

The distribution of biased versus alternating verbs affects preschoolers' verb bias adaptation

Language learning requires balancing the productive power of language with its many constraints. For example, most verbs can appear in multiple subcategorization frames, but individual verbs have different subcategorization probabilities, called 'verb bias'. Verb bias influences comprehension (e.g., Snedeker & Trueswell, 2004) and production (e.g., Gahl & Garnsey, 2004; Rowland, Chang, Ambridge, Pine, & Lieven, 2012) in adults and children. Artificial language learning studies, and training studies with familiar verbs, show that linguistic distributional learning can create verb bias learning. In *artificial language learning tasks*, adults successfully learn the biases of new verbs, as long as the majority of verbs in the language are biased toward one structure (Wonnacott, Newport, & Tenenhaus, 2008; Perek & Goldberg, 2015; Thothathiri & Rattinger, 2016). In contrast, an artificial language with many more alternating than biased verbs promotes across-verb generalization, and thus less reliance on individual verb biases. These patterns suggest that adults simultaneously track statistics at multiple linguistic levels, learning both about the syntactic behavior of individual verbs, and about the behavior of verbs in general. Similar multi-level learning about the co-occurrence of nouns and particles has been observed in children (Wonnacott, 2011). *Training studies with familiar verbs* have shown that adults and children track verb-syntactic distributions in new linguistic input, which then influence their subsequent production choices (Coyle & Kaschak, 2008; Lin & Fisher, 2017; Thothathiri, Evans, & Poudel, 2017). Does this adaptation depend on the distribution of biased versus alternating verbs within the task, as suggested by artificial language studies? We explored this question with children using a video description task.

Four- and five-year-old children (N = 74) described short videos depicting simple transfer events using 5 dative verbs, *throw*, *pass*, *bring*, *give* and *show*. An experimenter provided the sentence stems that children repeated and completed to describe the videos. In the *training phase*, the sentence stems ended at the first post-verbal noun phrase, constraining children to produce either a double-object dative (DO: Kate threw the pig __) or a prepositional-object dative (PO: Kate showed the fork __). These stems allowed us to restrict some verbs to appear only in the DO structure, others in the PO structure, and others to alternate between the two in training. In the *test phase*, the stems ended at the main verb (Kate threw __), allowing children to choose either structure. The 5 verbs were interspersed throughout training and test. The key manipulation involved the ratio of biased versus alternating verbs. The *high-alternating* condition had 1 DO-trained verb, 1 PO-trained verb, and 3 alternating verbs that occurred equally frequently in the two structures. The *low-alternating* condition had 2 DO-trained verbs, 2 PO-trained verbs, and 1 alternating verb. The assignment of verbs to training structure was counterbalanced across participants and low- vs. high-alternating conditions. We predicted that children would strongly adapt their existing verb biases in the low-alternating condition where most verbs were biased, but not in the high-alternating condition where most verbs alternated.

Children who did not produce both double-object and prepositional-object datives at test (an additional 9 children) were excluded from the final analyses. Test responses revealed effects of verb bias training that differed between the low-alternating and high-alternating conditions (Fig-1). In the low-alternating condition, children produced significantly more DO completions for DO-trained verbs than for PO-trained verbs. In the high-alternating condition, however, the rate of DO completions was about the same for all verbs. We also saw effects of pre-existing verb biases on the overall rate of DO completions in both conditions.

Our results lend support to a role for multi-level distributional learning in syntax acquisition and verb learning. Previous artificial language studies suggested that adults can simultaneously track the syntactic distributions of individual verbs and the distribution of verb-general properties across the whole language (e.g., Wonnacott et al., 2008). Here we show that 4- and 5-year-old children can similarly track statistics at multiple levels, within their native language, and that what they learn depends on which source of information is the most reliable in their input.

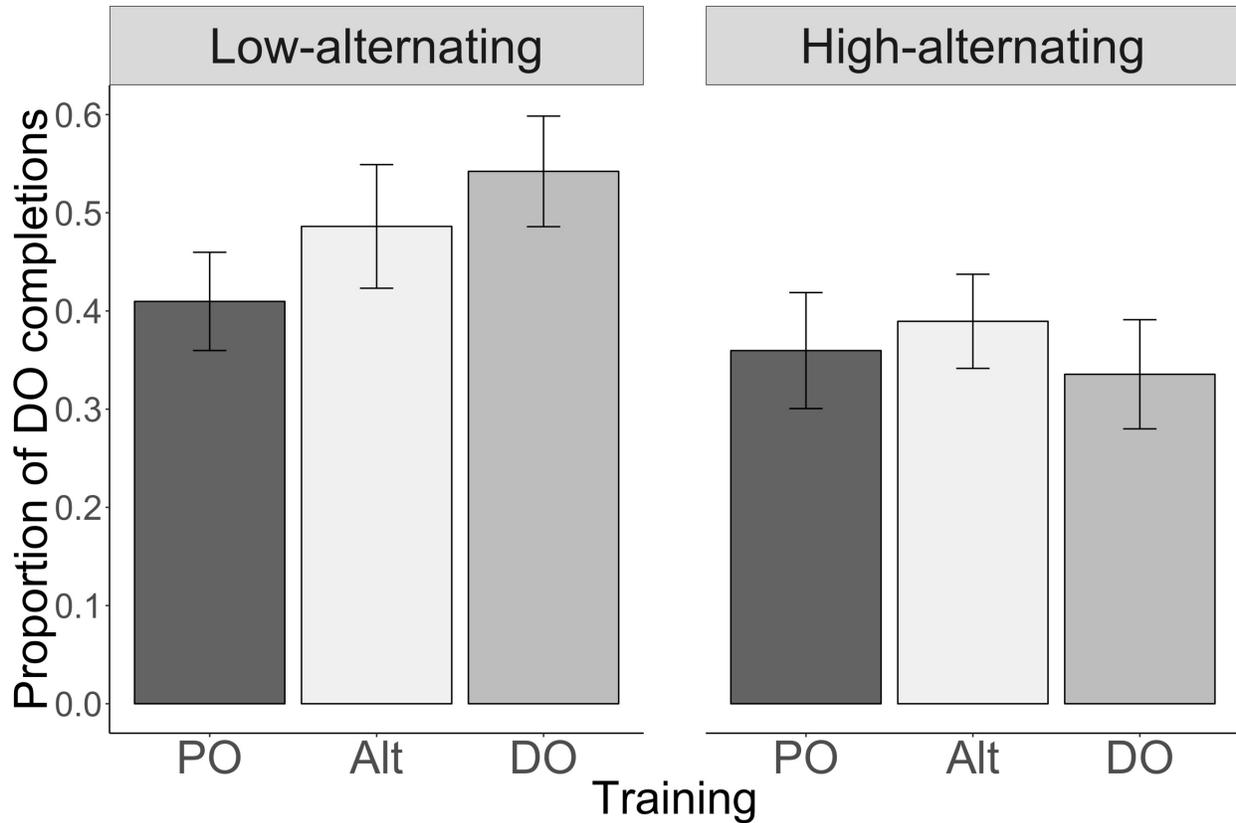


Fig-1. Mean proportion of double-object descriptions (out of double-object or prepositional-object datives only) for DO-trained, PO-trained, and alternating verbs in the low-alternating condition (left; 4 verbs are biased and 1 verb alternates) and in the high-alternating condition (right; 2 verbs are biased and 3 verbs alternate). Mixed effects logistic regression revealed a significant interaction between condition (low-alternating vs. high-alternating) and training structure. Follow-up analyses revealed a significant effect of training structure in the low-alternating condition but not in the high-alternating condition. Error bars reflect standard errors of the mean.