

What do eye movements tell us about reference resolution? using ambiguous pronouns to evaluate the linking hypotheses / Daphna Heller, Eiling Yee and Julie C. Sedivy

Obtaining a real-time perspective on anaphora resolution calls for a methodology that measures interpretation as it happens. The visual world eye-tracking paradigm seems especially suitable, as eye-tracking does not interrupt processing.

Although the visual world paradigm was developed specifically for measuring reference resolution, it was designed for action-based tasks such as picking up or clicking on an object. Because people typically fixate an object before reaching for it, it is assumed that in such tasks, proportions of looks are directly correlated with certainty in resolving reference. Action-based tasks, however, are not ideal for studying linguistic phenomena in narrative discourse. This has led investigators to use a 'passive listening' task, assuming that removing the action component will not alter the relationship between reference resolution and the probability of fixations. If fixations during pronoun resolution simply reflect attentional state, this assumption is unproblematic: a monotonic relationship should hold between the salience (or accessibility) of the referent and the probability of fixating it. If, however, looks reflect planned actions, then once the action component is removed, the link between fixations and reference resolution may be compromised.

To examine the relationship between eye-movements and salience, we examined the effects of discourse-based biases on the resolution of linguistically ambiguous pronouns. We constructed 4-sentence discourses, manipulating the relative discourse salience of two referents in the first two sentences. The third sentence contained an ambiguous pronoun (see table). Offline judgments confirmed that these three conditions differed in the degree of referential bias towards the intended antecedent (strong-bias, weak-bias and very-weak-bias). 42 participants then listened to these discourses while passively viewing scenes that contained objects and animals referred to in the stories. Upon encountering the pronoun, participants initiated fewer looks to the referent in the 'strong-bias' condition than in the 'weak-bias' condition. Furthermore, they were no more likely to fixate the referent in the 'strong-bias' condition than in the 'very-weak-bias' condition. There was a nonsignificant trend towards more fixations to the referent in the 'weak-bias' condition than in the 'very-weak-bias' condition.

We explore a multifaceted relationship between eye-movements and reference resolution in which fixations reflect the interplay between resolution and the interrogation of the scene required to achieve the targeted task. In passive listening, fixations are driven by reference resolution, but can also help facilitate it by increasing the salience of a potential referent. Thus, when a referent is extremely accessible, the visual support derived from fixating it is superfluous. Therefore, a monotonic correspondence between accessibility and fixations should exist only up to a certain level of salience. In active tasks, a more monotonic relationship may emerge due to differences in visual interrogation required to perform the action. Thus, passive listening may show a less tight relationship between resolution and fixations, while revealing something about the attentional salience of potential referents.

To evaluate the role of the experimental task, we are in the process of conducting a study using an active task with the same stories and scenes. Fixations on referents will be compared in the two tasks.

Strong bias condition:	Porcupine planned to take the bus to the library with Elephant. He walked over to the bus stop.
Weak bias condition:	Porcupine and Elephant planned to take the bus to the library. Porcupine met Elephant at the bus stop.
Very weak bias condition:	The animals planned to take the bus to the library. Porcupine and Elephant met at the bus stop.
Critical pronoun sentence and final sentence (held constant):	While waiting, he realized that taking the bus would be too expensive. They decided to walk instead.