

# Narrative structure scores in 7- to 9-year-old children are positively linked to fluent referential iconic gesture use and vocabulary knowledge

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Oral narrative abilities and vocabulary knowledge are important precursors to literacy in childhood (Dickinson & Tabors, 2001). Previous research has demonstrated that both receptive and expressive vocabulary skills are related and can be used to predict narrative performance across atypical and typical populations (e.g., Karlsen et al., 2021; Uccelli & Pérez, 2010). Further in development, studies with older children pointed out that gesture and narrative development co-develop with age (Colletta et al., 2015; Colletta et al., 2010) and that both referential and non-referential gestures produced in a narrative retelling task bootstrap and predict narrative discourse skills (Demir et al., 2015; Vilà-Giménez & Prieto, 2020). However, while most of the studies used longitudinal data, the concurrent relation between narrative abilities and gesture frequency is less clear, yielding mixed findings. For instance, a study by Pronina et al. (2023) found that, when controlling for age, gesture use in a context-based gesture elicitation task emerged as a significant negative predictor of the narrative scores in 3 to 4-year-olds. Here we expand the developmental window, focusing on 7- to 9-year-old children's narrative retellings to assess two main goals: 1) to examine the concurrent relation between narrative structure scores, vocabulary knowledge, and the production of fluent gestures at 7-9 years old, and 2) to determine what gesture types (i.e., referential iconic and non-referential gestures) are most predictive of narrative structure scores at this age. Crucially, we exclusively use the number of gestures used in fluent speech, avoiding in this way gestures associated with a disfluency function.

Eighty-three 7- to 9-year-old Catalan-Spanish bilingual children took part in the study ( $M_{age} = 7.98$  years;  $SD = 0.60$ ). The participants were part of the audiovisual narrative corpus by Vilà-Giménez and colleagues (2023). A narrative retelling task was administered to all participants, in which they were asked to watch and retell two wordless cartoons randomly selected from a set of four cartoons, yielding a total of 166 video-recorded stories (average length: 28.4 s;  $SD = 9.49$ ). All narratives were coded for gesture type (*referential iconics*, i.e., which imagistically portray or refer to semantic content in speech, and *non-referentials*, i.e., which lack semantic content) and were manually analyzed and scored from 0 to 6 for *narrative structure* (adapted from Demir et al., 2014). A measure of receptive vocabulary knowledge was obtained by administering the Peabody Picture Vocabulary Test-III (Dunn et al., 2010) in Catalan, the children's dominant language ( $M = 86.37\%$ ;  $SD = 9.38$ ).

To address the first aim, two GLMM regression analyses were conducted to examine the concurrent association between narrative structure scores, vocabulary knowledge, and overall gesture rate ( $n = 448$ ) produced in narrative speech. Results from the first regression analysis showed that variation in receptive vocabulary scores explained 70% of the variation in narrative structure scores, and the association was positive ( $\beta = .001$ ,  $SE = .000$ ,  $z = 2.69$ ,  $p = .007$ ). In a second regression analysis, we added the overall gesture rate and found significant effects for both receptive vocabulary knowledge ( $\beta = .001$ ,  $SE = .000$ ,  $z = 2.166$ ,  $p = .030$ ) and the total number of gesture use ( $\beta = .003$ ,  $SE = .002$ ,  $z = 2.534$ ,  $p = .011$ ). The explained variation increased to 84% (see Figure 1A).

Regarding the second goal of the study, to test the contribution of referential iconic gestures ( $n = 212$ ), we repeated the previous GLMM regression analysis by replacing the overall gesture frequency with the referential iconic gesture frequency. Results showed that both receptive vocabulary scores ( $\beta = .001$ ,  $SE = .001$ ,  $z = 2.406$ ,  $p = .016$ ) and the total number of referential iconic gesture use ( $\beta = .007$ ,  $SE = .002$ ,  $z = 3.022$ ,  $p = .003$ ) had a significant effect on children's narrative structure scores. The explained variation was 73% (see Figure 1B). We then repeated the same regression analysis by replacing the referential iconic gesture frequency with the non-referential gesture frequency ( $n = 236$ ). Results revealed that only receptive vocabulary scores proved to be the only significant predictor of narrative structure scores ( $\beta = .001$ ,  $SE = .001$ ,  $z = 2.352$ ,  $p = .019$ ), explaining 88% of the variation (see Figure 1C). However, the non-referential gesture rate did not explain additional variation in narrative structure scores when it was added to the model ( $p = .315$ ).

Our findings, on the one hand, corroborate previous research showing the importance of vocabulary knowledge as a good predictor of children's better-structured narratives at later stages of narrative development, particularly between ages 7 and 9. Crucially, on the other hand, overall gesture rate and referential iconic gesture rate also emerge as strong predictors of 7- to 9-year-olds' narrative performance. Interestingly, while referential iconic gestures are found to be positively linked with narrative performance in this developmental phase, non-referential gestures are not, something that could be influenced by both the type of narrative discourse and the differences in developmental paths between both gesture types in narrative discourse. The study supports previous evidence that language and gesture development are closely connected across development and pinpoints more complex relations between vocabulary and gesture use in children's narrative development at later stages of development.

**Index Terms:** gesture rate, vocabulary knowledge, narrative development

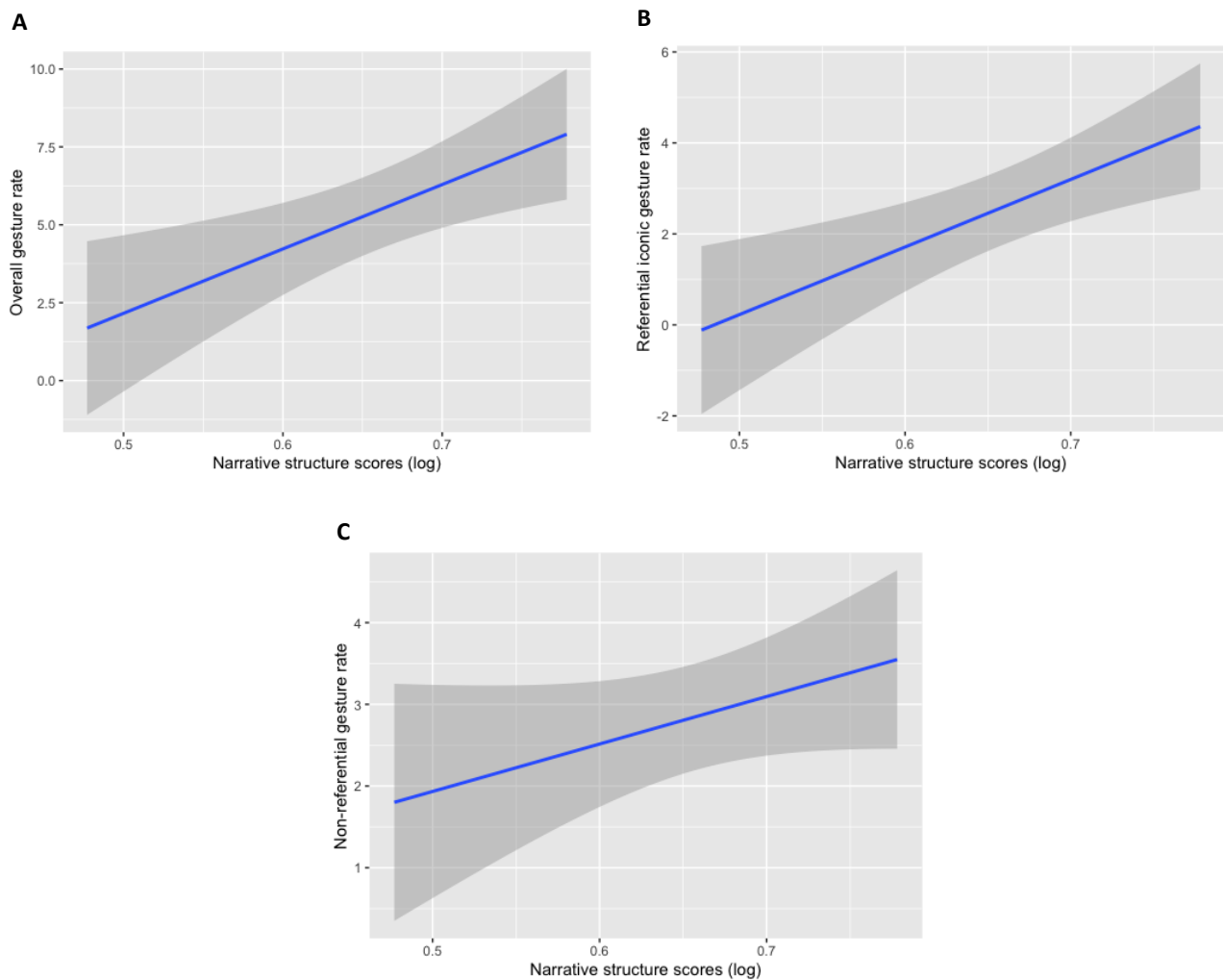


Figure 1: The figure shows the relation between overall gesture rate (A), referential iconic gesture rate (B), non-referential gesture rate (C) and narrative structure scores, as estimated by regression analysis.

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