

Adaptation to Prosody in Anticipatory Structural Analysis during Visual Search

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A growing number of studies have shown that prosody can guide syntactic interpretation and prosodic information is considered during very early processing stages (Ito & Speer [1]; Snedeker & Trueswell [2]; Schafer et al. [3]; Weber et al., [4]). It is reported that listeners process prosodic cues rapidly enough to *anticipate* a likely speaker-intended referent. Recent work on sentence processing has also addressed how processing expectations change with varying linguistic input, a process known as *linguistic adaptation* (Chang et al. [5]; Fine et al. [6]; Norris et al. [7]) and that comprehenders can weigh different kinds of information according to their reliability (Tanenhaus et al. [8]). These studies raise the possibility that listeners also modulate the degree to which they use prosodic cues in structural analysis based on the reliability of prosody they experience in the experiment. To address these questions, the current study investigated (i) the anticipatory effect of prosody in the processing of globally ambiguous sentences and (ii) whether listeners place less weight on prosodic information in structural decision when filler items have ‘uninformative’ prosody. [This work is in collaboration with Chie Nakamura and Jesse Harris.]

Experiments: Eye movements from native speakers of English (N = 32 per experiment) were recorded in a visual-world eye-tracking experiment setting. In the stimuli, a prosodic boundary was located either before or after the NP that precedes the ambiguous PP, encouraging ‘Modifier’ interpretation, (1a, *see the tiger that has the binoculars*), or ‘Instrument’ interpretation, (1b, *see the tiger by using the binoculars*). In addition to the location of prosodic boundary, we also manipulated the final word, which is either plausible as an instrumental object, *binoculars* in (1), or implausible as in (2), *popcorn*. The visual scene in Fig.1a was presented with the sentences in (1) and that in Fig.1b with the sentences in (2). If prosody guides listeners’ structural analysis, a garden-path effect is expected with Instrument prosody only when the Modifier interpretation is semantically plausible as in (2b). In Experiment 1, filler items had informative prosody (3a). In Experiment 2, filler items had ‘uninformative’ prosody (3b), in which the boundary was inappropriately located in the middle of the final NP and was realized as a L-L% (cueing phrase-final). Both experiments consisted of 24 target and 48 filler items.

Results: We analyzed the looks made to each object in the picture from the onset of ‘with’ until the mean onset of the final word. In Experiment 1, the analysis showed that participants looked significantly more at the instrument object with Instrument prosody than with Modifier prosody ($p < .05$) (Fig.2, left). Crucially, the effects were observed before participants heard the final word, reflecting anticipatory use of prosody in assigning a structural analysis. Also, for the looks to the target object during the final word, participants looked at *popcorn* less often when hearing the noun with Instrument prosody than with Modifier prosody, but no such difference between two types of prosody was observed with *binoculars*, demonstrating that participants anticipated an instrument object (*binoculars*) when presented with Instrument prosody in Implausible-instrument (*popcorn*) condition and were led down to garden-path when they heard ‘popcorn’. In Experiment 2, there was no main effect of PROSODY on the proportion of looks to the instrument object during the anticipatory time window (Fig2, right). Furthermore, in the proportion of looks to the target object during the final word time window, there was an interaction between PROSODY and TRIAL BLOCK (1st half, 2nd half) in Exp.2, with a bigger effect of prosody in the 1st Block than in the 2nd block. The difference between the two blocks was greater in Exp.2 than it was in Exp.1. This demonstrates that the more exposed to uninformative prosody, the less the participants used prosodic information. In sum, the current study showed an anticipatory use of prosody, which provides support for sentence processing models that assume immediate use of prosodic information. The results further suggest that listeners track how

informative prosodic cues are, adjusting the extent to which they use prosody in making anticipatory judgments during structural analysis.

- (1) Target items in the Plausible instrument condition
 - a. Modifier prosody: The boy _{L-H}% will see _{L-H}% the tiger with the binoculars.
 - b. Instrument prosody: The boy _{L-H}% will see the tiger _{L-H}% with the binoculars.
- (2) Target items in the Implausible instrument condition
 - a. Modifier prosody: The boy _{L-H}% will see _{L-H}% the tiger with the popcorn.
 - b. Instrument prosody: The boy _{L-H}% will see the tiger _{L-H}% with the popcorn.
- (3) Filler items
 - a. Informative prosody: The boy _{L-H}% will touch _{L-H}% the necktie and the razor.
 - b. Uninformative prosody: The boy _{L-H}% will touch the necktie and the _{L-L}% razor.

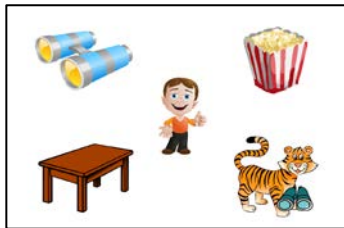


Fig.1 a. Visual scenes presented with (1a,b)



b. Visual scene presented with (2a, b).

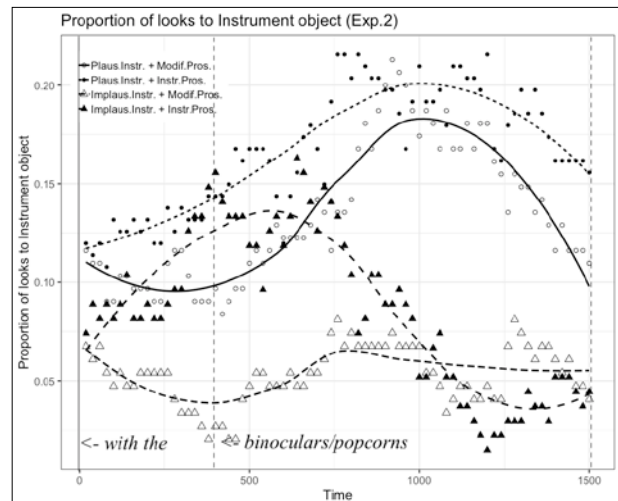
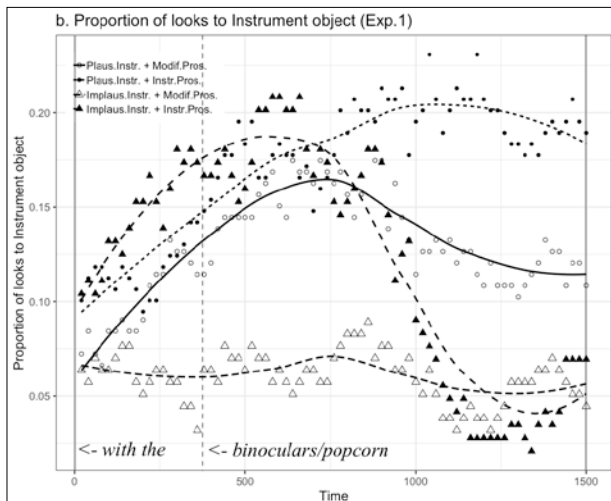


Fig.2 Proportion of looks to the Instrument object (e.g., binoculars) in Exp.1 (left) and in Exp.2 (right). Circles represent ‘plausible’ instrument nouns and triangles ‘implausible’ instrument nouns. Filled shapes are for Instrument prosody and empty shapes are for Modifier prosody.

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