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What our hands say:

Exploring gesture use in subgroups of children with language delay

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Keywords: gesture, language delay, late talkers, symbolic comprehension, CSBS

Abstract

Purpose: The aim of this study was to investigate whether children with receptive-expressive and expressive-only language delay differ in their use of gesture; to examine relationships between their use of gesture, symbolic comprehension and language; and to consider implications for the nature of problems underlying different profiles of early language delay and for assessment.

Method: Twelve children with expressive language delay (ELD) and 10 children with receptive-expressive language delay (R/ELD), aged 2-3 years, were assessed on measures of gesture use and symbolic comprehension.

Results: Performance of the R/ELD group was significantly poorer than performance of the ELD group on measures of gesture and symbolic comprehension. Gesture use and symbolic comprehension were significantly associated with receptive language, but associations with expressive language were not significant.

Conclusion: Findings of this study support previous research pointing to links between gesture and language development, and more specifically, between delays in gesture, symbolic understanding, and receptive rather than expressive language. Given potentially important implications for the nature of problems underlying ELD and R/ELD, and for assessment of children with language delay, this preliminary study invites further investigation comparing the use of different gesture types in samples of children matched on age and nonverbal IQ.

This Research Note reports a study that set out to investigate whether children with receptive-expressive and expressive-only language delay differ in their use of gesture, and the relationship between their use of gesture and understanding of nonverbal symbols. This investigation was motivated by previous research indicating relations between gesture and language in typically and atypically developing children, and suggesting that early difficulties in receptive language in particular may be linked to difficulties in use and understanding of symbols.

In this context, gestures are defined as actions used to intentionally communicate, expressed either by the hands, facial expressions, or body movements (Iverson & Thal, 1998). Gesture and language both involve the use of symbols to convey meaning intentions, and close relationships have been found between language and gesture milestones in typically developing children from 6 months onwards (Bates & Dick, 2002). The frequency and range of gesture use predict later language outcomes (Butterworth & Morissette, 1996; Calandrella & Wilcox, 2005; Rowe, Ozcaliskan, & Goldin-Meadow, 2008; Watt, Wetherby, & Shumway, 2006), and gesture paves the way for subsequent language development, with gestures appearing in children's repertoires predicting the vocabulary that will emerge soon after (Iverson & Goldin-Meadow, 2005). Examination of gesture development in young children indicates that gesture functions in the same way as words (Namy & Waxman, 1998), with words and phrases taking over as the primary means of communication by about 24 months (Wetherby, Cain, Yonclas, & Walker, 1988). Acredolo and Goodwyn (1988, p.463) state that 'symbolic gestures provide a unique window into the process that underlies language development in general'. Accordingly, evidence of symbolic gesture use and how this relates to language in children with language delay may provide a window into their difficulties and may further our understanding of this clinical group.

A series of studies by Thal and colleagues (Thal & Bates, 1988; Thal, Tobias, & Morrison, 1991; Thal & Tobias, 1992) investigated gesture in a group of nine late talkers and found delays in gesture development which appeared to be related to children's receptive

language. Follow-up of the late talkers one year after initial assessment revealed that the four who continued to present with language deficits had been significantly poorer on language comprehension and gesture tasks at initial assessment than the children who recovered. A further study investigated these children's spontaneous gesture used communicatively in interactions and found that the same four children not only used fewer communicative gestures to initiate and in response to questions asked, but also used fewer deictic and symbolic gestures. In contrast, the children who had caught up appeared to use gesture to compensate for their expressive language deficits. In line with observed associations between language comprehension and gesture, Thal and Tobias (1994) found that a group of children with expressive-only language delay did not differ from age-matched peers in their imitated and spontaneous gesture production, demonstrating appropriate ability to represent objects and events symbolically. These findings supported the hypothesis that language comprehension rather than production shares underlying cognitive abilities with gesture use.

The associations observed between linguistic and non-linguistic aspects of cognition at particular points in development are in line with the local homology model put forward by Bates et al. (1979). This model views language as an 'interactive system that depends crucially on processes and representations from a variety of cognitive domains' (Bates, Bretherton & Snyder, 1988, p11). It holds that at certain points in development, linguistic and non-linguistic skills draw on the same underlying processes or processing mechanisms that will grow apart over time. Language and gesture are both thought to be served by a common underlying capacity for symbolic representation (Namy et al., 1998). However, later in development language diverges from general symbol use as more complex linguistic skills emerge. The acquisition of phonology and morphosyntax involves distinct cognitive processes and allows children to represent meaning intentions that are more complex and precise than the meanings that can be expressed by symbolic gestures (Chiat, 2001). Hence, children's language becomes increasingly distinct from symbolic gesture in both form and meaning.

This theoretical view of relations between gesture and language, together with the findings of Thal and colleagues, motivated the present investigation. Thal's evidence of limited gesture use in children with poor receptive language was retrospective, and confined to four children in a sample of nine. The aim of our study was, first, to carry out a larger and more systematic comparison of gesture use in groups of children with receptive-expressive versus expressive-only language delay, in order to evaluate further the hypothesis that gesture use is significantly poorer in those with receptive problems. Taking up the further hypothesis that relations between language comprehension and gesture use stem from a common underlying capacity for symbolic representation (Namy et al., 1998), we further predicted that children with receptive language delay and limited use of gesture would have difficulty understanding other types of nonverbal symbols. If children's receptive language skills are age-appropriate, on the other hand, this would suggest that they are able to understand meaning intentions behind the use of symbols, and we would not expect them to have problems with gesture use or with understanding nonverbal symbols, even if they have expressive language difficulties. In order to evaluate these further predictions, we compared performance of the R/ELD and ELD groups on a test of symbolic comprehension, and investigated relations with their receptive language, expressive language, and gesture use.

Method

The aim of this preliminary study was to explore whether, as predicted, children with ELD vs R/ELD differ in their use of gesture and symbolic comprehension, and depending on the outcome, to inform a future larger scale study including a control group and consideration of further factors that may account for observed relations between gesture, symbolic comprehension and language.

Participants

Participants were recruited from children referred to local Speech and Language Therapy clinics because of concerns about their language development. Inclusion criteria for

participation in this study were for children to be aged between 24 and 36 months and from monolingual English speaking families; have an identified receptive and/or expressive language delay; and have no history of hearing loss or repeated ear infections, and no identified learning disabilities, behavioural disturbances, neurological impairments or social/emotional impairments. While these criteria excluded children with any identified learning difficulties, for a number of reasons no strict nonverbal IQ criterion was adopted. First, the group of children sampled were to reflect the variability that is typically seen in a clinical population of preschool children. Second, the stability of IQ measures with this age group of children is problematic (Gilliam & Mayes, 2004) and it is well established that cognitive abilities change rapidly in the early years. Last, the goal of this study was to examine gesture use in relation to language ability. Fey, Long and Cleave (1994) indicated that in children with language impairment, language scores do not differ significantly between children with performance IQ scores between 70 and 85 and those who meet the traditional criteria (i.e. scores above 85). They further stated that use of IQ scores is questionable as it does not take into account the standard error of measurement, and because there is no upper boundary on the IQ score range, an artificial group may be created by exclusion at the lower end of the scale. This view has recently been endorsed by both parties in a recent debate on SLI (Bishop, 2014; Reilly et al., 2014).

Ethical approval for the study was obtained from the Health Service Executive Regional Ethics Committee and the City University School of Health Sciences Research Ethics Committee, and all parents of participants gave informed consent.

ELD and R/ELD groups

The 22 children recruited were allocated to one of two groups based on performance on the Auditory Comprehension and Expressive Communication subscales of the Preschool Language Scale-Third Edition (PLS-3 (UK); Zimmerman, Steiner, Pond, Boucher & Lewis, 1997). Criteria for expressive only language delay (ELD) were Auditory Comprehension score within 1.0 *SD* of the mean of the reference population ($M=100$, $SD=15$; Zimmerman et al., 1997) and Expressive Communication score at least 1.0 *SD* below the mean. Twelve of

the 22 children met these criteria for ELD. Criteria for mixed receptive and expressive language delay (R/ELD) were both Auditory Comprehension and Expressive Communication scores at least 1.0 *SD* below the mean. Ten children met the criteria for the R/ELD group. The 1.0 *SD* criterion was chosen as Zimmerman et al. (1997) indicate that scores below 85 are indicative of language deficit. Descriptive data for each group can be found in Table 1.

The Auditory Comprehension mean for the ELD group, at 97.5, was very close to the mean of the reference population. In contrast, all children in the R/ELD group scored at least 1.46 *SD* below the population mean on Auditory Comprehension, with the group mean 2.08 *SD* below the population mean, indicating severe difficulties in this area. The difference between the Auditory Comprehension scores in the two groups was significant ($t(20)=-11.12$, $p<.005$). Importantly, there was no overlap between the two groups.

In contrast, all children in both groups scored at least 1.2 *SD* below the mean for Expressive Communication, and although the mean of the ELD group was slightly higher than that of the R/ELD group (73.6 vs 69.9), the difference was not significant ($t(20)=-1.6$, $p=.116$). Hence, while the ELD group showed a substantial gap between Auditory Comprehension and Expressive Communication scores in favour of the former (mean difference 23.9), for the R/ELD group there was almost no gap (mean difference 1.2).

There was a significant difference in age between the two groups: the children in the R/ELD group were older than those in the ELD group ($t(20)= 2.52$, $p=.02$). This age difference was taken into account in analyses (see below). In addition, five pairs of children matched within one month of age were identified in the two groups, allowing comparison of age-matched subgroups.

Procedure

Every child was tested individually over two 45-60 minute sessions in a quiet unfamiliar clinic room. Each child sat at a small table opposite the researcher, next to one or both parents. Assessments were administered in a set order: at the first session, the language assessment was administered and parents were given a questionnaire to fill out and return

on the next visit. At the second session, assessments of symbolic comprehension and gesture use were administered. Both were videoed for later scoring.

Measures

Language was assessed using the Preschool Language Scale-Third Edition (PLS-3 (UK); Zimmerman et al., 1997). In addition, the MacArthur-Bates Communicative Development Inventory: Words and Gestures (CDI:WG; Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick, & Reilley, 1993) parental checklist of words understood and words produced (each with maximum score 396) was administered. Although the children in this study were older than the normative range for the CDI:WG (8-16 months), this measure was deemed appropriate given the children's reported language delays. The use of this assessment with older children is well documented in other studies with preschool children with language delay (Crais, Watson & Baranek, 2009; Thal, O'Hanlon, Clemmons, & Fralin, 1999). Due to the children's age, only raw scores were obtained.

Gesture was evaluated using two sections of the Communication and Symbolic Behaviour Scales (CSBS; Wetherby & Prizant, 2003). The Communicative Temptations section consists of eight structured situations that provide opportunities for children to communicate non-linguistically with gestures and vocalizations in order both to request and comment on interesting and novel objects and toys (e.g. balloons, wind-up toys). In the Sharing Books section, the child is encouraged to choose a book from a choice of three, and is allowed to examine the book while the tester shows interest in what the child looks at, points out, or comments on.

Children's use of communicative gestures in these two sections was later scored from the video recordings. A gesture is deemed communicative if it is accompanied by eye contact or a vocalization directed towards the tester immediately prior to, during, or after the communicative act. Two gesture scores are calculated from the CSBS assessment: a distal gesture score, which includes all gestures made when the child's hand does not touch a person or object, for example, open handed reaching, pointing, waving or any symbolic gestures made by the hands (e.g. child may use depictive gesture without contacting an

object or person to request opening a jar) , and a conventional score which is a measure of variety of culturally defined gestures used socially, for example, nodding and shaking the head, showing and giving an object. These two scores were combined into a total frequency gesture score.

Symbolic comprehension was assessed using a subtest of the Early Sociocognitive Battery (ESB, available at <http://www.city.ac.uk/health/research/centre-for-language-communication-sciences-research/veps-very-early-processing-skills>; Chiat & Roy, 2008). This subtest was adapted from an experimental task developed by Tomasello, Striano and Rochat (1999) to investigate young children's ability to understand symbolic representations of objects in three symbolic conditions: gestural, miniature, and substitute object. In each condition, the tester asks the child to find an object from a set of six, using a symbolic representation to indicate which object the child should find. In the gestural condition, the researcher mimes an action related to the target object (hammer, comb, toothbrush, bottle, sock and scissors). In the miniature condition, the tester holds up a miniature version of the target object (teddy, brush, book, shoe, spoon and t-shirt) and asks 'give me the'. In the substitute object condition, the tester uses a substitute object as if it were the target object (cup used as a hat, banana as a telephone, stick as a crayon, shell as a plate, apple as a ball, brick as soap). After carrying out actions with three substitute objects at a time, the tester holds up each corresponding real object in turn and asks the child to 'find the best one', gesturing across the choice of 6 objects. This task involves minimal verbal instruction and is supported by gesture. One point is awarded for correct selection of each target object in each of the three conditions (maximum score=18).

Results

Table 1 shows the mean, standard deviation, minimum and maximum scores for all measures according to group (ELD vs R/ELD).

INSERT TABLE 1 ABOUT HERE

Gesture and Symbolic Comprehension

CSBS Total Gesture Score: As the gesture data did not meet the normality assumption, Mann Whitney U tests were used to compare groups. The groups differed significantly, with the ELD group using a higher number of gestures (median=37, IQR=30.75-40.75) than the R/ELD group (median=20.5, IQR=17.75-21) (Mann Whitney U=.00, $p < .001$), and the effect size was large ($r = -0.84$). Strikingly, there was no overlap at all between the distributions of scores in the two groups, with the highest number of gestures achieved by a child in the R/ELD group not reaching the lowest number of gestures used by a child in the ELD group.

ESB Symbolic Comprehension: An ANCOVA controlling for age revealed a significant group difference in symbolic comprehension: ELD adj $M = 7.23$, $SE = .636$; R/ELD adj $M = 1.3$, $SE = .705$; $F(1,19) = 34.1$, $p < 0.001$). Again, the ELD group ($M = 6.9$, $SD = 2.57$) had better skills than the R/ELD group whose performance was at floor ($M = 1.7$, $SD = 1.33$). The distribution of scores in the two groups again showed almost no overlap, with only one child in the ELD group scoring lower than the highest score achieved by a child in the R/ELD group.

As further evidence that age differences were unlikely to be responsible for group differences, the age-matched subgroups showed the same gap in gesture and symbolic comprehension scores as the larger groups from which they were drawn (Table 1). In all five pairs, the child with ELD achieved a higher score for both measures. In contrast, mean scores on Expressive Communication and Vocabulary Production were similar, and indeed slightly higher, in the R/ELD group.

Relationships between Language, Symbolic Comprehension, and Gesture

Correlational analysis was used to investigate relations between language (PLS-3), symbolic comprehension (ESB), and gesture measure (CSBS) (see Table 2). This revealed large significant positive correlations between receptive language, symbolic comprehension, and gestures; children with better receptive language gained higher scores for gestures and symbolic understanding, and children with higher symbolic comprehension gained higher scores for gesture. In contrast, and strikingly, expressive language was not significantly related to gesture or symbolic comprehension.

INSERT TABLE 2 ABOUT HERE

Discussion

The differences in gesture use and symbolic comprehension that we found between our groups of children with receptive-expressive (R/ELD) and expressive-only (ELD) language delay are in line with our predictions and add to previous research in two ways. First, our results provide more systematic evidence of the associations between early receptive language difficulties and poor gesture use that Thal and colleagues observed in four children (Thal & Bates, 1988; Thal et al., 1991; Thal & Tobias, 1992). They also corroborate Thal (1994)'s evidence that children with expressive-only language delay use gestures appropriately communicatively. Second, the marked discrepancy between our two groups' performance on the test of symbolic understanding, and the significant relationship found between gesture and symbolic understanding as well as receptive language, are consistent with the local homology model indicating associations between non-linguistic correlates of language development. Our finding that the R/ELD group scored at floor on symbolic comprehension task suggests that they either did not understand the researcher's symbolic intention (use of a gesture, miniature or substitute object to identify a referent), or understood her intention but could not see any connection between these nonverbal symbols and their referents.

Conversely, the ELD group's substantially better performance on symbolic comprehension demonstrates that they were at least able to understand the intention behind the researcher's use of symbols and had the cognitive skills to make links between at least some symbols and referents. Together with their better performance on gesture and their intact receptive language, this suggests that their problems were not with meaning intentions and meanings expressed in language, but with accessing and/or producing linguistic forms to convey these. Since our study did not include a control group, we do not know whether the ELD group's scores for gesture and symbolic comprehension were within the normal range, and cannot rule out the possibility of some deficit in gesture and symbolic understanding. Given previous suggestions that gesture may play a compensatory role in

communication when there is a delay in using verbal language (Evans, Alibali, & McNeil, 2001; Thal & Tobias, 1992; Whitehurst, Fischel, Arnold, & Lonigan, 1992), it is also possible that the ELD group's scores on gesture would exceed those for typically developing children. These possibilities require a larger-scale investigation that includes an age-matched control group.

Consideration of our findings and their implications must take account of limitations in the samples we recruited and our nonverbal assessments which may have affected our results. First, although attempts were made to match the groups in crucial respects, the R/ELD group were significantly older than the ELD group. This could indicate that the problems of the R/ELD group were more persistent as well as more pervasive than expressive-only problems. It is therefore possible that group differences in gesture use and symbolic comprehension were due to the greater persistence and severity rather than nature of problems in the R/ELD group. However, our finding that that group differences remained when we controlled for age, and were of a similar magnitude when we compared subsamples of children matched for age, suggests that age and persistence were not key factors.

Since we did not carry out an assessment of nonverbal IQ, we also need to consider the possibility that children in the R/ELD group had unidentified nonverbal deficits and that these could explain their poorer performance on gesture and symbolic comprehension. Some support for this possibility is provided by Desmarais et al. (2010) and Bushmann et al. (2008) who found that pre-schoolers with receptive delay had weaker cognitive profiles than their counterparts with expressive-only delay. However, differences in cognitive ability might be expected to have similar effects on expressive and receptive language performance. While the mean score on Expressive Communication showed a slight advantage for the ELD group, this difference did not approach significance, and in the age-matched subgroups, it was the R/ELD group that showed a slight advantage. Furthermore, on parent report of vocabulary production, the two groups attained similar mean scores (ELD 75, R/ELD 76) despite a marked difference for vocabulary comprehension in the expected direction (ELD

292, R/ELD 233.7), and results for the age-matched subgroups showed a marked advantage for those with R/ELD over ELD (mean scores of 110.6 and 77 respectively).

Research on early language delay has until recently focused on expressive language. This is most evident in the substantial body of research on 'late talkers' that exclude children with receptive problems resulting in the current research base on children with R/ELD including under 50 children (Desmarais, Sylvestre, Meyer, Bairati, & Rouleau, 2008). Yet recent research has demonstrated that children with receptive language delay are at particular risk of longer term problems (Rescorla, 2011; Chiat & Roy, 2013). Both in research and in clinical practice, there is a move from assessing not only a child's language level but also key underlying skills that may result in particular language profiles (Chiat & Roy, 2008, 2013). Our findings suggest that measures of gesture and symbolic understanding may throw more light on the nature of their problems and play a valuable role in clinical assessment of children with language delay. As assessments of gesture use and symbolic comprehension are play based assessments, they are enjoyable and child centred, can be used with young children and may be a valuable clinical tool alongside a more traditional standardized language assessment. Furthermore, the availability of both developmental norms and formal and informal assessment measures for gesture use (see Crais et al 2009 for full review) and the web availability of the Symbolic Comprehension test (ESB, available at <http://www.city.ac.uk/health/research/centre-for-language-communication-sciences-research/veps-very-early-processing-skills>; Chiat & Roy, 2008).make assessment of these skills readily accessible.

Given the potentially important implications of our findings, this preliminary study invites replication with larger R/ELD and ELD groups, and typically developing control groups, all matched on age and nonverbal IQ. In addition, studies investigating different types of gestures (deictic versus symbolic versus conventional) and different methods of elicitation (spontaneous versus imitated) might yield new insights into the nature of children's problems with gesture and symbolic understanding.

Table 1: Means, standard deviations (SD), minimum and maximum age, PLS-3 standard scores, and total scores for CDI vocabulary, CSBS gesture production, and symbolic comprehension, for full ELD and R/ELD groups and for age matched subgroups (matched at ages 24, 25, 26, 30, 32 months)

	Total sample							
	ELD N=12 (8 boys)				R/ELD N=10 (8 boys)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Age (months)	27.3	2.3	24	32	30.8	4.1	25	35
PLS-3 (UK) Auditory Comprehension (SS)	97.5	6.5	86	112	68.7	5.5	59	78
PLS-3 (UK) Expressive Communication (SS)	73.6	5.3	65	82	69.9	5.4	61	82
CDI Vocabulary Understanding (max=396)	292	75.5	153	390	233.7	120.8	54	372
CDI Vocabulary Production (max=396)	75	55	17	177	76	99.9	1	312
Total gestures (raw score)	38.6	10.3	26	61	19.2	3.22	13	23
Symbolic Comprehension (max=18)	6.9	2.6	3	12	1.7	1.3	0	4
	Age-matched subgroups							
	ELD (n=5)				R/ELD (n=5)			
PLS-3 (UK) Auditory Comprehension (SS)	95.6	6.8	86	105	67.8	3.3	65	73
PLS-3 (UK) Expressive Communication (SS)	72	6.7	65	82	73.2	5.1	69	82
CDI Vocabulary Understanding (max=396)	334	56.2	259	390	230.8	159	54	357
CDI Vocabulary Production (max=396)	77	71.7	17	168	110.6	137.6	1	312
Total gestures (raw score)	33.6	5.55	26	40	18.8	3.35	13	21
Symbolic Comprehension (max=18)	8	1.6	6	10	1.2	1.3	0	3

Table 2. Correlations between direct measures of language (PLS Auditory Comprehension and PLS Expressive Communication), symbolic comprehension and gesture

	Expressive language	Symbolic comprehension	Gesture
Receptive Language	.379	.831**	.703**
Expressive Language		.107	.342
Symbolic Comprehension			.605**

** Correlation is significant at the 0.01 (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

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