Verb bias in individuals with developmental language disorder

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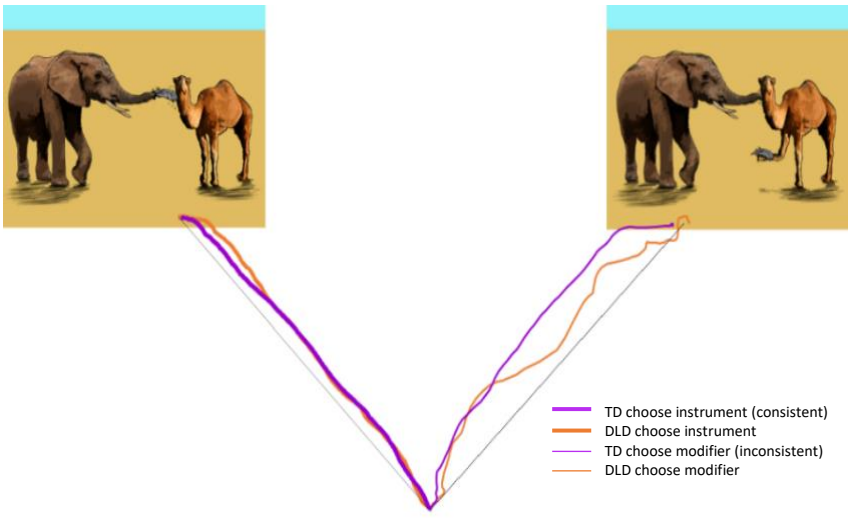
Background. Children can use information associated with a verb to predict its argument, an effect termed *verb bias* (e.g., Snedeker and Trueswell, 2004). Verb bias is flexible and reflective of lifelong learning (Peter et al., 2015; Ryskin et al., 2016), but it has not been examined in children with developmental language disorder (DLD). Based on studies of children with DLD that show poor verb learning (Oetting et al., 1995) and difficulty with verb argument structure (Ebbels, 2005; Thordardottir & Ellis-Weismer, 2002) relative to typically developing (TD) peers, as well as findings from our own study of verb bias with college-age participants with DLD (Hall et al., 2019), we predict children with DLD will be less sensitive to verb bias than their TD peers.

Methods. We tested verb bias sensitivity in 37 children, 7-9 years old, 17 of whom were identified as having DLD by a score of 95 or lower on the Structured Photographic Expressive Language Test, 3rd edition (Dawson, Stout, & Eyer, 2003). Children listened to sentences that were syntactically ambiguous but could be disambiguated using verb bias, with the same biased verbs as Snedeker and Trueswell (2004): "The elephant pokes the camel with the feather." Children used a computer mouse to choose between two pictures that each contained a possible interpretation of the sentence: one in which "with the *x*" is interpreted as an instrument and one in which it is interpreted as a modifier (see Figure 1). Picture choice served as an explicit measure of verb bias sensitivity; mouse tracking provided an implicit measure.

Results. A mixed effects logistic regression revealed that participants across groups were 84% likely to choose instrument on any given trial, $p < .0001$. The bias of the verb did not influence choice of interpretation, $p = .17$; participants were 88% likely to choose the instrument picture when the bias was instrument, compared to 79% likely when the bias was modifier. Mouse movements reflected some sensitivity to verb bias, with trajectories that curved more toward the unselected picture when their response was inconsistent with verb bias, $p = .03$ (see Figure 1). Diagnostic group membership did not contribute significantly to either model, ps > .05. We ran a secondary analysis comparing children and adults. We included as a covariate the strength of verb bias, as measured by norms in Snedeker and Trueswell (2004). We found a significant interaction between age, diagnostic group, verb bias, and strength of bias. TD adults had more curved trajectories when they chose modifier on strongly instrument-biased trials than on weakly instrument-biased trials, ps < .05, an effect no other group showed (see Figure 2).

Conclusions. Our findings were surprising because verb bias is evident at younger ages, and in our study with adults with identical stimuli, verb bias significantly impacted interpretation choice for both DLD and TD groups. However, results fit a pattern of findings of ongoing development. In Snedeker and Trueswell (2004), verb bias cues outweighed referential cues for 5-year-old children, differentiating them from adult participants. But children's eye movements indicated emerging consideration of referential cues. Peter et al. (2015) also found age effects for verb bias in their study of 3-6-year-olds and adults. We propose the 7-9-year-olds in our study are learning to integrate and weight different cues to interpret sentences. This instability may account for both the differences from adult performance as well as the lack of diagnostic group differences in children. Our finding of graded sensitivity to verb bias in TD adults is further evidence that verb bias and cue weighting may remain relatively unstable for individuals with DLD while their TD peers become more consistent and stable over development.



Participant hears "The elephant pokes the camel with the feather."

Figure 1. Solid lines represent averaged mouse trajectories for choosing an interpretation consistent with bias (left) and inconsistent with bias (right) for children with typical development (TD, pink) and developmental language disorder (DLD, orange). Thin black lines represent ideal lines from start to end point from which maximum deviation was measured, the dependent variable in our analyses. Trajectories are straighter for both groups when they chose interpretations consistent with verb bias.

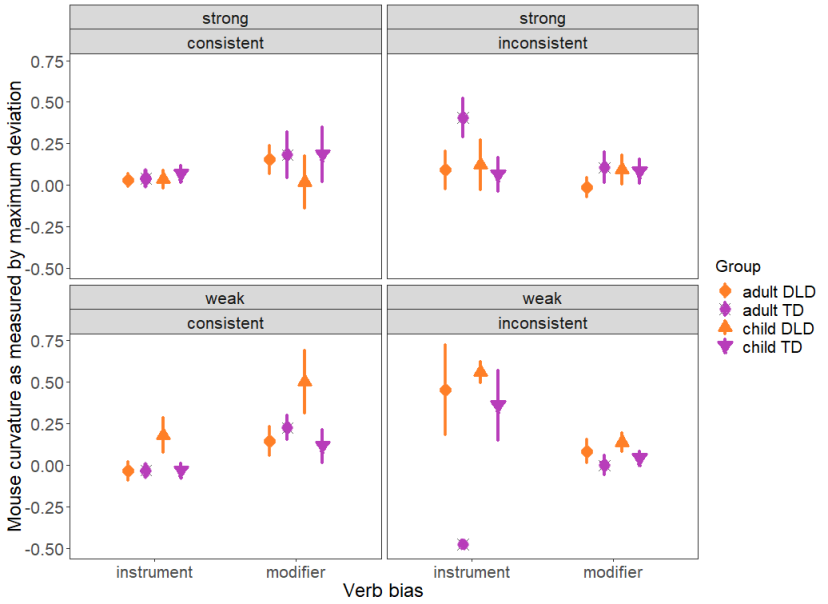


Figure 2. Mean mouse trajectories by age and diagnostic group for trials with strongly biased verbs (top) and weakly biased verbs (bottom), for responses consistent with verb bias (left) and inconsistent (right). TD adults (pink circles) showed more curved trajectories on trials when their choice was inconsistent with strongly instrument-biased verbs compared with other trial types, an effect no other group showed.

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