing full language abilities. In such a child, sign language may be paired with speech not only to increase his or her productive speech skills, but also as a way to increase his or her receptive speech skills. For a hearing child to be able to understand speech, that child must be able to receive the auditory signal, keep it in memory, and be able to discern patterns within the auditory sequence. For a typically developing child, this process occurs very quickly. Many children with developmental language disorder, however, have auditory-processing difficulties (Corriveau et al., 2007) or deficits in auditory-temporal processing (Alvarez et al., 2015; Tallal, 2003; Tallal, Miller, & Fitch, 1993; Tallal & Stark, 1981) and may need much more

time to accurately process the rapid sequences of sounds often present in speech.

In light of these concerns about some children's difficulties in rapid auditory-temporal processing, computer-based intervention programs were developed to improve these skills. Examinations of the outcomes of interventions using these computer-based programs (e.g., *Fast ForWord*®), however, have not provided evidence that these programs are effective language intervention approaches (Fey et al., 2010; Strong et al., 2011). Because combining manual signs with speech often slows a communication partner's rate of speaking (Hyde & Power, 1991; Wilbur & Petersen, 1998), some children with DLD may find speech input more intelligible when it is combined with manual signs. The use of iconic or representative signs together with speech may also facilitate such children's vocabulary development by making the meaning of many spoken words more transparent. Indeed, in some special classroom units for children with DLD, manual signing systems have been employed to support the children's learning (Conti-Ramsden & Botting, 2000).

Although hearing children with developmental language disorder experience difficulties across a wide range of expressive and receptive language skills, these children often have particular difficulty learning new words. This word-learning deficit results in a smaller vocabulary size and more limited word knowledge at a given age. Moreover, this vocabulary deficit emerges early in a child's life and continues at least into adulthood (Rice & Hoffman, 2015). Some children with DLD may need to hear a new word twice as often as their typically developing peers before gaining an understanding of that word's meaning. Similarly, many children with DLD also will need to practice saying a new word additional times before they are able to use it without assistance (Gray, 2003). In light of the importance of vocabulary knowledge for effective interpersonal communication and for reading comprehension, such deficits in word-learning abilities are a very serious concern for parents and educators.

What might account for these children's problems in learning new words? One view that has been advanced by a number of investigators is that many children with DLD have deficits in the phonological short-term memory component of their working memories (Archibald & Griebeling, 2016; Jackson, Leitao, & Claessen, 2016; Montgomery,

Magimairaj, & Finney, 2010). That is, the working memories of many children with DLD often hold significantly less verbal information than those of their typically developing same-age peers. This smaller size combined with less effective processing of verbal material might help explain why children with DLD have difficulty forming stable phonological representations of newly encountered words as well as their smaller vocabulary sizes overall. One possibility that might be explored in the future would be to pair to-be-learned spoken vocabulary items with corresponding iconic or representative manual signs. Because children with DLD have nonverbal skills in the normal range, such an approach of harnessing visual and motor skills with phonological-processing deficits might assist these children in building their vocabularies.

Finally, although the primary deficit of children with developmental language disorder is, by definition, language, they may have deficits in other domains as well. These deficits include attention control (Noterdaeme et al., 2001), motor control (with deficits in fine and gross motor skills) (Hill, 2001), and the ability to imitate body postures and hand movements (Marton, 2009). Moreover, a subgroup of children with DLD also shows deficits in visual-motor integration (Nicola & Watter, 2016). In contrast, children with DLD typically show age-appropriate visuospatial immediate memory skills (Archibald & Gathercole, 2006). It is possible that teaching these children to sign may facilitate their development of motor control and motor imitation skills, as well as increase their ability to pay attention by having them look at others when they sign.

Developmental Delays in Deaf Children's Signing

Despite hearing loss officially excluding children from a diagnosis of developmental language disorder, hearing children are not the only individuals who may experience a disruption in their developing linguistic skills. It should be noted that DLD appears to affect the language acquisition and processing of deaf children learning to sign in many of the same ways it affects hearing children learning to speak (Herman et al., 2014; Herman, Shield, & Morgan, 2019; Marshall, Denmark, & Morgan, 2006; Marshall & Morgan, 2016; Marshall et al.,

2013, 2015; Mason et al., 2010; Morgan, Herman, & Woll, 2007; Quinto-Pozos, Forber-Pratt, & Singleton, 2011; Woll & Morgan, 2012; see also Metz-Lutz et al., 1999). Analysis of the linguistic development of deaf children is particularly difficult because of a number of factors. First, since most deaf children are born to hearing parents who do not know sign language (Lu, Jones, & Morgan, 2016; Mitchell & Karchmer, 2004), deaf children are rarely exposed to sign language until they are older, unlike hearing children that are exposed to spoken language from birth (Marschark, 1997). This simple demographic fact means that unless hearing parents are immediately aware of their newborn's deafness, choose to learn a sign language, and teach it to their infant, he or she will not receive complete linguistic input in any modality, especially if his or her deafness is severe or profound. This situation of linguistic deprivation means that deaf children are often delayed in their sign language development in comparison to typically developing hearing children (Herman et al., 2019).

Furthermore, with the relatively recent emergence of sign language linguistics as a field, particularly in countries where sign languages lack official linguistic status, studies of the typical course of sign language acquisition in a specific sign language may not be available. When the typical course of language acquisition is not known, it is difficult to impossible to figure out how or if a child is diverging from age-related linguistic norms. Even if such information is known, there may not be any official, evidence-based sign language assessment instruments for that particular sign language or for more specific skill sets within that language (Herman et al., 2019; Quinto-Pozos et al., 2011; Woolfe et al., 2010; see also Haug, 2005 and Haug & Mann, 2008). These concerns, as well as other multiple compounding factors, make it difficult to determine whether deaf children learning a sign language are delayed in their development.

Non-word repetition tasks in hearing children often are a good indicator of developmental language disorder in spoken languages (Bishop, North, & Donlan, 1996; Chiat & Roy, 2008; Conti-Ramsden, 2003; Conti-Ramsden & Hesketh, 2003; Dollaghan & Campbell, 1998; Ebbels, Dockrell, & van der Lely, 2012; Herman et al., 2019; Reuterskiöld-Wagner, Sahlén, & Nyman, 2005), so some sign language researchers worked to develop a non-sign repetition task and tested it

on fifteen typically developing deaf children learning BSL (Marshall et al., 2006). The task involved variations in the complexity of the handshape and/or movement parameters of meaningless signs; the signs were phonologically possible but did not actually exist in BSL. Errors included producing the wrong handshape; using only one hand instead of two; changing, deleting, or adding a movement; performing internal and path movements consecutively rather than simultaneously; reversing the direction of the movement; and adding or deleting contact. In general, the greater the complexity of the sign, the more errors that were produced, and task performance tended to improve with age (Marshall et al., 2006). This task was later revised and tested on another ninety-one deaf children with no known language impairments (Mann et al., 2010). Results showed that the task was quite difficult and that deaf participants correctly repeated the non-signs with much less accuracy than hearing children repeated non-words (Marshall, Mann, & Morgan, 2011). Whereas non-word repetition tasks are indicative of DLD in hearing children, it appears that non-sign repetition tasks are hard for many typically developing deaf children and thus are not a clear diagnostic indicator of DLD in deaf populations.

One case study of a deaf five-year-old boy of deaf parents was conducted that found impairments in both the comprehension and production of certain aspects of British Sign Language (BSL) grammar (Morgan et al., 2007).¹⁷ Since both of the boy's parents were deaf, the child had been exposed to BSL from birth; therefore, his signing deficits could not be attributed to linguistic deprivation. He also did not have any cognitive impairments or intellectual disability that could have explained his signing difficulties. The researchers noted that he had particular problems with regard to negation, noun-verb distinctions, spatial verbs, and classifiers. His expressive language was delayed by about two years, thus supporting a diagnosis of developmental language

17 The early course of language acquisition in British Sign Language is relatively well known; norms for age of acquisition, familiarity, and iconicity for 300 BSL signs were developed (Vinson et al., 2008). In addition, an adapted version of the MacArthur-Bates Communicative Development Inventories (which is for hearing children, see Fenson et al., 1993, 1994) was tested for the assessment of vocabulary development in deaf children learning BSL (Woolfe et al., 2010) and one is also available for deaf children learning ASL (Anderson & Reilly, 2002). Finally, there are assessment instruments for both receptive BSL skills (Herman, Holmes, & Woll, 1999) and for productive BSL skills (Herman et al., 2004).

disorder (Morgan et al., 2007). In contrast to hearing individuals with DLD, this young boy did not have impairments in phonology or receptive vocabulary.

A later study by these and additional researchers focused on identifying and assessing a wider population of deaf children (including those with hearing parents and deaf parents) who were suspected of having delays in their BSL acquisition (Mason et al., 2010). All of the deaf children had been exposed to at least three years of sign language input. Out of a larger group of children that were referred to the study for assessment, thirteen were fully assessed and showed evidence of language impairment. Over half of the children had deficits in receptive BSL skills and all failed at least one aspect of productive BSL skills on a narrative task (content, structure, grammar). The distribution and severity of the impairments varied, a finding in line with results of developmental language disorder in hearing children learning a spoken language (Mason et al., 2010).

In a comparison study of eleven deaf children with developmental language disorder and eleven typically developing deaf children on a sentence repetition task in British Sign Language (Marshall et al., 2015), researchers found that the children with DLD were much less accurate overall than the control group. The DLD group also performed more poorly on specific measures of repetition of lexical items, sign order, sentence meaning, facial expression, and verb agreement. The fact that the deaf children with DLD in this study had trouble with signed sentence repetition is in line with findings of poor verbal sentence repetition in hearing children with DLD (Chiat et al., 2013; Contemori & Garraffa, 2010; Conti-Ramsden, Botting, & Faragher, 2001; Riches et al., 2010; Stokes et al., 2006). Another comparison study examined the narrative abilities of seventeen deaf children with DLD to seventeen typically developing deaf children in British Sign Language who watched a language-free video (Herman et al., 2014). When later describing the content of this video, the DLD group produced shorter, less structured, and grammatically simpler signed narratives than the group of typically developing deaf children. Once again, verb agreement or morphology was an area of particular difficulty for the children with DLD, as were classifiers, role shifting, and their ability to infer meanings from the video (Herman et al., 2014). Similar findings of impairment

in verbal narrative skills have resulted in this being seen as a marker of developmental language disorder in hearing children (Botting, 2002; Pearce, James, & McCormack, 2010; Reed et al., 2007; Wetherell, Botting, & Conti-Ramsden, 2007).

Finer distinctions between typically developing deaf children and deaf children with developmental language disorder have been observed in a study of semantic fluency (Marshall et al., 2013). In this study, twenty-two typically developing deaf signers and thirteen deaf signers with DLD (ten of the same participants from Mason et al., 2010's study) were tested on their ability to produce lists of different types of animals and food within a sixty-second time frame. Results from both the typically developing deaf signers and the deaf children with DLD were similar to results from semantic fluency tasks performed by typically developing hearing children (Marshall et al., 2013).¹⁸ These results imply that semantic fluency is not a key marker of DLD in deaf signing children. However, the deaf children with DLD were slower to respond initially and also displayed word-finding errors that the typically developing deaf group did not.

Finally, in an interview study of educators and language professionals who worked with deaf students learning American Sign Language (ASL), the participants discussed atypicalities in the signing of deaf children with whom they were familiar (Quinto-Pozos et al., 2011). Examples of such atypicalities included sign stuttering/repetition, lack of facial expressions, errors in the formational parameters of signs, failing to properly use space to set up referents, poor role-shifting, and leaving out necessary referential information such as the time, place, and people involved in a story (Quinto-Pozos et al., 2011). These professionals also noted the difficulty of distinguishing between normal errors that children made while learning to sign and errors that are more attributable to atypical development or a potential communication disorder. Standards for the identification of such errors and for comparison with typically developing populations were not widely available. Many times, the educators and speech-language therapists within a school had to develop their own tools for analysis and intervention with a child they

18 This similarity in findings supports the idea that the development and structure of deaf children's semantic sign networks is largely comparable to the development and structure of hearing children's semantic word networks.

suspected of having a developmental language disorder. Such concerns reveal that much work remains to be done in defining, assessing, and creating therapeutic interventions for developmental language disorder in deaf children. Moreover, it is possible that the incidence of DLD in deaf children is equal to or greater than the 5–7% incidence of DLD in hearing children (Mason et al., 2010; Morgan et al., 2007). In order to receive proper consideration of and support for linguistic interventions in deaf children, it will be important for the definition of DLD to evolve to include the experiences of deaf populations.

Childhood Apraxia of Speech

Some children experience substantial difficulty in their production and sequencing of speech sounds. These children evidently have deficits in the planning and programming of the movements underlying their speech but do not show neuromuscular deficits in general (Aziz et al., 2010). The term frequently used to identify this condition is childhood apraxia of speech, although the terms developmental apraxia of speech, childhood verbal apraxia (or dyspraxia), childhood dyspraxia (of speech), and developmental articulatory apraxia have been employed as well.¹⁹ The spoken language of children with apraxia of speech often is not intelligible, with inconsistency and variability of speech sound production underlying this problematic condition (Proctor, 2014). Childhood apraxia of speech frequently is viewed as being highly heritable; individuals with this disability often come from families where other members also manifest speech or language disorders (Lewis et al., 2004). Systematic efforts to determine a specific genetic cause of childhood apraxia of speech have not yet proved successful; indeed, the view is emerging that the syndrome has a complex heterogeneous genetic etiology (Peter et al., 2016). In addition to their speech difficulties, many youngsters with childhood apraxia of speech frequently have other impairments, such as an intellectual disability or autism spectrum disorder (Tierney et al., 2015). As a consequence, children with apraxia

19 When children get older and their apraxia of speech persists, their speech disorder is still considered childhood apraxia. This helps differentiate it from adult-acquired apraxia of speech. Adult-acquired apraxia of speech typically is the product of cerebrovascular accidents (strokes) or other brain trauma (Proctor, 2014).

of speech should be evaluated for these conditions as well. Academically, children with apraxia of speech also often experience difficulties in reading and other language arts areas (Beukelman & Mirenda, 2005; Davis, 2007).

Because the spoken language of many individuals with childhood apraxia of speech is largely unintelligible, they frequently participate in various augmentative and alternative communication programs. Selecting an effective communication program for these children, however, may prove difficult as they often are also identified as having a limb apraxia. This limb apraxia is evident in their difficulties with sequencing the motor movements of their hands and arms. Despite these impairments, some children respond well to interventions based on sign language or the manual alphabet. Other children may do better with communication boards or speech-generating devices. These various augmentative and alternative communication intervention approaches do not impede the children's progress in spoken language development and may even promote it (DeThorne et al., 2009). Additionally, with the children frequently more successful in their communicative interactions with others after intervention, they often show improvements in their behavior as well (Beukelman & Mirenda, 2005; Culp, 1989; Cumley & Swanson, 1999; Shelton & Garves, 1985).

Finally, Helfrich-Miller (1984, 1994) has reported promising results in reducing the frequency of articulation and phonemic sequencing errors in youngsters with childhood apraxia of speech by combining two different treatment approaches. More specifically, she combined Melodic Intonation Therapy, an approach often used with adults with aphasia, together with Signed English signs. In this combined approach, the verbal input to a child and the child's output would be slowed down and the rhythm and stress exaggerated. The signs were paired with spoken words because this procedure slowed both the rate of language presentation to each child and each child's rate of speaking, as well as helping to convey to each child the meanings of the words and phrases. In light of the promising results from this study and others using various augmentative and alternative communication approaches, it is hoped that larger and more systematic studies of the effectiveness of these approaches will be conducted in the future.

Concluding Remarks

After concentrating almost entirely on enhancing the often limited spoken language skills of individuals with aphasia, investigators in recent decades have expanded their focus to include the use of different non-oral approaches in fostering communication skills. Among the non-oral approaches that have shown some success are those that have used signs from various sign languages or sign systems. If persons with aphasia or developmental language disorder are able to acquire some signing skills, then that ability to communicate, regardless of language modality, should make their lives more fulfilling and considerably less frustrating. Additionally, the pairing of iconic manual signs with speech shows promise of facilitating spoken language development in some individuals.

Studies of manual sign learning in adults with aphasia have shown widely varying training outcomes among the studies' participants. Some participants have acquired substantial sign lexicons and learned to combine signs. Other participants have made only very modest gains in communication skills despite considerable investment of time and effort. Examination of these different studies and their participants reveal that there are at least several factors involved in successful sign learning by persons with aphasia. The type and severity of the aphasia affect sign learning, with the most severely impaired individuals typically making the most limited progress. The characteristics of a particular sign also affect its learning. A sign that is highly iconic and easy to form is likely to be learned more readily than a sign without such characteristics. The iconic nature and formational ease of many Simplified Sign System signs will likely make them relatively easier to learn than most signs from genuine sign languages. These characteristics should also make the signs easier to learn by children with aphasia, Landau-Kleffner syndrome, developmental language disorder, or apraxia of speech, not to mention the family members, friends, teachers, and medical staff with whom such individuals come into contact.

In fact, in recent years there has been growing recognition that hearing children and adults with full mental capacities might also benefit from learning and using manual signs. Some of the interest in this domain appeared to emerge after scholars began to discuss their findings about

signing in babies. Rather suddenly, many thousands of hearing babies of hearing parents were being taught to communicate through manual signs and gestures. Moreover, this interest has continued to expand; manual signs and gestures have come to be recognized as potential vehicles of instruction in fostering language and cognitive development more generally. We discuss this growing interest in and excitement about the use of manual signs and gestures to facilitate learning in the larger population in Chapter 7.