Integration of discourse and semantic structure in children's resolution of ambiguous pronouns

The interpretation of non-reflexive pronouns depends on a complex interplay of semantic factors and discourse constraints.[1] One extensively studied effect is implicit causality, which is particularly apparent in sentences involving *psych-verbs*.[2,3,4,5,6]

(1) Sally *frightens* Mary because she is mean.

(2) Sally *fears* Mary because she is mean.

"She" appears to refer to Sally in (1) but Mary in (2), an effect which emerges rapidly in on-line processing.[5,6] The word *because* indicates that the second clause explains the first. Since explanations often refer to causes, many researchers interpret implicit causality as a pragmatic inference based on world knowledge about the likely causes of events.[2,3,5,6] Pragmatic inferencing appears to be slow and variable in children.[7,8,9] Thus, on this account we might expect the effect of implicit causality on online pronoun resolution to emerge late in development even though children can infer implicit causes of events in offline tasks.[10,11]

An alternative is that the "cause" of psych-verbs like *frighten* and *fear* is semantically encoded; in (1), Sally carries the semantic role CAUSE, while in (2), Mary has the CAUSE role. Indeed, most *frighten*-verbs (cause-subject) bias the subsequent pronoun to the subject, and all *fear*-verbs (cause-object) bias the pronoun to the object.[4] No pragmatic inference is required at the pronoun because the cause is linguistically encoded in the first clause, and thus this online effects might appear as soon as children master the relevant linguistic structure.

Pretesting revealed 5yos but not 4yos reliably process the semantic structures of both *frighten*-verbs and *fear*-verbs (distinguishing *Sally loves Mary* from *Mary loves Sally*). A subset of *frighten*-verbs and *fear*-verbs verbs known equally well to 5yos was selected. Adults and 5yos listened to sentences like (3) accompanied by scenes including the two mentioned characters, while their eye-movements were recorded.

(3) Arthur likes Diego very much, because he is such a nice boy. Can you point to him?

Adults and 5yos pointed to the subject in the *frighten*-verbs condition and the object in the *fear*-verbs condition, though children did not reach significance in the *fear*-verb condition (Table 1). Eye-tracking data (Table 2) revealed that while the bias emerged rapidly for *frighten*-verbs (adults: 300-400ms after pronoun onset; kids: 700-800ms after pronoun onset), *fear*-verbs elicited equal fixations to both targets until "point to him."

Thus children who are just mastering psych-verbs perform similarly to adults in both on-line and off-line measures, consistent with either early pragmatic competence in this domain or with implicit causality being driven by linguistic structure. Surprisingly, an on-line difference between *frighten*-verbs and *fear*-verbs verbs was observed in both groups. This difference has not been previously reported, presumably because processing studies have not distinguished the two classes of verbs.[5,6] These results are consistent with a semantic analysis in which *frighten*-verbs directly encode cause, while *fear*-verbs do not.[12] On this account, (2) requires an extra pragmatic inference, leading to slower online processing and perhaps explaining 5yos slightly worse performance.

480 words

Table 1

	Adults	Children
CS	79% (4%)**	72% (5%)**
CO	38% (5%)*	42% (5%)

*Percent choosing grammatical subject, with standard errors. Statistical difference from chance: * p<.05, ** p<.01. Adults and children differed in neither condition (ps > .1)*

Table 2

	0	100	200	300	400	500	600	700	800	900	1000
Adults (N=28)											
CS	47%	50%	54%	**58%***	**64%***	**64%***	**65%***	**62%***	**61%***	**60%***	**59%***
CO	48%	46%	47%	52%	51%	52%	49%	47%	46%	48%	47%
5yos (N=27)											
CS	60%	57%	56%	54%	56%	58%	59%	**58%***	**60%***	**62%***	**63%***
CO	56%	54%	49%	46%	47%	46%	46%	45%	45%	45%	44%

*Looks to grammatical subject / (looks to either character) in 100 ms time windows from pronoun onset + 200 ms (to correct for saccade planning and launch). * p<.05, ** p<.01*

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