Early children's use of non-referential beat gestures predicts narrative abilities at 5 years of age

Ingrid Vilà-Giménez[1,2], Natalie Dowling[3], Özlem Ece Demir-Lira[4,5,6], Pilar Prieto[7,1], & Susan Goldin-Meadow[8,3]

[1]Dept. of Translation and Language Sciences, Universitat Pompeu Fabra, Catalonia
[2]Dept. of Subject-Specific Education, Universitat de Girona, Catalonia
[3]Dept. of Comparative Human Development, University of Chicago, IL, USA
[4]Dept. Of Psychological and Brain Sciences, University of Iowa, USA
[5]DeLTA Center
[6]Iowa Neuroscience Institute
[7]Institució Catalana de Recerca i Estudis Avançats (ICREA), Catalonia
[8]Dept. Of Psychology, University of Chicago, IL, USA

INTRODUCTION

- Children's early gesturing **precede and predict simple linguistic milestones** (Iverson & Goldin-Meadow, 2005).
- **Referential iconic gestures** (i.e., gestures that visually depict properties of a referent in speech, McNeill, 1992; e.g., character-viewpoint gestures) **predict** children's **better well-structured narratives** (Demir et al., 2015; Vilà-Giménez et al., 2020).
- **No study** has examined the **predictive role of non-referential gestures** produced in children's early spontaneous speech **in narrative abilities**.
- **Non-referential beat gestures** are devoid of semantic content and typically associate with prominent prosodic positions in speech. They (1) associate with **key positions in discourse**, and (2) perform a range of **pragmatic and discourse meanings** (Kendon, 2017; McNeill, 1992; Shattuck-Hufnagel et al., 2016; Vilà-Giménez et al., 2021, for a review).
- Non-referential beats have both **cognitive effects** (Llanes-Coromina et al., 2018) as well as act as **causal mechanisms for narrative performance** in children (Vilà-Giménez et al., 2019; Vilà-Giménez & Prieto, 2020).
- **Non-referential flips** (i.e., "palm-up" gestures, often with a shoulder shrug) convey **epistemic and interactive meanings** (Cooperrider et al., 2018).

RESEARCH QUESTION

(1) Does the early frequency of use of non-referential beat and flip gestures—vs. referential iconics—in early childhood predict narrative abilities at 60 months?
(2) Which pragmatic functions of speech are associated with these gestures?

METHODOLOGY

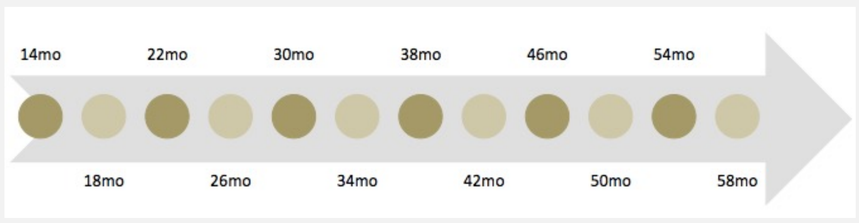
PARTICIPANTS A

45 parent-child dyads

- 20 females, 25 males
- Larger longitudinal study of language development: University of Chicago
- Monolingual English speakers; typically developing
- *M* parent education = 16.13 years (*SD* = 1.82)
- Racial, ethnic, economic, and educational diversity of Chicago area

MATERIALS & PROCEDURE B

- **14** (1;2 years) – **58** (4;8 years) **months of age**; visited in their home **every 4 months**
- 12 sessions of recordings (90' each): unguided parent-child interaction, including **mealtimes**, **book readings, play sessions, etc.**
- Children's **narratives at age 5** (*M* = 6; *SD* = 0,42); from Demir et al.'s (2014) study



60 months = 5 years of age

DATA ANNOTATION C

SPEECH: At the utterance level, determined by pauses, prosody, turn transitions and syntax.

GESTURES: (1) **Non-referential beat gestures**; (2) **Non-referential flip gestures**; (3) **Referential iconic gestures** (adapted from McNeill, 1992)

NARRATIVE STRUCTURE SCORES: Rating from 0-6; adapted from Stein et al.; e.g., Stein (1988)

CODING OF PRAGMATIC DISCOURSE FUNCTIONS D

- **18 children (**8 males, 10 females)
- *M* parent education = 15.5 years (*SD* = 2.25)
- Not significantly different from the group of 45 (*p* = .25)

PRAGMATIC CODING OF SPEECH:

- **Unbiased assertions** (declarative, explanation, information response)
- **Biased assertions or questions** (epistemic uncertainty, epistemic agreement, negation)
- **Requesting speech act**
- **Expressive speech act**

Adapted from Ninio et al. (1994). Based on Krifka's (2015) commitment space semantics framework

RESULTS (RQ1): Predictive analysis

Generalized Linear Mixed Model (GLMM)

Narrative structure scores

Predictors	*Estimates*	*Std. Error*	*CI*	*z value*	*p*
(Intercept)	3.465	0.338	2.803 – 4.128	10.247	**<0.001**
Non-referential beat gestures	0.299	0.111	0.081 – 0.518	2.689	**0.007**
Non-referential flip gestures	-0.163	0.109	-0.377 – 0.052	-1.489	0.137
Referential iconic gestures	0.029	0.077	-0.122 – 0.180	0.381	0.703
Observations	45				

Per session:
1.19 non-ref. beats (*SD* = 1.74); **1.86 non-ref. flips** (*SD* = 1.87); **3.58 ref. iconics** (*SD* = 2.73)

Model: 88.4% of the variance in narrative outcomes (R^2 = 0.884)

Descriptive results (RQ2): Pragmatic discourse functions

Total *N* of gestures
Non.ref. flips: 335; **Non-ref. beats: 222**; **Ref. iconics: 553**

- **Non-ref. flip gestures:** 40.7% with biased assertions/questions; 36.7% unbiased assertions.
- **Non-ref. beat gestures (19%):** 6.9% more likely than ref. iconics (12.1%) to be associated with *biased pragmatic functions.*
- **Ref. iconic gestures:** slight tendency to appear more often than beats (69.8%) on unbiased *(*74.5%; *d* = 1.82, *p* < .001*)* vs. biased functions.

MAIN CONCLUSIONS

- Children's early production of **non-referential beat gestures** but not non-referential flip gestures or referential iconic gestures **in parent-child interactions** significantly **predicts their later narrative abilities** at 5 years.
- *Non-referential beats*: **meaningful prosodic cues** that play an important **discourse-pragmatic role** starting early in children's language development. They may **reflect a distinct type of discourse knowledge**.
- Results in line with findings reporting **beneficial causal effects in training studies** (Vilà-Giménez et al.'s studies)
- The **information and discursive structure properties** of early non-referential beats can be a harbinger of subsequent narrative development.

Spanish Ministry of Science, Innovation and Universities (MCIU), Agencia Estatal de Investigacion (AEI), and Fondo Europeo de Desarrollo Regional (FEDER): PGC2018-097007-B-100; Generalitat de Catalunya: 2017 SGR_971; Generalitat de Catalunya, AGAUR: 2019FI_B2_00125; Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health: P01HD040605.

REFERENCES

- Cooperrider, K., Abner, N., & Goldin-Meadow, S. (2018). The palm-up puzzle: Meanings and origins of a widespread form in gesture and sign. *Frontiers in Communication, 3*, 1–16.
- Demir, Ö. E., Levine, S. C., & Goldin-Meadow, S. (2015). A tale of two hands: Children's early gesture use in narrative production predicts later narrative structure in speech. *J. Child Lang.*, *42*, 662–681.
- Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science*, *16*, 368–371.
- Kendon, A. (2017). Pragmatic functions of gestures. Some observations on the history of their study and their nature. *Gesture*, *16*, 157–175.
- Llanes-Coromina, J., Vilà-Giménez, I., Kushch, O., Borràs-Comes, J., & Prieto, P. (2018). Beat gestures help preschoolers recall and comprehend discourse information. *J. of Exp. Child Psychol., 172*, 168– 188.
- McNeill, D. (1992*). Hand and mind: What gestures reveal about thought.* Chicago, IL: University of Chicago Press.
- Shattuck-Hufnagel, S., Ren, A., Mathew, M., Yuen, I., & Demuth, K. (2016). Non-referential gestures in adult and child speech: Are they prosodic? In J. Barnes, A. Brugos, S. Shattuck-Hufnagel, & N. Veilleux (Eds.), *Speech prosody 2016* (pp. 836–839). Boston, MA: ISCA.
- Vilà-Giménez, I., Demir-Lira, Ö. E., & Prieto, P. (2020). *The role of referential iconic and non-referential beat gestures in children's narrative production: Iconics signal oncoming changes in speech*. Proceedings of the 7th Gesture and Speech in Interaction (GESPIN), KTH Speech, Music & Hearing and Sprakbanken Tal, Stockholm, Sweden.
- Vilà-Giménez, I., Igualada, A., & Prieto, P. (2019). Observing storytellers who use rhythmic beat gestures improves children's narrative discourse performance. *Dev. Psychol*., *55*, 250–262.
- Vilà-Giménez, I., & Prieto, P. (2020). Encouraging kids to beat: Children's beat gesture production boosts their narrative performance. *Dev. Sci., 23*, 1–14.
- Vilà-Giménez, I., & Prieto, P. (2021). The value of nonreferential gestures: A systematic review of their cognitive and linguistic effects in children's language development. *Children, 8*, 148.