



HAL
open science

How children with developmental language disorder use co-speech gestures to communicate

Corrado Bellifemine

► **To cite this version:**

Corrado Bellifemine. How children with developmental language disorder use co-speech gestures to communicate. Proceedings of the International Symposium on Monolingual and Bilingual Speech 2019, 2019, 978-618-82351-3-7. hal-03834362

HAL Id: hal-03834362

<https://hal.science/hal-03834362>

Submitted on 29 Oct 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

How children with developmental language disorder use co-speech gestures to communicate

Corrado Bellifemine

corrado.bellifemine@sorbonne-nouvelle.fr

Université Sorbonne Nouvelle - Paris 3

Abstract. This study explores whether gesture-speech coordination in children with developmental language disorder (DLD) enhances their communication. Multimodal approaches (Kendon, 1980, 2004; McNeill, 1992) have recently been integrated in the field of language impairment. Several authors (Botting et al., 2010; Iverson & Braddock, 2011; Alibali et al., 2009) showed that children with DLD produce more gestures than typically developing (TD) children, when struggling with conceptual expression or lexical access (Mainela-Arnold et al., 2014). Can gestures aim to compensate for linguistic difficulties, thus making children with DLD produce more gesture than TD children? We video-recorded 30 French-speaking children (15 children with DLD and 15 TD children) aged 8 to 11. Children first played a guessing game with the examiner and then described their room. For each recording, we determined the quantity and types of hand gestures produced. We then examined whether gestures were strictly related to speech and how they were integrated in children's verbal productions in the two types of activities. Results showed significant qualitative and quantitative differences between TD children and those with DLD. During the guessing game, children with DLD produced more gestures, which were mostly representational. TD children produced fewer gestures, which were mostly rhythmic and self-regulatory. However, during the description task, children with DLD used fewer gestures than TD children. Both groups produced deictic and representational gestures. Moreover, the gestures were strongly complementary to speech. The findings show the complexity of gesture-speech coordination in children with DLD. Speech elaboration is a multimodal process where gestures play an important role. However, according to the nature of the difficulties in communication, gestures can both be inhibited or strongly mobilized and facilitate expression. Gestures can therefore convey additional information to what is conveyed verbally in both types of population and are used differently according to the type of activity.

Keywords: developmental language disorder, multimodality, co-speech gestures

Introduction

A multimodal approach in language development

Children's language development is dynamically multidimensional (Karmiloff & Karmiloff-Smith, 2001): the phonological system is necessary for the lexicon and syntax to be acquired. Children's language development is also multimodal (Morgenstern, 2014), verbal and non-verbal modalities being interdependent. Children's communication is achieved first through gestures, facial expressions and gaze, then through speech in coordination with the other modalities. Thus, gestures are preferred during the first stages of language development, to be then primarily replaced by speech, once vocal linguistic structures are acquired and integrated. But verbal and non-verbal signals are then fully articulated as children continue using all semiotic resources at their disposal. Children modulate their gestural behavior in interaction, depending on their communicative intention, interlocutor, context, and current activity (Cienki, 2017). Multimodal communication involves bodily nonlinguistic productions that can convey meaning, but also involuntary movements that are not necessarily related to the content of speech. Gestures accompanying speech are called co-speech gestures (Colletta, 2004).

A multimodal approach was recently integrated in the field of language disorders by authors who, in line with McNeill (1992), consider speech and gestures to be part of the same system. DLD is a severe and persistent language disorder that hinders the production and/or comprehension of language at the phonological, morphosyntactic, lexical, semantic and pragmatic levels. Due to the compensatory

mechanisms of the brain, children with developmental language disorder may frequently switch from one sub-category to another (Parisse & Maillart, 2009; Botting & Conti-Ramsden, 1999). Studies on the use of gestures in children with DLD bring out varied and heterogeneous data, sometimes confirming or contrasting the various hypotheses put forward by different authors. Based on the assumption that these children produce a higher number of gestures during different types of activities such as explanations, narrative or description tasks, authors state that children with DLD use gestures as a compensation mechanism to overcome language difficulties (Blake, Myszczyzyn, Jokel, & Bebiroglu, 2008; Iverson & Braddock, 2011; Mainela-Arnold, Alibali, Hostetter, & Evans, 2014). Moreover, the gestures produced often convey additional information that is not transmitted verbally (Evans, Alibali & McNeil, 2001). Other studies (Botting, Riches, Gaynor, & Morgan, 2010; Wray, Norbury, & Alcock, 2016) have shown that children with DLD performed equally to typically developing controls but their gestures were less precise. Gestures seem to have an important role as far as language production is concerned, but also in language comprehension, since using gesture in pedagogical contexts facilitates new words acquisition in children with and without language impairment (Vogt & Kauschke, 2017; Tellier, 2008).

This study explores whether gesture-speech coordination in children DLD enhances their communication. To our knowledge, no study has been conducted as far as French-speaking children with DLD are concerned, so it would be interesting to observe their multimodal behavior also in comparison with typically developing children. Moreover, in France research on gestures focuses more on younger children who are still in a developing phase. Little is known about older children who are in later stages of language development, as well as children with DLD, who have already been through several years of speech therapy. Can gestures compensate for verbal difficulties, thus making children with DLD produce more gestures than TD children?

Method

To answer this question, we video-recorded 15 French-speaking children with DLD and 15 age-matched typically developing children. All children were aged 8 to 11 years old. Children with DLD were all officially diagnosed by a speech therapist. The following exclusion criteria were applied: no hearing impairment, no phonatory organs' malfunction, good Nonverbal IQ, no social deficit disorder, no cerebral lesion, no behavioral deficit.

Each child was video recorded during two tasks: A) each child played a guessing game with the examiner. The examiner showed 16 cards to the child. Each card contained the image of the item to be guessed. Children had to describe the image to the examiner so that he could guess the correct answer. The instructions for the game did not specify which modality should be used (gestures or speech), so children were free to use whichever strategy they preferred. B) Each child had to describe their room, while they were in another room. No detailed instructions were given during this task. The children were free to say whatever they wanted and to employ whichever modality they preferred (nonverbal or verbal).

As far as gesture types are concerned, authors have proposed several gesture classifications (Efron, 1941; Ekman & Friesen, 1969; Kendon, 1980; McNeill, 1992). We propose here a simplified gesture classification:

- Deictic gestures, which include pointing and localization gestures.
- Iconic gestures, which include gestures referring to a salient feature, shape, size, mime of a referent.
- Emblems, which include conventional recurrent gestures such as salutations, counting, thinking gestures, shrugs, palm ups.
- Self-Adaptors, which include self-regulatory gestures such as rubbing and scratching and touching a body part to adapt oneself to the interaction.
- Beats, which include gesticulation and gestures structuring speech or giving emphasis to certain words.

Thus, we hypothesized that children with DLD rely more than TD controls on gestures and that children with DLD and TD controls use different types of gestures, depending on the task. In particular, children with DLD might use more iconic gestures during the guessing game and more deictic gestures during the description task

As far as the relationship between speech and gestures is concerned, its coding was based on the classification proposed by Colletta et al. (2011), consisting of the following:

- Independent relation: gestures are independent from speech and they convey different meanings that are not related to each other. This is more the case for adaptors and beats.
- Complementary relation: gestures complete the meaning conveyed verbally and they add information about the concept or the referent.
- Substitution relation: gestures replace speech and convey meaning that is not transmitted verbally.
- Redundant relation: speech and gestures convey the same meaning; the hand movement refers to a concept expressed verbally and occurring at the same time as the gesture.

Thus, we hypothesized that, during the guessing game, speech and gestures would be in a complementary or substitution relationship whereas, during the description task, speech and gestures would be in a more redundant and complementary relationship.

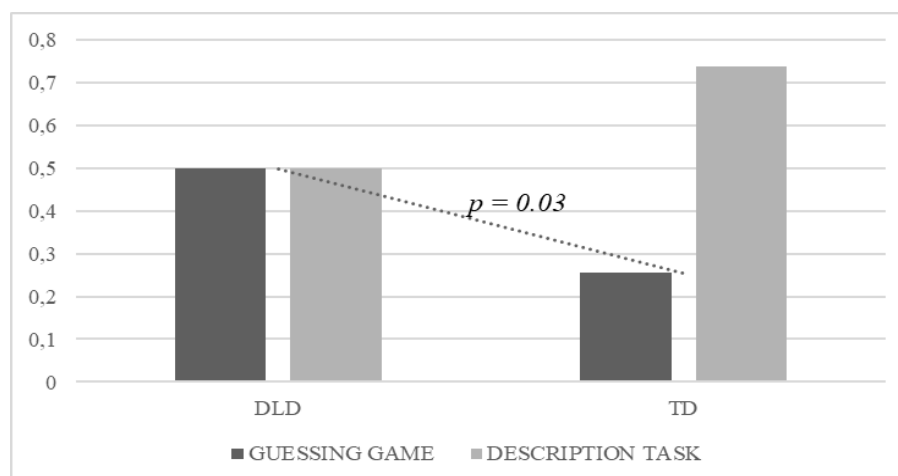
Results

Gesture – utterance ratio

Table 1. Total number of gestures and total number of utterances

	GUESSING GAME		DESCRIPTION TASK	
	DLD	TD	DLD	TD
Gestures	285	140	70	147
Utterances	571	548	140	199

Figure 1. Gesture – utterance ratio



During the guessing game children with DLD produced a gesture-utterance ratio of 1:2, as well as during the description task (guessing game ratio: 0.5; description task ratio: 0.5). Each child gestured during the guessing game but not all children gestured to describe their room. They seemed to rely more on gestures during the guessing game because their verbal productions were constrained by the task, whereas during the description task children with DLD seemed to rely on compensatory

strategies to reduce difficulties and therefore, they sorted and selected what could be said without their expression being affected by the language impairment (Delage, Monjauze, Hamann, & Tuller, 2008).

During the guessing game TD children produced a gesture-utterance ratio of 1:4, whereas they produced almost one gesture per utterance during the description task (guessing game ratio: 0.2; description task ratio: 0.7). It should be noted that the TD children's descriptions were longer than those of children with DLD. The more information there was, the more chances there were for co-speech gestures to occur. This could be the case for TD children. On the contrary, not all the TD children gestured during the guessing game, which could relate to a better mastery of the task, as well as better language skills. While the strategies of children with DLD were based more on the non-verbal modality, TD children gave more precise verbal cues to make the examiner guess the item.

Gesture types

Table 2. Gesture types produced during the two tasks

	GUESSING GAME			DESCRIPTION TASK		
	DLD	TD	<i>p</i>	DLD	TD	<i>p</i>
ADAPTORS	14%	21.50%	0.3	17%	8.10%	1
BEATS	9.47%	44%	0.11	20%	18.40%	0.3
DEICTIC	5.20%	3.60%	0.1	30%	40.80%	0.1
EMBLEMS	10%	4.20%	0.03	3%	0.68%	1
ICONIC	61%	26.40%	0.001	30%	31.90%	0.1

During the guessing game, children with DLD massively produced iconic gestures (61%). Overall, it seems that children with DLD relied more on gestures to convey meaning. Children with DLD focused mostly on a salient feature of the item to be guessed and they exploited it to provide the observer with visual non-verbal cues. The referential gestural representation of the items may derive from the fact that for these children the non-verbal modality is an alternative and a compensatory strategy accompanying their verbal productions, hindered by the language impairment. The number of adaptors (14%) could be explained by a feeling of discomfort caused by the interaction with an unknown examiner, or by moments of reflection.

As far as TD children are concerned, the most frequently produced gestures are beats (44%) and iconic gestures (26.4%). Beat gestures are not dependent on the content of speech but are used to structure and give rhythm to speech or emphasize a certain word.

During the description task children with DLD produced a much lower number of gestures compared to the number of gestures produced by typical children. During this task, the group produced as many deictic as iconic gestures (30%). Children with language disorders have trouble with spatial and temporal representation, therefore, we need to conduct specific qualitative analyses of the group performance: deictic gestures are produced more by two children in particular, while almost all children who produce gestures during this task produce iconic gestures.

Typically developing children produce a higher number of gestures. The group produced a majority of deictic gestures (40.8%) but also iconic gestures (31.9%). Children produced deictic gestures by pointing at a referent, often absent in the room or replacing the target referent by a same referent present in the room (*Deixis ad fantasma*, Bühler, 1934). Deictic gestures can also be finger movements tracing lines or drawing geometric forms, placing the elements of the room in the space around oneself. Above all, they can be movements of the arms or hands, to the right or to the left,

front or back, up or down, indicating the direction or the spatial placement of the elements of the room.

Gesture-speech relation

Since we know that, during the guessing game, children with DLD produced a majority of iconic gestures, we found a complementary or substitution relationship between speech and gestures: gestures convey either part of the message conveyed or the entire meaning of what the child wants to express, the verbal modality being absent. Since we know that, during the description task, children with DLD produced a majority of deictic and iconic gestures, the former have a complementary relationship with speech, while the latter are mainly in a relationship of redundancy (see Table 3).

Table 3. Gesture – speech relation during DLD children’s tasks

DLD: gesture-speech relation								
	GUESSING GAME				DESCRIPTION TASK			
	COM	IND	RED	SUB	COM	IND	RED	SUB
ADA	0.00%	14.39%	0.00%	0.00%	0.00%	17.14%	0.00%	0.00%
BEA	0.00%	8.77%	0.00%	0.00%	0.00%	20.00%	0.00%	0.00%
DEI	4.21%	0.00%	0.00%	1.05%	17.14%	0.00%	12.86%	0.00%
EMB	5.61%	0.00%	0.70%	3.86%	2.86%	0.00%	0.00%	0.00%
ICO	29.12%	0.35%	12.63%	19.30%	14.29%	0.00%	15.71%	0.00%
Total	38.94%	23.51%	13.33%	24.21%	34.29%	37.14%	28.57%	0.00%

As far as TD children are concerned, we know that during the guessing game they produced a majority of beat gestures, therefore we found an independent relation between gestures and speech. In particular, beat gestures are independent of the content of speech but not of the utterance structure, because these gestures give rhythm to the child’s speech. During the description task, TD children produced a majority of deictic gestures: these gestures mostly have a relationship of redundancy (the gesture refers to a referent already expressed verbally) and complementarity (the gesture complements the child’s utterance) with the verbal modality (see Table 4).

Table 4. Gesture – speech relation during TD children’s tasks

TD: gesture-speech relation								
	GUESSING GAME				DESCRIPTION TASK			
	COM	IND	RED	SUB	COM	IND	RED	SUB
ADA	0.00%	21.43%	0.00%	0.00%	0.00%	8.16%	0.00%	0.00%
BAT	0.00%	44.29%	0.00%	0.00%	0.00%	18.37%	0.00%	0.00%
DEI	3.57%	0.00%	0.00%	0.00%	15.65%	0.00%	17.69%	7.48%
EMB	0.00%	0.00%	0.00%	4.29%	0.00%	0.00%	0.00%	0.68%
ICO	15.71%	0.00%	7.14%	3.57%	14.29%	0.00%	14.97%	2.72%
Total	19.29%	65.71%	7.14%	7.86%	29.93%	26.53%	32.65%	10.88%

Discussion

The aim of this study was to investigate the use of gesture by children with developmental language disorder, in comparison to typically developing age-matched controls. Thus, we asked how children with DLD use gestures to convey meaning during two different types of activities, namely a guessing game and a description task. We hypothesized that children with DLD would rely more on gestures than TD children, throughout the two tasks proposed. This hypothesis was partially validated: children with DLD produced a higher number of gestures (285 occurrences) than TD children (140 occurrences) during the guessing game. A Wilcoxon Test showed that these differences were significant ($p = 0.01$). Children with DLD produced fewer gestures (70 occurrences) than the TD group (147 occurrences) during the description task. Differences between the two groups on this task were not significant ($p = 0.07$) as the number of gestures was related to the number of utterances. We also asked what types of gestures children produced during the two tasks, which led us to a second hypothesis: there would be a difference in the multimodal productions during the two tasks, especially in the use of gesture types. As expected, children with DLD produced more iconic gestures (61%) during the guessing game, whereas TD children produced more beats (44%) and iconic gestures (26%). Differences were significant only as far as emblems ($p = 0.03$) and iconic gestures ($p = 0.001$) were concerned. Children with DLD produced the same number of deictic and iconic gestures (30%) during the description task, whereas TD children produced more deictic gestures during the description task (40.8%). A Wilcoxon test showed no significant differences between DLD children and TD. Finally, a Wilcoxon Test showed significant differences in relation to the tasks for the DLD group ($p = 0.001$).

Our results are similar to those of other authors. In general, children with DLD in our study produced more gestures in relation to speech than TD children. This result confirms other authors' studies such as Blake et al. (2008), Iverson and Braddock (2011), and Mainela-Arnold et al. (2014). During the description task, children with DLD produced fewer gestures than TD children but they were mostly deictic and iconic, as suggested by Blake et al.'s study. In terms of gesture-speech relation, our findings go in the same direction as Mainela-Arnold et al. (2014) and Evans, Alibali and McNeil (2001) who found that, during a narration task, children with DLD were less redundant, so gestures conveyed more meaning than speech. Even though the tasks in the other studies mentioned above were different, we can say that, globally, children with DLD use more gestures as a compensatory strategy or to convey additional meaning, given that they have difficulties conveying verbally. As far as TD children are concerned, the abundant use of beats highlights the final stage of multimodal language acquisition: beat gestures emerge from five years old (McNeill, 1992) when almost all the linguistic structures are acquired and integrated by the child. We shall also stress the role of the task: the type of activity influences the amount and the type of gestures produced to convey meaning and the more difficult and complex is the task, the more gestures are produced or not, depending on the semantic content of communication. As was shown by the description task, children with DLD produced fewer gestures because their knowledge about space is limited, thus gestures are hindered as well as speech.

Conclusion

In conclusion, we found differences between groups, tasks and the type of gestures produced and their relation to speech. Gestures seem to be strongly complementary to speech. Thus, they are inherent to the elaboration of speech but according to the nature of the difficulties in the linguistic elaboration, gestures can either not be relied upon, which was the case during the description task, or be strongly mobilized and facilitate communication, which was the case during the guessing game.

The fact that not all children with DLD produced gestures during the guessing game, as well as the fact that not all children with DLD produced gestures during the description task, highlights the heterogeneity of this language disorder for which causes and effects are not fully known.

In this study, gestures seem to have two different functions: they are a support for children with DLD when they fail to use speech. Gestures are therefore an additional means that conveys information, sometimes absent from the child's speech. In addition, recourse to gestures takes place in particular in

cases where linguistic constraints are imposed or when children encounter difficulties in expressing concepts or accessing lexicon: during the guessing game, children had to be careful not to say certain words that would have been too transparent for the aims of the activity, that is, to make the interlocutor guess a word through explanation. Gestures, even the most referential ones, help children with DLD to communicate better and they occur in multimodal productions in which their relation is typically redundant but often complementarity to speech. These gestures seem to be a support for the child to fully express concepts conveyed verbally.

These findings show the complexity of gesture-speech coordination in children with DLD. Speech elaboration is a multimodal process in which gestures play an important role. However, according to the nature of the situation or activity, gestures can be either inhibited or strongly mobilized and facilitate expression. The interaction between spontaneous gestures, speech and mental representation of referents could be a key factor to improve language mastery in children with DLD.

Acknowledgment

The author would like to thank Anne Salazar Orvig and Aliyah Morgenstern for their support, advice and suggestions.

References

- Alibali, M.W., Evans, J.L., Hostetter, A.B., Ryan, K., & Mainela-Arnold, E. (2009). Gesture-speech integration in narrative: Are children less redundant than adults? *Gesture*, 9(3), 290-311.
- Blake, J., Myszczyzyn, D., Jokel, A., & Bebiroglu, N. (2008). Gestures accompanying speech in specifically language-impaired children and their timing with speech. *First Language*, 28(2), 237-253.
- Botting, N., Ritches, N., Gaynor, M., & Morgan, G. (2010). Gesture production and comprehension in children with specific language impairment. *British Journal of Developmental Psychology*, 28, 51-69.
- Bühler, K. (1934). *Sprachtheorie: Die Darstellungsfunktion der Sprache*. Jena: Gustav Fischer.
- Cienki, A. (2017). Cognitive linguistics, gesture studies, and multimodal communication. *Cognitive Linguistics*, 27(4), 603-618.
- Colletta, J.M. (2004). *Le développement de la parole chez l'enfant âgé de 6 à 11 ans: Corps, langage et cognition*. Hayen: Mardaga.
- Colletta, J.-M. et al. (2011). *Transcription et annotation de données multimodales sous ELAN – Manuel de codage*. Projet ANR « Multimodalité » 2005-2009.
- Conti-Ramsden, G., & Botting, N. (1999). Characteristics of children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, 42, 1195-204.
- Delage, H., Monjauze, C., Hamann, C., & Tuller, L. (2008). Relative clauses in atypical acquisition of French, In: A. Gavarró & M.J. Freitas (Eds.), *Language acquisition and development: Proceedings of GALA 2007* (pp. 166-176).
- Efron, D. (1941, 1972). *Gesture, race and culture: A tentative study of the spatio-temporal and "linguistic" aspects of the gestural behavior of eastern Jews and southern Italians in New York City, living under similar as well as different environmental conditions*. The Hague: Mouton.
- Ekman, P. (1976). Movement with precise meaning. *Journal of communication*, 26(3), 14-26.
- Ekman, P., & Friesen, W. (1969). The repertoire of nonverbal behavior: Categories, origins, usage and coding, *Semiotica*, 1(1), 49-98.
- Evans, J.L., Alibali, M.W., & McNeil, N.M. (2001). Divergence of verbal expression and embodied knowledge: Evidence from speech and gesture in children with specific language impairment. *Language and Cognitive Processes*, 16, 309-331.
- Iverson, J.M., & Braddock, B.A. (2011). Gesture and motor skill in relation to language in children with language impairment. *Journal of Speech, Language and Hearing Research*, 54, 72-86.
- Karmiloff, K., & Karmiloff-Smith, A. (2001/2003). *Comment les enfants entrent dans le langage*. Paris: Retz.
- Kendon, A. (1980). Gesticulation and speech: two aspects of the process of utterance, In: M.R. Key (Ed.), *The relationship of verbal and nonverbal communication* (pp. 207-227). The Hague: Mouton.
- Kendon, A. (2004). *Gesture: Visible action as utterance*. Cambridge, UK: Cambridge University Press.

- Mainela-Arnold, E., Alibali, M.W., Hostetter, A.B., & Evans, J.L. (2014). Gesture-speech integration in children with specific language impairment. *International Journal of Language and Communication Disorders*, 49(6), 761-770.
- McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago: University of Chicago Press.
- Morgenstern, A. (2014). Children's multimodal language development. In: C. Fräcke (Ed.), *Manual of language acquisition* (pp. 123-142). Berlin: De Gruyter.
- Parisse, C., & Maillart, C. (2009). Specific language impairment as systemic developmental disorders. *Journal of Neurolinguistics*, 22, 109-122.
- Tellier, M. (2008). *Dire avec des gestes. Le Français dans le monde. Recherches et applications, CLE International* (pp. 40-50). hal-00371029
- Vogt, S., & Kauschke, C. (2017). Observing iconic gestures enhances word learning in typically developing children and children with specific language impairment. *Journal of Child Language*, 44(6), 1458-1484.
- Wray, C., Norbury, C.F., & Alcock, K. (2016). Gestural abilities of children with specific language impairment. *International Journal of Language and Communication Disorders*, 51(2), 174-182.

To cite this article: Bellifemine, C. (2019). How children with developmental language disorder use co-speech gestures to communicate. In E. Babatsouli (ed.), *Proceedings of the International Symposium on Monolingual and Bilingual Speech 2019* (pp. 8-15). ISBN: 978-618-82351-3-7. URL: <http://ismbs.eu/publications-2019>