

Learning new linguistic information about familiar verbs in 5-year-olds and adults

Probabilistic knowledge of the sentence-structures occurring with particular verbs -- *verb bias* -- guides sentence processing in adults and children (Snedeker & Trueswell, 2004). For example, in *Tickle the pig with the flower*, the underlined prepositional-phrase (PP) could stipulate an instrument for tickling, or could be a modifier describing the pig. Online interpretations of such ambiguities depend on whether the verb takes instrument-PPs often ("tickle"), or rarely ("choose").

How do we learn verb bias? Multiple information-sources may contribute. One possible source is *event knowledge*. Upon encountering a verb, adults and children retrieve knowledge of likely referent events (Altmann & Kamide, 1999; Borovsky et al., 2012). Perhaps we interpret *with*-PPs as instruments following *tickle* because tickling-events plausibly involve instruments. On the other hand, many have argued that verb learning and sentence interpretation depend on linguistic-distributional knowledge (Trueswell & Gleitman, 2004; Wonnacott et al., 2008). Perhaps we interpret *with*-PPs as instruments following *tickle* because this verb has often appeared in sentences with instrument-PPs. In natural language exposure, these two information-sources are confounded. Here we experimentally explore what aspects of ongoing linguistic experience influence children's and adults' verb-bias knowledge.

In Experiments 1 (5-year-olds) and 2 (adults), participants watched dialogue-videos in which 8 familiar verbs ("equi-bias" verbs; Snedeker & Trueswell, 2004) preceded ambiguous *with*-PPs (Fig-1a). Discourse context and noun-phrase choice promoted either instrument or modifier interpretations of the dialogue *with*-PPs. Each participant heard instrument and modifier dialogues, for different verbs. Next, in the test phase, participants followed instructions containing ambiguous *with*-PPs ("Feel the frog with the feather!"), by moving toys in a display while a camera recorded their eye-movements. Eye-movements revealed effects of the training dialogues: Children and adults looked more at target instruments and less at target animals for test sentences containing verbs they had heard in instrument rather than modifier dialogues (Fig-2a, 2b). Thus, brief linguistic exposure modified the biases of familiar verbs.

The dialogues of Experiments 1-2 used *with*-PPs to describe events involving instruments or modifiers; thus they provided both linguistic-distributional and event information. In Experiment 3 (5-year-olds), we replaced the *with*-PPs in the dialogues with phrases that described the same events using different linguistic expressions (e.g., *using the towel*; Fig-1b). At test, children heard the same instructions as in Experiments 1-2, containing ambiguous *with*-PPs. Comprehension questions in the dialogue-phase confirmed that children understood these dialogues as well as those of Experiment 1; nonetheless, 5-year-olds' eye-movements at test revealed notably weaker effects of the revised dialogues (Fig-2c). No analysis-interval revealed a reliable dialogue effect on interpretation of ambiguous *with*-PPs; in analyses of gaze patterns across the test sentence, the dialogue effect in Experiment 3 was marginally smaller than that of Experiment 1. This suggests that the wording of the training dialogues, not only their event content, mattered.

These findings point to effects of linguistic-distributional knowledge in verb-bias learning. During the dialogues, listeners encoded information about each verb's occurrence with instrument versus modifier *with*-PPs (not just instrument versus modifier phrases of any kind), and later used that information to interpret ambiguous PPs.

Fig. 1

a. Experiment 1 & 2 Dialogue Phase



Instrument Training

A: I love the game Black Box. How did you feel the fish?

B: I felt the fish with the bath towel!

Modifier Training

A: I love the game Black Box. Which fish did you feel?

B: I felt the fish with the pretty tail.

b. Experiment 3 Dialogue Phase



Instrument Training

A: I love the game Black Box. How did you feel the fish?

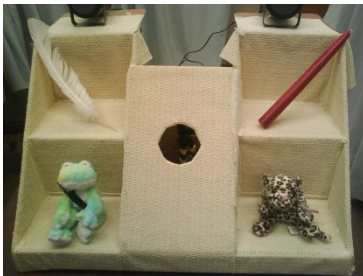
B: I felt the fish using the bath towel!

Modifier Training

A: I love the game Black Box. Which fish did you feel?

B: I felt the fish that has the pretty tail.

c. Test Phase



Look at the camera.

Feel the frog with the feather.

Now make both animals jump over the candle.

Fig. 1: Example Dialogue and Test phases for Experiments 1-3. (a) Sample dialogue sentences in Experiments 1 (5-year-olds) and 2 (adults). For each verb, each participant heard either an instrument or a modifier training dialogue. b. Dialogue video in Experiment 3 (5-year-olds); c. Toy layout for the test sentence *Feel the frog with the feather*. The target animal is the green frog, which is holding a feather. The target instrument is the big feather. Other display items include another possible instrument (the big candle) and another animal (the leopard, which has a tiny candle).

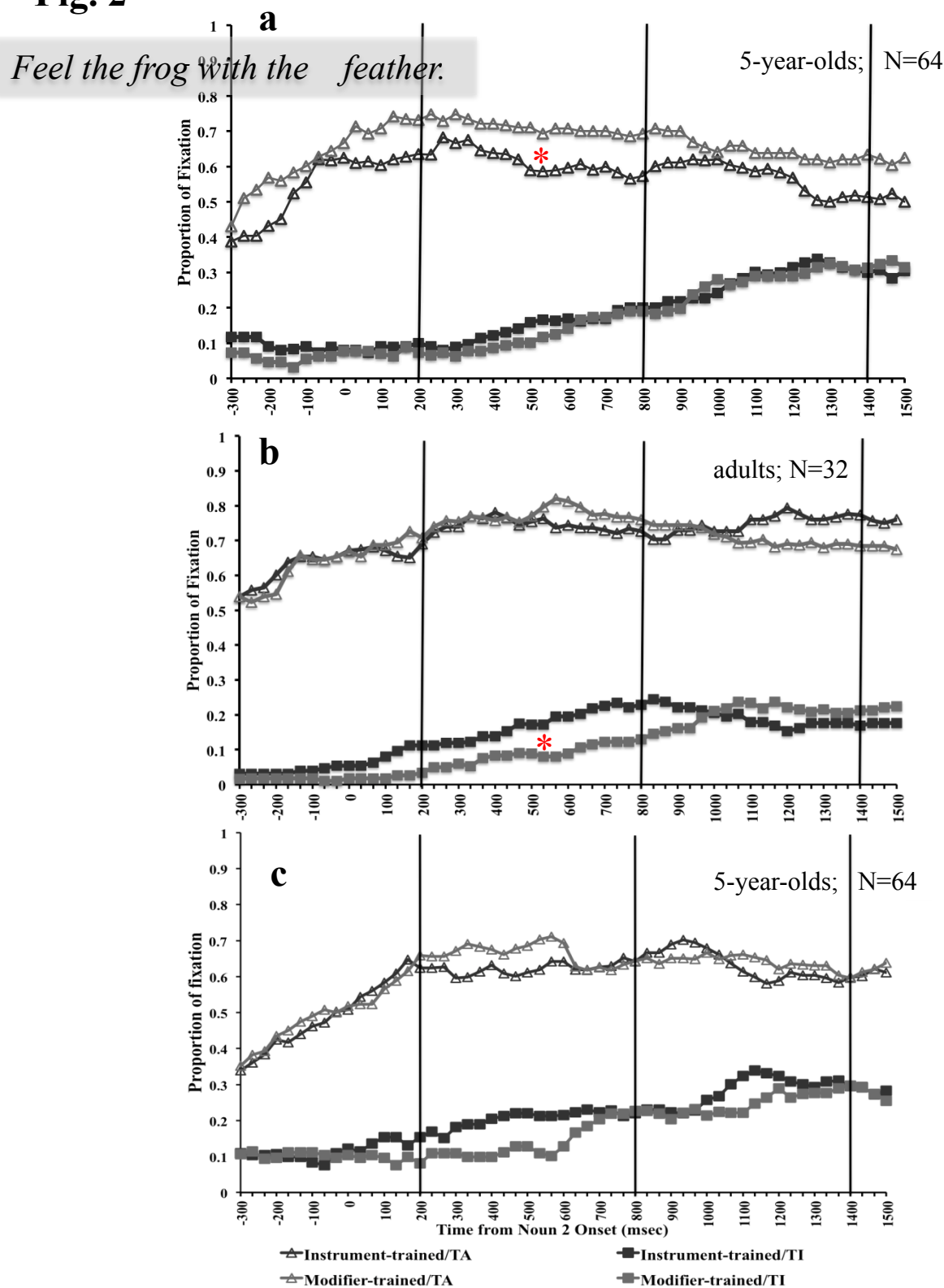
Fig. 2

Fig. 2. Fixations to target animal and target instrument after the onset of the *with*-PP object noun (e.g., *feather*) in Experiment 1 (a), 2 (b) and 3 (c), offset by 200 msec to allow time to program an eye-movement. The dark grey lines represent test trials containing instrument-trained verbs. The light grey lines represent test trials containing modifier-trained verbs. The vertical lines in each plot define the width of the analysis window. TA: target animal; TI: target instrument. A red asterisk indicates significant differences between the two training conditions.