Deficits in narrative abilities in child British Sign Language users with specific language impairment.

RUNNING HEAD: Narratives in Sign Language SLI

Abstract

This study details the first ever investigation of narrative skills in a group of 17 deaf signing children who have been diagnosed with disorders in their British Sign Language development 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 were asked to generate a narrative, based on events in a language free video.

Narratives were analysed for global structure, information content and local level grammatical devices, especially verb morphology. The language-impaired group produced shorter, less structured and grammatically simpler narratives than controls, with verb morphology particularly impaired. Despite major differences in how sign and spoken languages are articulated, narrative is shown to be a reliable marker of language impairment across the modality boundaries.

Introduction

Specific Language Impairment (SLI) is a disorder characterized by a marked impairment in developing language, despite normal non-verbal IQ, neurological function, motor development, social interaction, no impairments in facial–oral structure and function and *normal hearing* (Leonard, 1998). It is estimated that around 7% of children in the general population have SLI (Tomblin, Records, Buckwater, Zhang, Smith & O'Brien, 1997) with a significant genetic contribution (Fisher & Scharff, 2009). While SLI is a heterogeneous disorder, deficits are most commonly reported for phonology and morphology, especially the rules of agreement, tense and marking of plurals (Bishop, North & Donlan, 1996; Rice & Wexler, 1996; Wetherell, Botting & Conti-Ramsden, 2007). Difficulties are also reported with pronouns and syntactic devices for sentence complementation (van der Lely, 1996).

Across different languages, SLI differs in relation to typological characteristics (Spanish: Bedore &Leonard, 2001; Italian: Bortolini, Caselli & Leonard, 1997; Hebrew: Dromi, Leonard, Adam & Zadunaisky-Ehrlich, 1999; and British Sign Language (BSL): Mason Rowley, Marshall, Atkinson, Herman, Woll & Morgan, 2010).

Broadly, if a grammatical feature is consistently marked in the language, children with SLI have less difficulty in that area. For example, there are marked differences in the verb agreement systems between Spanish, which has extensive and consistent verb morphological paradigms, and English which has very little verb morphology and also displays inconsistent patterns with these inflections. Consequently, children with SLI who are acquiring English have more difficulty mastering verb inflections than their peers who are acquiring Spanish (Bedore & Leonard, 2001).

For children with sign language SLI one particular difficulty identified at the sentence level of language in Mason et al., (2010) was person agreement and spatial verb morphology. In the current study we look at these same constructions but in multi-sentence contexts.

Narrative development in typically developing children and those with SLI

The production of connected sentences has been seen as a reliable marker of SLI in several languages, including among children who are deaf (Mason et al., 2010). Narratives have two levels of structure that children need to produce simultaneously. At the local level children are required to describe a single event or episode by use of personal and temporal references i.e. pronouns, connectives and tense and person markers. The second level of structure is at the global level. All narratives need a start, a middle and an end, as well as a message that is carried through the narrative which transcends the individual sequences of local level episodes. In laymen's terms this is 'the plot'. While describing local episodes clearly, children also have to advance the plot by keeping in focus an overall aim expressed through the linking of local events through a setting, an introduction of the characters through to a resolution or final outcome. It is extremely challenging for young typically developing children, and more so for children with SLI, to use their language to describe both levels simultaneously during a narrative. Children's ability to control both levels develops gradually over the early school years (Norbury & Bishop, 2003).

Pragmatic skills are also involved in understanding narratives, especially inference making. When children are processing the global level of narratives, they are required to use their pragmatic skills to understand motivations and consequences of actions which transcend the single event. Good narrative skills in production and comprehension are therefore important

for many aspects of academic learning, socio-emotional development and literacy. Thus understanding the development of this area of language in deaf children is an important topic.

In typical development, proto- stories emerge from the time young children combine words in order to reference non-present events. But children continue to refine their narrative skills through their teens and into adulthood (Berman & Slobin, 1994). Around age 4 years, children begin to use the global components of narrative – orientation (the mention of a place and time), complicating actions (the behaviour of characters, a climax and its resolution), plot evaluations and the sequencing of events (Trabasso & Stein, 1994). More complex narratives emerge from 5 years onwards and include the use of literate language commonly used by teachers and found in the curriculum (Westby, 2005).

During primary school, children integrate meta-cognitive verbs (e.g. think and know) into their narratives as theory of mind becomes consolidated and use more elaborate noun phrases and recursive sentences. These structures continue to develop into early adolescence and are essential for relating the hierarchical relationships between events in complex narrative productions (see Nippold & Scott, 2010 for a review). All of these later developments are used less frequently by children with language impairment (Greenhalgh & Strong, 2001).

This why narrative tests have been used to identify children with SLI in spoken languages (Botting, 2002; Wetherell et al., 2007; Reed et al., 2007; Pearce, James & McCormack, 2010;

Reed, Patchell, Coggins & Hand, 2010). These children often produce stories similar to younger typically developing children, e.g. Botting (2002) reported children with SLI produce shorter narratives than their age matched peers. Although there is some evidence that there are also qualitative differences between SLI and language matched controls.

At the local level, Wetherell, et al. (2007) described local level morphological errors by adolescents who were diagnosed with SLI, e.g. 'he looked unders his bed' and 'these massive like branch_'. The same authors also reported errors in global level reference, such as omitting subjects, e.g. '_ annoys the teacher'. Marini, Tavano & Frabbro (2008) found that Italian children aged 5-11 years old with SLI also produced narratives with less developed local level sentence structure, reduced verb morphology and had difficulties producing unambiguous anaphoric (global level) pronouns, e.g. as in the omission of subjects: '_ annoys the teacher'.

While Merritt and Liles (1987) and Wetherell et al., (2007) reported delays at the local and global levels of narrative in children with SLI, the evidence is somewhat contradictory across studies as to whether global structure is affected in different groups. Norbury and Bishop (2003) analysed narratives produced by children aged 6-10 years with autism (ASD), pragmatic language impairment (PLI) or SLI in comparison with typically developing (TD) controls. No differences between groups were reported for global story structure with all clinical groups expressing as much information as their TD peers but with semantically simpler vocabulary and simpler syntax. Inconsistent findings may arise because of differing methodologies between studies. Studies that have used picture books will allow children to describe in words what they see in front of them (Botting, 2002; Norbury & Bishop, 2003).

While children might get the local level grammatical information wrong, they may be able to label the global level information by using the picture book as a narrative scaffold. With respect to narrative comprehension, Bishop (1997) described children's answers to questions based on elements not explicitly mentioned in the story. Children with language impairments were more likely to be literal when responding to such questions, showing they had not understood the story's underlying message.

In summary, research shows that children with SLI carry over their difficulties with language in single sentences into their production of connected sentence narratives. There are two levels of developmental delay identified in children with SLI: problems using local level grammatical devices and control of the global level (plot) of the narrative. There are some mixed findings with this second level. It has been documented that children with SLI have difficulties with story grammar and the use of devices which connect sequences of events across sentences but not all studies find differences in how well children with SLI can build a global structure of the narrative (Norbury & Bishop, 2003). Connected to this global level, some studies have highlighted that generally children with SLI do less well at inference making (for a review see Liles, 1993; Liles, Duffy, Merritt & Purcell, 1995).

Sign languages are produced in the visual modality though the use of movement of signs in space and call upon local linguistic and global level devices that at face value are very different in form to those used in spoken languages. For this reason, it is possible that impairments in narrative development may be different to those described for hearing children. While sign languages are fully fledged languages they do share some similarities with non-linguistic gestures. Indeed, research on deaf children who use elaborated gesture systems – termed *homesign* - created in the absence of useable sign or spoken language input has revealed that some children can innovate aspects of narrative structure even without any formal language input. In their study, Morford & Goldin-Meadow (1997) showed that deaf children who used homesign were able to indicate the global structure of a story with an introduction leading to actions and conclusion. These findings offer the possibility that narrative production at the global level in the visual modality will be more robust in the face of linguistic impairments than those produced in spoken languages.

Sign Language: Acquisition and impairments

An exciting discovery in language acquisition research is that sign languages such as American Sign Language (ASL) or British Sign Language (BSL), used by deaf communities, are learned by deaf and hearing children of deaf parents in ways similar to spoken languages acquired by hearing children. First signs appear just before 12 months; two-sign combinations appear at 18-24 months; the 500-sign stage is reached by 36 months and grammar emerges between 2 and 3 years (see Chamberlain, Morford & Mayberry, 2000; Morgan & Woll, 2002; Schick, Marschark & Spencer 2006; Woolfe, Herman, Roy & Woll, 2010). Less is known about the acquisition of higher-level language such as local and global devices used in narratives (Morgan, 2005).

There has been substantial research carried out on the linguistic structures of BSL and how these are used by adult native signers (see Sutton-Spence & Woll, 1999 for more details). In the current study, three main BSL linguistic devices were studied in the narratives of the child participants: morphological markers of verb agreement, classifiers and 'role shift'. An example agreement verb is shown in figure 1. The sign moves across space between two previously set up locations in the narrative on the right and left of the signer to express who is doing what to whom. The same locations can be maintained across sentences and used for anaphoric reference.

INSERT FIGURE 1 HERE

Agreement inflections on verb signs emerge around 2 years of age and are mastered by the age of 3-4 years (Meier, 2002; Morgan, Herman & Woll, 2002; Morgan, Barriere &Woll,

2006). Classifiers describe the location or movement of a class of nouns (e.g. people, vehicles, animals) and are used for anaphoric reference. The classifier is a pronominal element that refers back to a previous referent. Their full interpretation, as in the agreement verb example, is dependent on previous mention of nouns. In figure 2, two objects are named in the preceding sentence (CAR and BRIDGE) and then located in sign space by the corresponding classifiers. The classifiers refer to their referents and thereby indicate how we are to interpret their relative spatial locations or movement.

INSERT FIGURE 2 HERE

In a small number of studies, it has been shown that young children use BSL classifiers appropriately around age 3-4 years but mastery of their use in narrative occurs later at 7-8 years (Morgan, 2005).

Finally 'role shift' is a device similar to reported speech in spoken language and conveys different perspectives in a narrative. In reported speech, a narrator introduces the words or thoughts of a character typically with 'and he said' and then follows this with some monologue, often in character, which is a verbatim report of that character's words. Signers exploit this option extensively in narratives and adopt features of characters in the narrative by the use of changes in body position and eye gaze to indicate shifts between different roles. In the development of BSL narrative, children aged 4-6 years old use role shift to refer to characters but sometimes have difficulty maintaining the separate identities of characters across sentences. Full use of role shift is acquired at 9-11 years of age (Morgan & Woll, 2003, and Loew, 1980 for ASL).

Language delays versus impairments

Most research is based on native signers but they comprise a small minority of the deaf population: less than 10% of deaf children are born to deaf parents who use sign language. The vast majority of children learn sign language beyond early childhood from their hearing parents who are themselves non-native learners (Marschark, 1997) or from fluent adult signers outside the family in schools with deaf signing staff, as well as from their peers. This means that many deaf children are at risk of developing limited fluency as a result of delayed exposure to sign language and as a consequence, differentiating language delay from language impairment is complex. When identifying deaf children with possible sign language SLI in comparison to their peers, it is therefore important to match for a range of variables including amount and quality of exposure to BSL. The approach taken in the current study was to compare deaf children suspected of SLI with their deaf same-age school peers who have experienced comparable quality and length of exposure to BSL.

To date there has been no reported research on narrative skills in deaf children with SLI in any sign language. The general aim of the study therefore is to investigate this level of language in close detail and compare how signing children with and without language impairments deal with the demands of narrative production. The SLI narrative research based on hearing children cited previously found difficulties in using verb morphology at the local level and in applying reference across sentences. We ask if the same difficulties will be apparent in the sign language narratives of a language impaired population. The current study can therefore contribute to debates about the core linguistic deficit in SLI by comparing narrative production in children with SLI who are acquiring language in another modality.

Specific hypotheses

Based on research on hearing children with SLI, this study asks if deaf signing children with language impairment will produce narratives with marked differences to those of carefully matched typically developing peers. At the local level it is predicted that there will be less use of grammatical morphology. At the global level we predict that signers with SLI will produce narratives that are less well constructed, contain fewer clauses and contain less instances of anaphoric reference across sentences. Finally the narratives produced by children with SLI will show less understanding of the plot and character motives compared to a matched typically developing group.

Method

Participants

Following ethical approval from the Psychology and Language Sciences committee at UCL, recruitment of deaf children with suspected language impairments in BSL was carried out by sending a questionnaire to 60 schools for deaf children and hearing impairment units in the UK that used sign language. Teachers were asked to identify severely-profoundly pre-lingual deaf children whose language development they considered to be below that of their same age peers, despite similar exposure to BSL and otherwise normal development.

Teachers were asked to provide information on the child's degree of hearing loss, type and use of amplification device and medical history (children with neurological impairments, head injury, or developmental disorders were excluded). Information on parental hearing status and the quantity and quality of exposure to sign language that each child had received was collected. This included age of first exposure to signing, the child's preferred means of

communication, spoken and signed languages used at home and at school, and numbers of fluent deaf and hearing signers at home and at school. No information was obtained about language development in English or academic achievement.

The questionnaire also contained a screening checklist of characteristics associated with SLI to facilitate teacher identification. As there was no precedent for sign language, a list of transferable characteristics of SLI was compiled from studies of spoken languages (as reviewed by Leonard, 1988; Leonard, 2009). Further details of the screening checklist and the recruitment process are presented in Herman, et al. (in press).

Language impaired (SLI) group: A group of 17 deaf children whose first language was BSL were recruited. These children had been identified through teacher and therapist referral as having persistent delays in BSL comprehension and production despite normal non-verbal performance. The mean age at testing was 10; (range 5;0-14;8). All children were described by their teachers as prelingually severely-profoundly deaf with no concerns other than language. Two were severely deaf, the remainder were profoundly deaf; 8 wore hearing aids, 8 were fitted with cochlear implants and 1 child wore no amplification. There were 10 boys and all children were from hearing families with differing levels of BSL ability. All children had been exposed to BSL before the age of 5 (mean years exposure 6;6, range 3;8-9;0). Five children attended schools for the deaf; the remainder attended hearing impaired resources within mainstream schools where they were exposed to BSL from fluent deaf and hearing models.

Typically developing (TD) group: We recruited a control group of 17 deaf children whose first language was BSL. They were matched to the SLI group for age, gender, hearing level, language exposure, family hearing status, type of school and normal non-verbal development through information provided by teachers. Nine children came from the same schools as the SLI participants so that they had an equivalent quantity and quality of exposure to BSL; 8 children were recruited as part of a separate study but were subject to the same matching criteria. Mean age at testing was 11;0 (range 7;2-13.0). Two were severely deaf, the remainder were profoundly deaf; all wore hearing aids. There were 11 boys; all children came from hearing families; all had been exposed to BSL before the age of 5 (mean years exposure 7;1, range 3;0-11;1). Five children attended schools for the deaf; the remainder attended hearing impaired resources within mainstream schools where they were exposed to BSL from fluent deaf and hearing models. Analyses indicated no significant differences between SLI and TD groups for age $t(32)= .198$, $p=.845$, or years exposure to BSL $t(28)=-.485$, $p=.632$.

As inclusionary criteria, children were assessed for their language comprehension, non-verbal abilities and motor skills. The language measure used was the BSL Receptive Skills Test (Herman, Holmes & Woll, 1999). This test measures comprehension of BSL morphosyntax based on children's responses to 40 pre-recorded signed sentences of increasing difficulty. Children respond by selecting the correct picture from a choice of three or four. The SLI group's mean standard score was significantly lower than that of the TD group, although there was a wide variation in scores within each group, especially the SLI group (see Table 1).

To confirm that these language difficulties among the SLI group were not due to non-verbal IQ, participants were tested using 3 subtests from the British Ability Scales (Elliot, Smith & McCulloch, 1996): matrices, pattern construction and recall of design. A mean standard score was calculated from the three non-verbal subtest scores. Taking a cut-off of -1.3, all SLI participants achieved z scores within the normal range (mean -0.446, SD 0.64, range -1.2-0.7).

To establish whether language production difficulties might be related to poor fine motor skills affecting hand and eye coordination, a timed standardised bead-threading task (White, Fisher, Geschwind, Scharff & Holy, 2006) was used. Children were timed twice as they threaded 15 large coloured beads on to a piece of string and the faster time was recorded. Scores were compared to data collected for typically developing deaf and hearing children reported in Mann, Marshall, Mason and Morgan (2010). All SLI children performed within the normal range using this measure (mean group score 1.09 mins, SD 0.39, range 0.45–1.52)

Procedure

Informed, written consent was obtained from parents prior to assessment. All children were assessed by a deaf native signer and a hearing fluent signer in their schools. Following non-verbal IQ and motor skills tasks, SLI and TD children were administered a range of language measures.

Language measures

Narrative samples were collected by all participants completing the BSL Production Test (Herman, Grove, Holmes, Morgan, Sutherland & Woll, 2004). This test assesses expressive

language in BSL based on a story telling task. Children view a two-minute film shown on a laptop featuring a boy and a girl acting out a series of events without communicating to each other in either signed or spoken language. Children are told beforehand that they will tell the story to a deaf native signer who has not seen the film. The child is able to watch the film a second time if they wish. At the end of the story production, children are asked three questions to check their overall understanding of the story and inference skills. Narratives produced by the participants and responses to questions are video recorded for later analysis.

Analysis of narrative samples: Scoring was based on spontaneous recall of the story without prompts, following the test administration guidelines (Herman et al., 2004). Narratives were first coded for number of clauses by counting events with a subject and a main verb. Next, children's narratives were scored for four aspects:

1. Narrative content: Children were awarded a point for explicit mention of each of 16 narrative episodes (maximum score = 16, see appendix 1).

2. *Narrative structure:* Using a high point analysis (Labov & Waltesky, 1967), narratives were scored for orientation, complicating actions (1 & 2), climax, resolution (1 or 2 points for each depending on the amount of detail provided), evaluation and sequence (1 point for each, maximum score = 12).

3. *BSL grammar:* correct use of 5 classes of morphological inflections (maximum score = 30, reflecting the number of different verb forms targeted and for role shift, the degree of mastery rated from 0-4 – see below):

- spatial verbs including classifiers (12 points), e.g. PERSON-GO-TABLE

- agreement verbs (4 points), e.g. SHE-GIVES-HIM

- manner inflections (5 points), e.g. CHEW-HUNGRILY

- aspectual inflections (5 points), e.g. TAKE-REPEATEDLY

- role shift (4 points), e.g. use of body orientation to identify each character

4. *Story comprehension and inferencing questions:* To check whether participants had an appreciation of the story message, three questions were asked concerning content and motivations of characters. Each question was allocated a maximum score of 2 points depending upon whether it was partially or fully correct (maximum total score = 6, see appendix 2).

Narrative performance was a composite score of these four aspects.

Reliability: An independent rater who was blind to participant group scored a 10% sample of narratives and there was over 90% agreement. For the small number of disagreements, the raters arrived at a consensus after discussion.

Results

BSL Production Test scores: The BSL Production Test provides percentiles rather than standard scores, therefore group means based on raw scores were used for analysis.

As can be seen in Table 1, in all areas, the SLI group produced significantly simpler narratives than the TD group with lower scores for content, narrative structure, BSL grammar and responses to questions.

INSERT TABLE 1 HERE

Discussion

To our knowledge, the current study represents the first ever description of narrative abilities in a rare group of children diagnosed with SLI in their sign language acquisition. We were fortunate in having access to language measures standardised for BSL to explore differences between children with SLI and their typically developing deaf peers. Children with SLI scored more poorly on standardised measures (the BSL Receptive Skills Test), despite normal non-verbal IQ and motor skills.

We found narrative development to be vulnerable in sign SLI. By comparing children with sign SLI to carefully matched typically developing peers, we were able to limit the likelihood that delayed and/or reduced language exposure was the sole reason for narrative difficulties. Previous research has suggested that hearing children with SLI have impaired abilities at the global and local level of narratives and this is borne out by the current data from SLI in BSL. These findings indicate that, regardless of language modality, language impairments lead to similar patterns of difficulties. They also support the value of narrative assessment as a diagnostic tool for children who use sign language.

The results of the current study extend previous descriptions of deaf children with sign language impairments in their nonsense sign repetition (Woll & Morgan, 2012), sentence repetition (Marshall, et al., submitted) and semantic fluency (Marshall et al., 2012), as well as compliment studies of children exposed to ASL (Quinto-Pozos et al., 2011).

Botting (2002) described hearing children with SLI as producing shorted narratives than their typically developing peers. In the current study the children with SLI signed fewer clauses overall than their peers. More interestingly than length, the SLI group had difficulty using all the local level grammatical features important for narrative, especially use of spatial locations for subject, object and location agreement across sentences.

Morphological inflections on verbs in BSL move between spatial locations to encode agreement (e.g. SHE-ASKS-HIM). Classifiers express pronominal as well as movement and spatial information simultaneously (e.g. CAR-MOVES-UNDER-BRIDGE). There is thus close similarity between deaf and hearing children with SLI for reduced abilities in dealing with morphologically rich words or signs (Bortolini et al., 1997; Dromi et al., 1999; Bedore & Leonard, 2001). Therefore language impairment in spoken and sign effects how informative and detailed children tell stories.

We did not observe any major qualitative differences in narratives between groups. The SLI group used a level of language characteristic of much younger signers. For example at the local level (BSL grammar) the SLI group did not consistently use the grammatical structures: verb agreement, classifiers and role shift. These BSL devices work by being associated with previous overt descriptions and particular parts of the sign space. For the children with language impairment space was often not set up during the introduction of the characters and thus could not be used subsequently by the children to refer back to with anaphoric pronouns or the movement of verb agreement. The children with SLI preferred generally to produce a linear sequence of predicates with uninflected signs, much like younger signing children, rather than exploit the option of grammatically richer signs and sign space.

At the global level the presence of each structural and pragmatic feature of the narratives was compared across the two groups. The SLI group achieved lower scores than the TD group on each aspect. Not all of these differences were statistically significant but those that were are crucial for interlocutors understanding of the general plot and for appreciating why certain events follow each other. The SLI group mentioned significantly less information about the climax, how the characters came to a resolution and offered far fewer evaluative comments which allow an interlocutor some understanding of the motivations of each character's actions. The SLI group's narratives missed key plot elements such as evaluative comments and information about how the end of the story was linked to preceding episodes. There were also differences in the SLI group's correct narrative sequencing but this did not reach statistical significance. Thus differences at the global level in the SLI group were in those crucial aspects of narrative production that require control of the overall packaging together of information which transcends the sentence level. This meant the interlocutor was forced to do more work in interpreting these narratives than those of the TD group. This quality of narrative production in the SLI group is characteristic of the signing of much younger children. The SLI group also answered fewer inference-requiring questions, indicating their understanding of underlying meaning was poorer than TD children.

We had suggested that the global level of narrative might be less demanding for children with language impairment in sign than in speech because of the overlap between signs and gestures. These non-linguistic gestures include using full-body mimes, pointing and using real world objects and spaces. Gesture–based communication systems are sometimes used successfully in conjunction with speech for hearing children with intellectual and spoken language difficulties (e.g. Grove & Walker, 1990). In previous research deaf children who use homesigns (systematic gestures) were able to tell rudimentary narratives (Morford & Goldin-Meadow, 1997). However, the potential overlap between gesture and sign did not

benefit the SLI group in the current study when retelling their narratives. The children in our study were exposed to BSL and their everyday communication was in that language. It was not the case that the SLI group were able to step out of the language and use gestures to compensate for their linguistic impairment. This finding underlines the difference between sign language and gestures. It also highlights again the specificity (to language) of the SLI disorder. By studying developmental sign disorders, unique insights can be gained concerning the core properties of language.

So why does impaired language effect narrative abilities? It is not clear if SLI leads to a failure to understand sequences of non-verbal events in the stimuli and/or whether SLI impacts negatively on internal monitoring during story telling. As mentioned in the introduction, research findings on global level impairments in children with SLI are inconsistent across studies, perhaps related to elicitation methods. The current study required children to generate a narrative from memory. Encoding events in verbal working memory for later recall is probably more demanding for children, as it involves accessing stored information and expressing it through the language devices available in the particular grammar (Slobin, 1996). Having a language system which is less efficient, as in the case of SLI, would mean children might encode narrative events poorly and as a consequence will have more difficulties with articulating the logical sequence of events when retelling the story (Ellis, Evans, & Hesketh, 1999).

Some research has suggested hearing children with SLI may have a shorter non-verbal spatial memory span (Bavin, Wilson, Maruff & Sleeman, 2005). The sign SLI group in the current study had normal NVIQ, yet were impaired in the use of spatial locations for achieving cohesion of reference at the global level. It is unknown if this group have more subtle differences in their memory for spatial arrays. The interaction of impaired language and memory abilities in signing children could be a useful area for future investigations, since

sign language users rely on intact visuo-spatial memory to anchor certain BSL linguistic devices. While in spoken languages subtle deficits might be focal in their effects, e.g. solely on the spatial prepositional system, in BSL these memory deficits would provoke more general problems across the grammar.

One other area for future exploration relates to the fact that all children who use BSL are developing bilinguals. It is not clear from the current study what effects English skills would have on BSL narratives. Despite our attempts at matching, there were differences between participants in their access to spoken language. Children in the TD group all used hearing aids, whereas this was true for only some of the SLI group, with half using cochlear implants and one child using no amplification at all. Since cochlear implants improve deaf children's access to spoken language, the SLI children with implants might be expected to have stronger bilingual skills than children with hearing aids. Research on bilingual hearing children with SLI has shown them to have difficulties in both of their languages (Genesee, Paradis & Crago, 2004). Conversely stronger skills in one language may protect impairments in the other language. Our findings suggest the SLI group have significant language difficulties in BSL, their preferred language, in spite of any advantages that a cochlear implant may convey for their speech.

Turning to clinical implications of our research, narrative skills are an integral part of language development, providing children with higher-level linguistic skills to comprehend and describe complex interlinked pieces of information. Narrative is also related to later literacy skills in hearing children (e.g. Nippold & Scott, 2010). Although there is no research documenting the relationship between BSL narrative development and reading in deaf children (Rathmann, Mann & Morgan, 2007), literacy skills are known to present a perennial problem for many deaf children. Further research exploring these areas is needed in deaf children with and without SLI. Narrative represents a rich area in which to study SLI and in

particular to compare the range of difficulties reported across different levels of linguistic organisation. Our study has contributed to this research and highlighted areas of narrative that signing children with SLI find challenging. This information will be of use to staff in schools whose job it is to assess deaf children's communication and develop interventions.

Narrative interventions have proved successful with hearing children (Joffe, 2012), however these cannot be simply translated into programmes for deaf children who use BSL. Signed narratives have their own structure and it is important that creators of narrative interventions keep this in mind. Design of BSL narrative interventions must involve language specialists and native sign language users working together to develop materials that enhance development of features unique to BSL narratives (Rathmann et al, 2007). There is still too little known about narrative development in deaf children acquiring BSL. Further research that details typical patterns of BSL narrative development with larger groups of deaf children of different ages is needed.

In addition, with more widespread use of cochlear implants and subsequent improvements in spoken language skills, it is also necessary to carry out investigations into deaf children's English narrative development. The link between expressive language skills in older children and their social-emotional and educational development has been documented for hearing children with SLI (Wetherell et al., 2007); future work is needed to address this area in deaf children who use BSL and/or English.

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Appendix 1: Story episodes

1. The girl brings in a tray of food and drink

2. The boy is watching TV.

3. The girl helps herself to sweets, which the boy demands (using an outstretched arm movement and an insistent facial expression) and she gives to him.

4. Episode 3) is repeated with a cake.

5. Episode 3) is repeated with a drink.

6. The girl sees a spider.

7. She tiptoes over to pick up the spider (whilst the boy continues to watch TV).

8. She makes a sandwich by placing the spider between two pieces of bread.

9. She pretends to eat the sandwich.

10. The boy demands the sandwich.

11. The girl hands over the sandwich to the boy.

12. The boy bites the sandwich (and realises there's a spider inside).

13. He takes the spider out of his mouth.

14. He chases the girl round the room.

15. He throws the spider at the girl.

16. Additional information provided, e.g. the boy is lazy or the spider is horrible

Appendix 2: Questions

1. What was on the tray?

Correct placement of two or more objects placed in different locations on the tray achieves a score of 2 points.

2. Why did the boy throw the spider?

Score one point for each idea expressed which is a correct response to the question, maximum score 2 points.

Examples of correct responses:

- He found a spider in his mouth
- The boy was angry
- The girl put a spider in the sandwich
- The girl laughed/was naughty/was teasing him
- He didn't like the spider
- He was playing about

Examples of incorrect responses:

- The boy was hungry
- It was dangerous
- He threw the spider

3. Why did the girl tease the boy?

Score one point for each idea expressed which is a correct response to the question, maximum score 2 points.

Examples of correct responses:

- She was fed-up
- The boy kept taking her food
- The boy was lazy/greedy
- The boy should get food himself
- She wanted to surprise him

Examples of incorrect responses:

- The girl was naughty/happy/hungry
- Because he doesn't know
- She laughed at the boy
- He ate the spider

Figures and tables

Figure 1. Agreement verb ‘he asks her’

Figure 2. Use of spatial verbs and classifiers to describe the movement of one object under another: ‘the car drove under the bridge’.

Table 1: SLI and TD group means on standardised language measures

Measure	**SLI group (n=17)**			**TD group (n=17)**			**t test**	
	Mean	**SD**	**Range**	**Mean**	**SD**	**Range**	**t(32)**	**p**
BSL Receptive Skills Test - standard scores	87.47	19.897	56-116	100.13	14.746	78-129	2.065	0.047
BSL Production Test - raw scores: Semantic content (max 16)	6.73	4.713	0-13	12.06	3.418	5-16	4.165	0.001
Responses to questions (max 6)	1.73	1.534	0-5	3.25	1.438	1-6	2.780	0.008
Narrative structure (max 12)	5.63	3.575	0-11	9.41	2.093	5-12	3.684	0.001
BSL grammar (max 30)	7.63	5.328	0-14	17.06	6.787	1-26	4.455	<0.001
Number of clauses produced	25.875	14.755	1-51	44.8	21.348	13-82	2.348	0.029