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Chapter 7.

SIGN LANGUAGE DEVELOPMENT IN DEAF CHILDREN WITH LANGUAGE IMPAIRMENTS AND AUTISM SPECTRUM DISORDERS

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INTRODUCTION

This chapter focuses on atypical patterns of sign language development in deaf[2] children. The issue is complicated by the need to differentiate between delays that are due to limited exposure to language, and delays due to health, educational or social difficulties**.** Sign language acquisition is often delayed in deaf children due to a variety of factors. Between 90-95% of deaf children are from hearing families (Mitchell and Karchmer, 2004). Although many such children eventually become proficient users of a sign language, they frequently experience delayed and impoverished sign language exposure at the crucial early stages of language development and throughout their school years, since hearing parents and professionals are often unable to provide fluent sign language, models (Lu, Jones & Morgan, 2016). Children raised in these environments can acquire some signing skills, and in extreme cases where no signs are used by parents, may even develop systematic, rule-governed gestural systems (Goldin Meadow, Mylander & Franklin, 2007). However, full mastery of the grammar, vocabulary and pragmatics of sign language is a challenge. By contrast, children raised in environments where sign is the first language (i.e., where one or both parents are deaf) typically follow the expected trajectory of development, unless they have an additional learning need.

Prevalence and type of additional needs

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[2] The term 'deaf' is used here to denote audiological deafness and any degree of hearing loss. When used with a capital D, it refers specifically to membership of the signing Deaf community.

Identification of deaf children with additional disabilities (DWD: Davis et al., 2010) includes diagnosis of the presence of hearing loss coupled with diagnosis of a further impairment. Estimates are calculated in two ways, either starting from the deaf population or starting from the relevant disability. Because children tend to be given a single primary diagnosis (i.e., deafness or another disability), it is necessary to collect both kinds of data.

Wiley and Meinzen-Derr (2012) estimated that 30% to 40% of children who are deaf have at least one additional disability, and that disability is more likely to be identified later in a deaf child than in a hearing child. However, recent estimates from the UK Consortium for the Research into Deaf Education (CRIDE, 2017) suggest this may be an overestimation, and that the figure is closer to 20%. The National Deaf Children's Society (NDCS, 2015) comments that overshadowing - the tendency of professionals to focus on only one aspect of a child's development and ignore others - is very common when diagnosing additional needs in deaf children. However, a cohort study of 180 deaf and hard of hearing children aged 3-5 years in Australia by Cupples et. al. (2018) found an overall rate of 39%. The most common additional needs in the tested subgroup of 67 children were: autism spectrum disorder (ASD) (9%), cerebral palsy (10.4%), developmental delay (22.4%), and visual impairment (13.4%). Over 37% of the children with developmental delays caused by syndromes, i.e. ASD and cerebral palsy, used speech alongside sign (Sign Supported English, SSE, using Auslan or Makaton signs), compared to the other children in the study, where the figure was just under 16%.

With regard to intellectual disabilities (IDs), Bruce and Borders (2015) quote a figure of 8.8% in a population of children who are deaf or hard of hearing, whereas Chilosi, et al., (2010) put the figure of cognitive neuromotor problems at 14%. Prematurity is the most frequent cause of hearing loss with ID (Knoors & Vervloed, 2011). This may be attributed to reduced mortality among very low birth weight and premature infants born prior to 25 weeks gestational age (Picard, 2004).Prevalence of reported hearing loss in the ID population as a whole varies according to age, aetiology and location (institution or community), but a study of nearly 10,000 individuals attending the Special Olympics from 2004-2011 (Herer, 2012) found a central tendency of around 24%, with sensorineural loss at 12.8% and conductive/mixed loss at 10.9%. Aetiologies of hearing loss with ID may be different from the aetiologies of deafness alone. For example, hereditary causes are twice as likely for individuals who are deaf than for individuals who are deaf with ID (Knoors & Vervloed, 2011). Down syndrome is an example of a genetic cause of ID and hearing loss. Around a quarter children may have permanent hearing loss, mostly bilateral, with up to a third experiencing transient losses (Nightengale et. al., 2017).

Another disability with a high prevalence of hearing loss is cerebral palsy (CP), with figures of 2-12% reported in the literature (NDCS, 2012). .Reid and her colleagues (2011) examined the records of over 700 children with CP in the state of Victoria between 1999 and 2004. %). Mild to moderate loss of 40% or less was reported for 7% of the group on the last test, and a severe loss of over 70dB for 3-4%. More recently, Weir and colleagues (2018) report a figure of 39% in over 900 children, for hearing loss greater than 15 dB HL at any threshold by pure tone or greater than 20 dB HL by soundfield audiometry. The most frequent types were conductive (65%) or mixed (48%) with sensorineural loss at 4%. In 23% of cases, loss was unspecified.

A further additional need is Developmental Language Disorder (DLD), previously termed Specific Language Impairment (SLI)[3], which refers to a persistent language disorder found in hearing children that is not the result of cognitive deficits (Bishop et. al, 2017). Although the term traditionally excluded children with any degree of hearing loss, recent research has identified the existence of language difficulties over and above those associated with deafness in signing deaf children (Quinto-Pozos, Forber-Pratt & Singleton, 2011; Mason et al., 2010).

Signing by deaf and hearing children with intellectual disabilities is described in several of the chapters of this volume. The remainder of the current chapter focuses on children with ASD and DLD, aiming to: -

(i) Explore the extent to which linguistic difficulties reported for each diagnostic category in the wider hearing population are also found among signing deaf children and which linguistic features are unique to sign language;

(ii) Discuss implications for interventions with each group.

[3] The term Developmental Language Disorders was officially adopted by an international panel in 2016; see http://www.rcslt.org/clinical_resources/language_disorder/overview. Accessed 15th July 2018.

SIGN LANGUAGE USE BY DEAF CHILDREN ON THE AUTISM SPECTRUM

ASD is a neurodevelopmental disorder affecting social communication and interaction and characterised by restricted interests and repetitive behaviors (APA, 2013). Estimates of the prevalence of ASD in deaf communities appear to be similar to that of the larger population (1 in 59: Baio et al., 2018; Szymanski et al., 2012). Conversely, individuals with ASD also appear to have a greater prevalence of hearing loss than that found in the general population (Carvill, 2001; Guardino, 2008; Rosenhall, Nordin, Sandström, Ahlsén, & Gillberg, 1999). Thus, there is a significant population of individuals who face co-morbid ASD and deafness. Early identification of ASD is key in order to begin early intervention and therapy, yet several factors render screening and diagnosis challenging. First, there is currently a lack of instruments designed for identifying ASD in deaf children, so children may be misidentified by tools designed for hearing children. Second, some symptoms of ASD may mimic hearing loss, or vice versa. For example, a child's inattentiveness to their name being called can be symptomatic of either hearing loss or ASD. Thus, clinicians must be aware of ASD-specific red flags (e.g., early lack of eye contact and joint attention, lack of pretend play; APA, 2013) to be able to perform a differential diagnosis (for more on this, see Szarkowski, Mood, Shield, Wiley, & Yoshinaga-Itano, 2014).

Though challenges with language are no longer considered a core feature of ASD, language is often atypical, for both hearing and deaf children alike. In recent years a number of studies have started to examine the language abilities of a group of native sign-exposed children with ASD (Bhat, Srinivasan, Woxholdt, & Shield, 2016; Denmark, Atkinson, Campbell, and Swettenham, 2014; Shield, 2014; Shield, Cooley, & Meier, 2017; Shield & Meier, 2012; Shield, Meier, & Tager-Flusberg, 2015; Shield, Pyers, Martin, & Tager-Flusberg, 2016). These studies represent the first attempts to understand the effects of ASD on sign language acquisition without the confounding factor of language deprivation, which can occur with deaf children of hearing parents, and the symptoms of which can also mimic ASD. The major findings of these studies are outlined in the sections below.

Language comprehension and related cognitive skills

The autism spectrum spans a wide range of intellectual and lingujstic ability, with some youngsters exhibiting fully fluent expressive language while others remain minimally verbal (see Chapter 6, this volume). The diagnosis of ASD does not entail language impairment *per se*; however, the social challenges associated with ASD can affect children's abilities to acquire language. For example, the ability to follow eye gaze in order to understand the meanings of new words is an important skill in word learning, yet children with ASD often have difficulty engaging in episodes of joint attention (Curcio, 1978; Leekam & Ramsden, 2006; Loveland & Landry, 1986; Mundy, Sigman, Ungerer, & Sherman, 1986) and deducing word meanings in such contexts (Baron-Cohen, Baldwin, & Crowson, 1997). Impairments in such social skills can thus have long-lasting effects on language acquisition, be it signed or spoken. For example, despite the fact that the twenty or so children with ASD in Shield and colleagues' samples were all exposed to American Sign Language (ASL) from birth by Deaf parents, their receptive language skills were significantly below that of an age- and IQ-matched group of typically-developing deaf children, as measured by performance on the ASL Receptive Skills Test (Enns, Zimmer, Boudreault, Rabu, & Broszeit, 2013). This suggests two possibilities: (1) that deaf children with ASD can struggle with language acquisition, even under optimal conditions (i.e. with Deaf signing parents), and/or (2) that deaf children with ASD but without co-morbid language impairment are currently under-identified. More studies with larger samples are needed to verify these findings. Furthermore, as with all deaf children, it is essential that children receive an adequate amount of accessible language exposure (i.e., sign language and/or amplification to gain access to spoken language), to ensure that they are not language-deprived. Children should be exposed to language (signed and/or spoken) as early as possible in a form that they are able to perceive, so as to be able to develop language on a typical trajectory.

In addition to deficits in receptive language, Shield et al. (2016) investigated whether social and cognitive skills thought to be related to language acquisition (theory of mind, the ability to impute mental

states to others, and visual perspective-taking, the ability to understand the differing perspectives of others) were impaired in native-exposed children with ASD. They found that the children with ASD (N=17) performed significantly more poorly than an age- and IQ-matched group of neurotypical deaf children (N=18) on both theory of mind and visual perspective-taking, despite the fact that both tasks were rendered minimally verbal. Interestingly, both groups performed equally on a purely spatial task (mental rotation), suggesting that the ASD group had a specific challenge with social cognition. Receptive language skills were strongly correlated with performance on these tasks. It is important to note that visual perspective-taking is particularly important for sign language learners. Since signers typically face each other, they rarely share the same visual perspective, and thus signers must learn to take the visual perspectives of others in order to fully understand what is being communicated.

A related issue has to do with the ability to glean linguistic and affective information from the face. Signed languages use facial expressions to signal a variety of linguistic structures, including questions (e.g., with raised or furrowed eyebrows; Baker, 1983), relative clauses (Liddell, 1978), conditionals (Liddell, 1986), topics (Coulter, 1979), and adverbial or lexical information (Anderson & Reilly, 1998). Yet individuals with ASD have difficulty looking at faces, especially eyes (Dawson, Webb, & McPartland, 2005; Klin et al., 1999; Schultz et al., 2003; Spezio, Adolphs, Hurley, & Piven, 2007), as well as in understanding the information communicated by facial expressions (Baron-Cohen et al., 1997; Baron-Cohen, Spitz, & Cross, 1993; Capps, Yirmiya, & Sigman, 1992; Grossman & Tager-Flusberg, 2008; Lacroix, Guidetti, Rogé, & Reilly, 2009; Rump, Giovannelli, Minshew, & Strauss, 2009). Few studies to-date have investigated the ability of deaf children with ASD to comprehend the linguistic uses of the face entailed in signed language. In the only published study on the subject, Denmark et al. (2014) found that a group of British deaf native signing children with ASD were worse than a control group of neurotypical deaf children at recognising emotions transmitted by facial expressions. However, in her earlier dissertation, Denmark (2011) found that a group of 13 deaf British children with ASD did *not* show a particular impairment in either comprehension or production of linguistic and affective facial expressions compared to a control group of 12 age-, IQ-, and language-matched deaf neurotypical children. Thus it is possible that when controlling for overall language abilities, the face-processing abilities of deaf children with ASD are not significantly impacted. Nonetheless more research is needed to fully understand how deaf signers with ASD are able to comprehend facial expressions employed in signed languages. One important unanswered question is whether or not sign language exposure could mitigate the challenges in face processing associated with ASD due to repeated long-term practice with gleaning information from the face.

Language production

Shield and colleagues have also described several interesting phenomena which distinguish the signing of deaf children with ASD from the signing of their peers. First, Shield and Meier (2012) documented a unique production error in the signing of four native signing children with ASD. These children tended to produce certain signs (especially fingerspelled letters) with a reversed palm orientation, such that signs appeared “backwards” from their citation form. Shield and Meier hypothesised that such a unique way of producing signs could be reflective of challenges with visual perspective-taking, though they have since revised their hypothesis to acknowledge that children and adults with ASD may approach the task of imitating signs and gestures differently from neurotypicals, resulting in these reversed palm orientations (Shield & Meier, 2018). It is important to note that not all deaf children with ASD make these reversals, and that the prevalence of this phenomenon is currently unknown. However, the receptive language skills of the children who produced the reversals were lower than the children with ASD who did not produce the reversals as well as a control group of neurotypical deaf children (none of whom produced the reversals).

In a later study, Shield, Cooley, and Meier (2017) documented sign language echolalia in seven deaf children with ASD. Like hearing children with ASD, these children tended to repeat the utterances of others in ways that were considered conversationally inappropriate. This study makes it clear that echolalia is not restricted to speech and that deaf, signing children with ASD also sometimes produce echoes. As with the palm reversals, the echolalic children had significantly lower receptive language scores than did either non-echolalic children with ASD (N=10) or a group of age- and IQ-matched neurotypical deaf children (N=18), suggesting that echolalia tends to occur in children who have overall poorer language skills.

Abnormal use of personal pronouns (such as the words *you* and *me* in English) have long been noted in the mainstream ASD literature (e.g., Kanner, 1943), and recent work suggests that this is also the case for some deaf children with ASD. Shield, Meier, and Tager-Flusberg (2015) studied the use of sign language pronouns by a group of native-sign-exposed children with ASD. They found that significantly fewer children with ASD used the ASL pronouns YOU and ME (which are indexical points at addressee and self, respectively) in a picture-naming task than an age- and IQ-matched group of neurotypical deaf children, instead producing their name sign or a noun. The non-use of pronouns was correlated with lower receptive language abilities, and overall pointing ability was correlated with higher receptive language. These challenges with sign pronouns may reflect overall difficulties with pointing, as children with ASD often show decreased pointing behavior, especially to show and comment (Baron-Cohen, 1989; Mundy et al., 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997).

Motor challenges can also affect the signing of deaf children with ASD. Approximately 50–80% of children with ASD have motor deficits (Ament et al., 2015; Bhat, Landa, & Galloway, 2011; Green et al., 2009; McPhillips, Finlay, Bejerot, & Hanley, 2014), including impairments in reaching and walking (Jansiewicz et al., 2006; Mari, Castiello, Marks, Marraffa, & Prior, 2003), gross and fine motor incoordination (Ament et al., 2015; Biscaldi et al., 2014; Green et al., 2009), and praxis/motor planning (Gizzonio et al., 2015; Mostofsky et al., 2006; Rogers, Bennetto, McEvoy, & Pennington, 1996; Smith & Bryson, 1994, 2007). Bhat et al. (2016) studied how deaf children with (N=11) and without (N=11) ASD were able to execute a series of handshapes while fingerspelling English words. They found that the deaf children with ASD exhibited more errors in pace, sequence precision, accuracy, and body part use and also took longer to fingerspell each word. These motor errors were also correlated with poorer receptive language skills. Subsequently, Shield, Knapke, Henry, Srinivasan, and Bhat (2017) studied the ability of 30 deaf children of Deaf parents (16 neurotypicals and 14 with ASD), matched for chronological and mental age, to imitate simple manual gestures. In this study too, children with ASD produced more errors than the neurotypical deaf children on six of nine praxis dimensions coded, suggesting underlying deficits in motor control/coordination leading to dyspraxia. Motor errors were again strongly related to severity of ASD symptoms and receptive sign language scores. Children with such motor challenges may benefit from physical therapy.

Finally, it is important to note that some deaf children with ASD are minimally verbal (i.e., they produce fewer than 50 words or signs), even when they are raised in an optimal language environment (i.e., they are exposed to a sign language from birth). It is estimated that up to 30% of hearing children with ASD show minimal expressive language (Tager-Flusberg & Kasari, 2013). Shield et al. (2015) reported that six of 23 (26%) deaf children with ASD were not included in their pronoun study because they had such limited expressive sign language that they could not complete the tasks. There have been a few other mentions of minimally verbal deaf children of hearing parents (Jure, Rapin, & Tuchman, 1991; Meinzen-Derr et al., 2014; Roper, Arnold, & Monteiro, 2003), though language deprivation must always also be suspected if children are not adequately exposed to a signed language. It is also important to realise that there can be discrepancies between children's expressive and receptive abilities; some children who are minimally verbal may actually comprehend language quite well. For deaf children with ASD who are minimally verbal, the use of augmentative or alternative communication (AAC) systems such as the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) and others should be explored. One case study of the use of PECS with a 10-year-old minimally-verbal deaf child with ASD demonstrated improved communication and psychosocial outcomes after a 4-month PECS training intervention (Malandraki & Okalidou, 2007).

Interventions with signing deaf children with ASD

Very little published research exists on the subject of interventions for deaf children with ASD. Beals (2004) described her family's experience navigating early interventions with their son, diagnosed with deafness and ASD. She describes a system in which deaf children with ASD fall between the cracks of two early-intervention worlds, and little progress has been made in the years that have passed since the publication of her report. We suggest that interventions targeting joint attention and engagement may prove fruitful for use with deaf children with ASD, given the importance of these skills to visual communication. Targeted joint attention interventions have the potential to benefit language development, both in the short (Goods, Ishijima, Chang & Kasari, 2013; Kasari, Paparella, Freeman, & Jahromi, 2008) and long term (Kasari, Gulsrud, Freeman, Paparella, & Hellemann, 2012).

Children with ASD have challenges in areas other than language as well. For example, sensory sensitivities must always be considered. These can include sensitivities to light, sound (e.g. hyperacusis), and touch. Although deaf children are by definition less likely to suffer from sensitivity to sound than hearing children with ASD, they are equally likely to exhibit particular sensitivities to light and touch. Sensory sensitivities should therefore always be taken into consideration, especially when children exhibit behavioral difficulties.

Finally, deaf children with ASD may be isolated due to their challenges with social communication and interaction. Even typical deaf children are often linguistically and socially isolated, especially in mainstream contexts. Thus inclusion and social integration are crucial factors to consider when interacting with deaf children with ASD.

SIGN LANGUAGE IN DEAF CHILDREN WITH DEVELOPMENTAL LANGUAGE DISORDERS

Around 7% of hearing children have a language learning disorder, now referred to as DLD. DLD in hearing children is typically diagnosed by poor performance on standardised language assessments and based on comparisons with the language acquisition patterns of typically developing children. Identification of DLD in signing deaf children is a relatively recent phenomenon and has not been without its challenges.

First is the lack of standardised sign language assessments available for professionals to use, in order to determine children's level of development in sign and to characterise their language behaviours. Furthermore, professionals rarely possess the necessary range of specialised skills needed to conduct an assessment, hence teams must be assembled from multiple disciplines to bring the requisite skill mix and include native signers, who bring unique insights to the language assessment process. A further issue is that, although studies have shown that children with native exposure to sign achieve predictable milestones during language development, they represent a very small proportion of the deaf child population. For the majority, deaf children with hearing parents, studies have found serious and long-lasting effects of early language deprivation on their linguistic and communicative competence. There has been little attempt to tease apart whether these problems are caused by delayed exposure, a language learning disorder or both. Indeed, the distinction between delay and disorder is a very difficult one to make and is tied to how we assess children's signing skills. Finally, there remains an incomplete understanding of the adult sign language system (i.e. the target) with which to compare children's development.

Despite these challenges, there is some relatively recent research investigating DLD in British Sign Language (BSL: Morgan, Herman & Woll, 2007; Mason et al., 2010; Marshall et al., 2013; Marshall & Morgan, 2016; Herman et al., 2014) and ASL (Quinto-Pozos, Forber-Pratt and Singleton, 2011). Mason and colleagues (2010) estimated a prevalence rate for DLD in BSL of 6.4% based on the 13 deaf children they identified with language disorders in sign, out of a total of 203 deaf children attending the schools who responded to their initial questionnaire. Although this finding is based on a relatively small sample compared to studies of hearing children, the prevalence is similar to that reported by Tomblin et al. (1997) for the hearing population. The picture that has emerged from research to date is that DLD in a signed language looks very similar to DLD in spoken languages, in that comprehension or expressive language may be affected, and in some cases, both are compromised. Analysis of data collected using new measures indicates varying difficulties with sentence and discourse level language, including morphology and co-reference (Herman Rowley, Mason, & Morgan, 2014; Marshall et al., 2015). Below we present more detailed information on two areas: phonological abilities and narrative skills, and conclude with a discussion of intervention research.

Phonological abilities

As repetition of non-words is known to be sensitive to DLD in hearing children, the manual phonological abilities of deaf signing children with and without DLD were investigated using a test of non-sign repetition (Mann, Marshall, Mason & Morgan, 2010; Marshall, Denmark & Morgan, 2006; Mason et al., 2010). Non-signs are manual forms that fit the requirements for being signs but are not known as existing signs in a specific sign language (here, for BSL). There are no exact parallels between phonological complexity in spoken and signed languages, but the non-signs included in this test differed in whether they contained an unmarked or a marked handshape (markedness is defined as a sign which is

more difficult to articulate and perceptually complex, and predicted therefore to be more difficult to repeat). Non-signs also differed in whether they had a single movement (either path or internal movement) or a movement cluster (i.e. path plus internal movement, which again was predicted to be more difficult to repeat). An example of a BSL non-sign with a marked handshape but a single movement is shown across the two stills in figure 1.

----------INSERT FIGURE ONE HERE----------

In Morgan et al.'s (2007) case study of a native signer called Paul, the participant who had suspected DLD performed extremely poorly on the non-sign repetition test (see Woll & Morgan, 2012). Following this, a group of deaf signers with suspected DLD were later tested on the same measure to see if poor non-sign repetition could be a clinical marker for sign DLD (Mason et al., (2010). However, of the 13 children tested, only 5 demonstrated impaired non-sign repetition, where impaired performance was defined as a score lower than one standard deviation below the mean. These findings suggested that repeating non-signs may be a weak skill in only a subset of sign language users with DLD, as opposed to being a clinical marker as has been reported for spoken language DLD.

At first glance, the performance of this group of DLD children on the non-sign repetition task, on which the majority performed comparably to typically developing deaf controls, might appear to challenge the hypothesis that DLD is caused by a phonological short term memory deficit (Gathercole and Baddeley, 1990). However, the repetition of non-signs appears to be a difficult task even for typically developing deaf children (Marshall et al., 2011). One explanation for this difficulty is that the phonological content of a non-sign is less predictable than the phonological content of a spoken non-word, and therefore its retention in short term memory is cognitively more costly. An underlying reason is that signs in BSL may have fewer limiting constraints than spoken language words with respect to how their sub-lexical components can be combined. In a sense, there are more *degrees of freedom* for how sub-components combine in a sign than a word and this makes processing demands higher (Marshall et al., 2011).

A higher level of language organisation to explore is narrative production. In contrast to conventional language tests which elicit production and test comprehension using artificial tasks, narrative tasks provide a more naturalistic setting to examine children's language skills (Dockrell & Marshall, 2015). Because of the challenges posed to young children in constructing a coherent narrative, these tasks have been used to investigate patterns of DLD in spoken languages (e.g. Botting, 2002; Wetherell, Botting & Conti-Ramsden, 2007). English speaking children and adolescents with DLD have been reported to produce narratives similar to those of younger typically developing children (Merritt & Liles, 1987; Wetherell et al., 2007). For example, Marini, Tavano and Fabbro (2008) found that they produced narratives with less developed sentence structure and use of verb morphology, and that they had problems with the anaphoric use of pronouns.

Herman et al (2014) investigated the narrative skills of a group of 17 deaf children with sign DLD with a mean age of 10 years (range = 5;00–14;8). All children were from hearing parents and had been exposed to BSL before the age of 5 (mean years of exposure = 6;6, range = 3;8–9;0). This group was compared with a control group of 17 deaf child signers matched for age, gender, education, quantity and quality of language exposure and non-verbal intelligence. Children generated a narrative based on events in a language free video (the BSL Production Test, Herman et al., 2004) and narratives were analysed for global structure, information content and local level grammatical devices, especially verb morphology. The language-impaired group produced shorter narratives (mean 26 clauses) than the non-impaired signers (mean 45 clauses).

There were also significant differences in the structural quality of the narratives between groups. For example, at the start of the story good narrators typically set the scene, i.e., identify the main participants and objects. This is evident in a sample from a 12 year old deaf signer in the non-DLD group. 'CL' refers to classifier signs, 'LOC' are specific locations in sign space:

GIRL WALK-CARRY-TRAY (body movement indicating walking, using CL-HOLD-TRAY at the same time) ROLE SHIFT OH THERE (point to location of table) PUT-DOWN-TRAY (CL-HOLD-TRAY) ON TABLE HMM (strokes chin) WHICH FOOD BOWL (LOC-1) LOTS SWEETS LOC-2 (CLPLATE) SANDWICH LOC-3 (CL-PLATE) CAKE

"The girl carries in a tray of food and places it on a table nearby. She thinks to herself 'which bowl should I fill with sweets?' She puts the bowl over there, the plate of sandwiches here and the cake next to it".

In contrast, there is no scene setting or clarity in the next example, from a similar part of the story recounted by a 12 year old child in the DLD group:

WALK (the handshape used is unclear as the child uses two hands instead of one) SIT SIT (different locations to show two people) BOY LAZY HANDS-TOGETHER-
LEAN-HEAD-ON-SOFA (use of gesture to describe boy's actions) WATCH-TV (unclear
handshapes) HE DEMAND DEMAND (unclear articulation which looks like the sign DON'T-KNOW) GIRL WALK
"Comes in and they sit, the boy is sat lazily with his head back watching TV. He keeps asking for things and the girl goes over there".

In all components of the BSL narrative, children with DLD were worse than controls, i.e., semantic content and grammar, including use of classifiers and role-shift (see Herman et al, 2014 for more details).

Lastly in terms of pragmatic inferences, signing deaf children with DLD were weaker at demonstrating understanding of the motives of the characters in the stories. The researchers tested this by asking children to answer questions about the stories which required some inference making. For example, the last question on the test was: 'Why did the girl tease the boy'? The answer to this question is not supplied in the video stimuli but instead requires some perspective-taking abilities and touches on Theory of Mind. A correct response would be 'She wanted to surprise him' and an incorrect one would be something like 'The girl was naughty' which only gives superficial information on motivations of the characters. Scores for answering these questions, where the maximum is 6 points, were: DLD group mean 1.73 and control children: mean 3.25. Similar difficulties in inference making have been reported for children with DLD in spoken languages (e.g., Norbury & Bishop, 2003).

In summary, it appears that most children with sign language DLD do not sign in a deviant or unusual way. Instead, features of their language performance appear to be characteristic of children at a significantly younger age. Further analysis is needed to confirm this and to describe individual cases which eschew this pattern.

Interventions with signing deaf children with DLD

Although there is no "quick fix" for DLD in spoken languages, there is a growing evidence base of what works and what does not with respect to language interventions (Law et al., 2003; Law et al., 2012). Much of this research may be applicable to deaf children with DLD, however a key issue is how to deliver the intervention most effectively. Speech and language therapists, whose role it is to assess children and design interventions, rarely have the necessary level of fluency in sign, hence will often work closely with Deaf staff. In a UK study, Hoskin (2017) explored the role of Deaf practitioners who deliver language interventions in sign language to deaf children. She interviewed Deaf staff with varied backgrounds, training experience, roles and qualifications to find out how they worked with deaf children in their care. Through delivery of a training programme, Hoskin explored whether language therapy strategies and resources developed for spoken language could be adapted for language therapy in sign to bring about change to staff therapeutic skills, for the benefit of the children they work with. The study findings were that Deaf staff bring varying levels of skills, knowledge and confidence to their role, and face challenges in accessing information on language disorder and ways of intervening which affects their ability to be maximally effective. Participants identified a need for shared terminology to discuss language difficulties and interventions in English and BSL, and a shared framework for assessment, goal setting, therapy and evaluation. To improve outcomes for children with DLD, further work is needed to develop accessible information, resources, training and supervision to support Deaf staff and their speech and language therapy colleagues in this work.

CONCLUSIONS

Deaf children who sign may experience a range of additional difficulties that affect their communication. This chapter has focused on deaf signers with ASD and DLD, and identified how these disorders may affect children's communication in sign.

There is little research into interventions for signing deaf children with the additional difficulties described here, although communication intervention research with signing deaf children is available in other areas (e.g. Herman et al., 2015). The recommended methodology for evaluating the efficacy and effectiveness of interventions is the randomised control trial (Law et al., 2003), i.e. studies whereby children are randomly allocated to groups and where a comparison can be made between a group who receives the intervention and a group who does not. One of the challenges with this approach for the populations considered here is their low prevalence and heterogeneous nature, which precludes group studies. An alternative is the use of single case study design, or a series of case studies. Although generalisation from single cases is necessarily limited, they can be highly informative in providing detailed information on the delivery and outcomes of interventions and are the first step in developing an evidence base for particular approaches to intervention (Robey & Shultz, 1998).

There is a chronic need for research into sign language interventions for children with ASD and DLD. It is hoped that the initial work reported in this chapter will assist in this endeavour.

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