LANGUAGE IMPAIRMENTS IN SIGN LANGUAGE: BREAKTHROUGHS AND PUZZLES

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Abstract

Background: Specific Language Impairment (SLI) has previously solely been documented for children acquiring spoken languages despite informal reports of deaf children with possible sign language disorder.

Aims: This research evaluates current theories of SLI in light of cases of sign language impairment. Current explanations for SLI include deficits in processing the acoustic signal, phonological short-term memory and grammatical computation.

Methods: We report the case of a deaf child deaf exposed to British Sign Language (BSL) from birth with no cognitive or social impairments, with significant developmental deficits in the comprehension and production of BSL grammar but not phonology or vocabulary, based on formal assessment and linguistic analyses of his everyday sign communication in comparison with age matched unimpaired signers.

Results: We show that linguistic processing difficulties with BSL verb morphology underlie the child's poor performance compared with same-age native signers.

Conclusions: SLI in children exposed to a soundless language is not explainable by deficits in the auditory processing of the speech signal. The appearance of linguistic impairments in sign and spoken languages in comparable domains provides evidence that some types of SLI involve higher-level problems with the abstract representation of rules and grammar.

Key words: British Sign Language, Development, Disorder

Introduction

Specific language impairment (SLI) is diagnosed where a deficit in normal spoken language acquisition is found with no apparent cognitive, social or neurological cause (Leonard, 1998). Since hearing loss is specifically excluded in diagnosing SLI, deaf children are never included in studies of SLI. If the incidence of SLI is the same in children who are born deaf (or are the hearing offspring of deaf signing parents) as in the general population, then at least 5-7% of children learning sign language *will have* SLI (Leonard, 1998).

There has been little consideration whether a child exposed to sign language could have SLI (Woll et al, 2003; Morgan, 2005). However, with increased knowledge about sign language acquisition and differences between sign language, gesture, and artificial sign based communication systems (Morgan & Woll, 2002; Schick et al, 2006), including recent work on sign language assessment (Herman, et al, 1999, 2004), we are now in a better position to consider the question of whether sign language SLI does indeed exist.

The nature of SLI

One influential account of the origin of SLI argues for underlying low-level auditory processing problems. In this view, children with SLI have difficulty processing the temporal characteristics of rapidly changing acoustic signals of any sort, including speech sounds and non-verbal auditory signals (Tallal, 2000; but see

Bishop et al, 1999). This theory excludes the possibility of language impairment in a child exposed to a non-auditory language.

A second explanation focuses on a deficit in general cognitive resources required for dealing with language, in particular a reduced ability to store information in phonological short term memory (Gathercole & Baddeley, 1990; Ellis-Weismer et al, 1999). A poor working memory will constrain the development of speech, which depends heavily on phonological storage capacity. Both the auditory processing and working memory models are cognitive accounts and differ from a third approach. This model lays claims to a deficit specific to grammatical aspects of language (including phonological grammar) and independent of non-linguistic skills (Bishop et al 1999; Bishop, et al 2000).

Sign language overview

Grammar

BSL has a complex internal morphology that packs many morphemes into a single unit. Grammatical markers function via agreement with particular positions in space. BSL uses space to tie pronouns and noun phrases to their dependent referents and verb arguments, thereby indicating who did what to whom (Sutton-Spence & Woll, 1999). Sign languages also exploit polymorphemic structures that resemble noun classifiers in spoken language (Emmorey, 2003). Because signing is slower than speaking, grammatical devices are often articulated across both hands and the face simultaneously, rather than in a sequence of words as in a spoken language sentence. Classifiers (CL) represent classes of nouns (e.g. flat objects, humans,

animals, stick-like objects, etc.) In the sentence shown in figure 1, the handshape on the signer's right hand represents the class of flat objects to which the noun 'car' belongs; the second hand CL encodes the position of the second noun (the bridge). The movement of the hand encodes the meaning of the verb location and path. This construction is glossed: CL (car)-MOVE-UNDER-IN-STRAIGHT-LINE-CL (bridge) 'the car goes under the bridge'. The verb contains 4 morphemes: the two objects, the location 'under' and the path 'straight-line' (see Emmorey, 2003 for more information)

--insert figure 1 here --

Acquisition

Infants exposed to sign language from birth babble with their hands at the same age as vocal babble emerges (6-12 months). The first 10 signs are produced around 12 months of age, and the 50 sign milestone is recorded from 24 months onward (Mayberry & Squires, in press). Children combine signs from 18-24 months and use uninflected noun and verb forms. Following the two-sign stage, children begin to use more complex aspects of sign language grammar: the location and movement of signs in space to express linguistic relations, and a rich set of morphological markers. Children make 'creative' errors as they attempt to identify morphological regularities, overgeneralising inflections to other verb types (Morgan et al, 2002).

By age 5;0 – 6;0 children can select the appropriate handshapes for different classes of objects and start to distinguish the beginning and end locations of actions in verbs of motion and location (Mayberry & Squires, in press).

Atypical development of BSL

The study of sign language impairments must be placed in the context of normal sign language acquisition, and also contexts of late language learning. The deaf offspring of hearing parents represent the vast majority of the signing community (around 90-95%). Within this group there is variation in terms of age of exposure to BSL and the quality and quantity of BSL input, compared with native signers, i.e. children in deaf signing families with access to BSL from birth. Care is needed to distinguish language delay as a result of late exposure to sign language from atypical development stemming from language disorder.

To date there have been no reports of abnormal sign language development comparable to SLI in spoken language acquisition, in otherwise cognitively normal deaf children, although practitioners are aware that such cases exist. In a series of case studies referred to our sign language assessment clinic, we have begun to document sub-types of sign language developmental impairments (e.g. Woll & Grove, 1996; Atkinson et al, 2002). In this paper, we describe assessment of a deaf child exposed to adult models of BSL from birth with normal general cognitive abilities but very restricted BSL grammar. Any deficiencies in his signing could therefore be attributed to a language disorder.

Methods

Participant

Paul is a deaf male aged 5;2, born with a profound bilateral sensori-neural hearing loss. Both of his parents are deaf, first generation signers and have signed with Paul in BSL from birth. Paul attended a mainstream school with sign language support and more recently a bilingual BSL-English school with full access to the curriculum through BSL. Paul was referred for assessment by the school because of worries about his BSL development. The Snijders-Oomen nonverbal intelligence test at 5;0 revealed no cognitive impairments (Snijders et al, 1989).

Language

An initial language assessment was carried out using video recordings of Paul interacting in BSL with his parents, teachers and speech and language therapist. These were supplemented by further observations and structured BSL assessments carried out at home and at school by a fluent BSL user.

Receptive language

We assessed Paul's receptive vocabulary using a non-standardised BSL version of the BPVS (Dunn et al, 1982). Norms used were based on scores collected from groups of normally developing signing children. Paul's receptive BSL vocabulary appeared normal for his age. In studies of spoken language SLI, most children have poor expressive vocabulary while some have relatively better receptive vocabulary (e.g. Rice, 2000). However, normal vocabulary development is not a characteristic of SLI in spoken language.

Analyses of spontaneous signing revealed that Paul did not understand complex signing. Tellingly, his mother used simple BSL structures to help him

follow her, but used fluent adult BSL with her husband and other deaf adults in Paul's presence. We evaluated receptive grammar using the BSL Receptive Skills Test (Herman et al, 1999), a test standardised on children aged 3-11 years. Paul scored –1.3 standard deviation below the mean and while this score does not meet any standard for a language disorder (typically 1.5-2 SD below the mean), the profile of Paul's performance was atypical, with success on some difficult items, and failure on many easier ones, which is the reverse pattern to that of native signers and late learners of BSL.

Because Paul could not use gesture and facial expressions to compensate for his poor linguistic competence, the test pinpointed specific areas of difficulty within BSL grammar. Paul's area of strength was plurals; his weaknesses were in grammatical constructions used to encode negation, noun-verb distinctions, spatial verbs and classifiers. In BSL, pluralisation is lexical rather than morphological, e.g. MAN TWO or BOOK MANY rather than 'men' or books'. The areas he scored poorly on were in contrast linguistic forms which encode meanings through morpho-syntactic rules. Negation is marked by a head-shake which co-occurs with a manual sign; noun-verb distinctions are signalled through phonological changes to a base sign and finally the verb system and classifiers exploit complex embeddings of morphological information. In contrast to morphologically simple lexical items, the latter set of devices rely on the processing of polymorphemic signs. Importantly, verb morphology emerges and is acquired in many contexts, at least 12 months earlier in typically developing children (3-4 years), than Paul. Classifier constructions, although complex, are understood by children after age 3.

Expressive language

Paul's expressive BSL was assessed through the initial video samples described above, further interactions with his mother, picture description tasks and the BSL Production Test (Herman et al, 2004). The latter is an analysis of BSL grammar and discourse structure based on an elicited narrative.

The initial sample highlighted expressive BSL restricted to small sentences made up of 1 or 2 signs with very limited grammar. Despite this, Paul clearly enjoyed communicating and provided a range of appropriate affective (but non-linguistic) facial expressions and gestures.

Paul's performance on the BSL Production Test was at the 25th centile for all criteria (grammar and discourse elements). In retelling the story he mostly produced a series of single signs with few grammatical inflections. At times he produced gestures in direct imitation of actions performed on the video. As with the receptive test, he demonstrated knowledge of quantifiers to express number.

Below we give examples of Paul's use of the classifier and verb systems to describe different events from the picture tasks, compared to similar age typically developing deaf children.

Classifiers:

Target picture: a dog in a box.

Paul: DOG whole body gesture with hands on the head (top of box)

Adult: DOG WHERE?

P: whole body gesture to show looking up

A: PICTURE WHAT?

P: BOX

A: AND?

C: DOG

A: DOG WHERE?

P: looks away and changes topic

Typically developing native signer aged 4;6

C: POINT (picture) CL-(box)-CL-(small animal)-SIT-IN-BOX

'there, it's in the (box)'

Verb morphology:

Target picture: a man giving a boy a letter.

Paul: GIVE GIVE SQUARE GIVE (citation forms)

A: SQUARE GIVE WHO?

C: GIVE GIVE POINT (picture) LETTER

A: PICTURE WHAT?

C: LETTER POINT

Typically developing native signer aged 4;6

C: MAN LETTER GIVE-3rd person

'the man gives the letter to (him/her)'

A native adult signer assessed the phonological well-formedness of Paul's signs informally from video. Some signs were produced with immature handshapes but overall phonology was judged to be age appropriate. Disordered phonology often accompanies spoken language SLI.

Finally, Paul's expressive signing was plotted onto the BSL scales of the ESPP Monitoring Protocol (DfES, 2004), indicating an approximate level of functioning for a normally developing native signing child of 24-30 months of age, i.e. a significant delay.

Discussion

Our analyses revealed a significant delay in comprehension and a more marked delay in the production of certain BSL grammatical constructions, but with normal phonology and receptive vocabulary. The crux of the auditory deficit explanation of SLI is that language-impaired children cannot efficiently process rapid changes in the speech signal. One difference between sign language and spoken language is that speed of phonological contrasts is about 1.5 times as slow, meaning sign language has much slower temporal resolution. Because the hands and arms are bigger articulators than the larynx, parts of signs are produced more slowly than phonemes in spoken words (Emmorey, 2002), making it unlikely that rapid temporal processing of the signal will be problematic. This may mean that SLI in signing children will be restricted to problems with linguistic structures beyond the phonological and citation word level.

This difference in temporal resolution may explain Paul's type of impairment and the dissociation between phonology/citation vocabulary and grammar, where only the latter is impaired. What caused Paul most problems were polymorphemic constructions. While these constructions emerge piecemeal during typical development, Paul was old enough to be accurately processing and producing many of them. In studies of different spoken languages, grammatical inflections and structures involving dependency relations have been highlighted as particularly difficult for children with SLI (Leonard, 1998). In classifiers the handshape selected requires knowledge of how the classifier is dependent on the previous noun (e.g. a car or a person). Similarly verb inflections in BSL are dependent on the assigned location of previous nouns.

Conclusions

The presence of children with SLI in sign language and future investigations of this population should lead us to re-examine theories of the origins of SLI and a modality-free notion of language. Therapists working with deaf children should be aware that deaf children with language delay may have language impairment rather than solely a problem based on limited language exposure (sign or speech).

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Figures

Figure 1 ‘The car goes under the bridge’.

What this paper adds

1. Much research has documented the spoken language of children diagnosed as having SLI.

2. We now know that SLI can and does exist in deaf signers suggesting language disorder goes beyond the disruption of speech perception.