

Pronoun resolution, cue frequency, and cue reliability
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Adults employ multiple cues to pronoun resolution: the syntactic positions, order and thematic roles of potential antecedents, sentential aspect, and discourse connections between utterances.¹⁻⁴ Some of these cues, such as the *first-mention bias*, apply widely: across a broad range of contexts, pronouns refer to the first-mentioned entity in the previous sentence (1; the *first-mention bias*).²⁻⁴

(1) Mary₁ went to the store with Sally₂. She₁ bought ice cream.

Others, like *implicit causality*, are narrower in scope.¹ In sentence like (2), pronoun resolution systematically depends on the verb. For instance, *frighten* gives rise to subject resolutions (*Mary*) whereas *fear* gives rise to object resolutions (*Sally*). Moreover, in at least some cases this is a systematic effect of verb semantic class: essentially *all* experiencer-object verbs (*frighten*, *confuse*) give rise to more subject resolutions than all experiencer-subject verbs (*fear*, *love*). Finally, as shown below, this effect depends crucially on the discourse connective *because*. In sentences like (3) experiencer-object verbs now elicit *object* resolutions while experiencer-subject verbs elicit *subject* resolutions.

(2) Mary VERBs Sally because she...

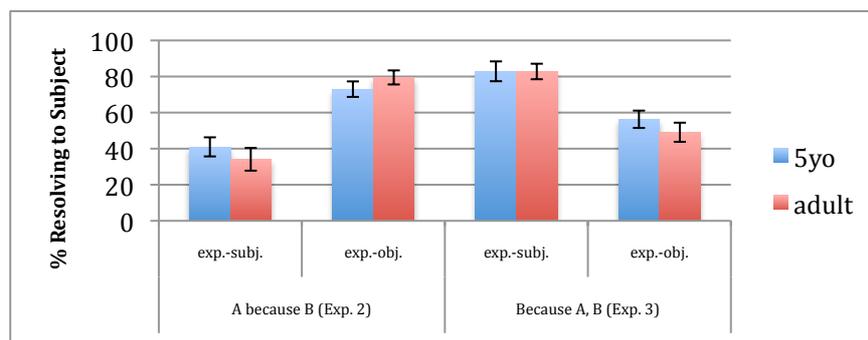
(3) Because Mary VERBs Sally, she...

If pronoun resolution cues are learned directly from the input, one might expect the *first-mention bias* to be learned prior to these *implicit causality* patterns simply because first-mention is applicable to a much wider range of sentences and thus occurs more often.³ Alternatively, if pronoun resolution is an merely an emergent properties of discourse interpretation or if cue reliability is more critical than cue frequency, then implicit causality cues might be acquired first.

Evidence for early acquisition of the first-mention bias is weak. Using online and offline measures, Arnold and colleagues found no first-mention bias in 4-6yos.³ Using preferential looking, Song and Fisher found a first-mention bias in much younger children, but the effect was small and emerged only after several seconds.⁴ Here we explore whether 5yos are sensitive to the implicit causality cue.

In Experiment 1, adults and 5yos listened to 4 sentences like (2) involving experiencer-subject verbs and 4 involving experiencer-object verbs as they viewed accompanying illustrations and their eye movements were tracked. These sentences were completed with neutral continuations (*is such a silly girl*). At the end of each sentence, participants were asked to *point at her*. Like adults, children were more likely to point to the subject (*Mary*) in sentences with experiencer-subject than experiencer-object verbs (Figure 1; *ps*<.05). This effect reversed in Experiment 2, which employed the sentence frame (3) but which was otherwise identical (Figure 1; *ps*<.05). Eye-tracking measures revealed compatible results.

Thus, at an age at which evidence for the first-mention bias is inconclusive, children showed clear sensitivity to implicit causality. This is striking given the paucity of relevant input (*because* appears in less than 1% of adult utterances in CHILDES). These results suggest that local pronoun



resolution cues may be learned first, consistent with theories in which pronoun resolution is a side-effect of discourse processing and the first-mention bias is a statistical generalization over a collection of independent, local biases for different kind of discourse connections.

Figure 1

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