The influence of prosody, case marking and visual cues on thematic role assignment

In language processing, adults rapidly recruit case marking (Matzke et al. 2002), prosody (Weber et al. 2006) and non-linguistic information such as the visual referential context, contrast between objects, and depicted actions (Chambers et al., 2004; Knoeferle et al., 2005; Tanenhaus et al., 1995). For children, by contrast, effects of prosody and case marking emerged in some (Grünloh et al., 2011; Özge et al., 2016) but not all (Dittmar et al., 2008) studies. Children also used depicted actions (Münster, 2016; Zhang & Knoeferle, 2012) but struggled to exploit visual referential context (Trueswell et al., 1999).

In six visual world eye tracking studies, we investigated whether five-year old children and young adult rapidly recruit prosody, case marking (Exp 1a,1b,2a,2b) and visual cues (Exp 3) for incremental thematic role assignment during real-time language comprehension. Visual scenes contained three clipart animal characters each. In Experiments 1 and 2, two characters performed identical actions. Thus, the scenes provided a context but did not disambiguate the role relations. Case unambiguously marked subject-verb-object (SVO) and object-verb subject (OVS) sentences in Exps 1a, 1b, 2a; Exp 2b manipulated ambiguity within OVS (unamb. vs. amb.). We emulated the SVO and OVS biasing prosody by Weber et al. (2006) - SVO: L*+H accent on the subject, H* accent on the verb; OVS: L+H* accent on the subject - and added a neutral prosodic contour as a baseline (Exp 1a and 1b). In Experiments 2a and 2b, sentences each had either an SVO biasing or an OVS biasing prosodic contour. In Experiment 3, we used ambiguous OVS sentences and presented visual cues to the agent in the scene (none, action-only, wiggle of target character only, and action plus wiggle). Visual cue presentation was time-locked to the onset of the verb of the sentence.

The results of Experiments 1 and 2 revealed no clear effects of prosody on thematic role assignment in either children, or adults. Adults rapidly exploited case marking to predict role relations, as early as the verb. However, when case marking was ambiguous, the SVO-biasing (vs. OVS-biasing) prosody caused participants to look slightly more at the agent (OVS interpretation). Children did not exploit case marking for thematic role assignment but mistakenly interpreted OVS as agent-first (SVO) sentences. One explanation for the absence of clear effects of prosody in adults might be that case marking is a stronger cue for thematic role assignment than prosody. In terms of previously-observed case marking effects in children, additional world knowledge may have facilitated children's role-relation disambiguation (e.g., Özge et al., 2016). In our study, we did not provide such information. Children at the age of five might need additional information in order to use case marking for thematic role assignment.

The results of Experiment 3 showed main effects of both visual cues (main effect of action and of wiggle) and a reliable interaction (all *ps* < .001) for the verb: Descriptively, post-hoc tests revealed more looks to the target for action-only, wiggle-only, and both action and wiggle conditions compared with the no-cue baseline. In the adverb region, children additionally directed more looks to the target in the two-cue condition compared to the wiggle-only condition. The results corroborate the rapid visual context effects reported by Zhang & Knoeferle (2012) and Münster (2016). However, unlike these previous studies, effects of the visual cues in children (vs. adults) on target anticipation were not delayed by one word region. These differences in the time course of gaze pattern likely resulted from differences in the materials: In our study, the visual cues were only available during the verb region of the sentence. The cues had a sudden onset and likely this dynamic onset boosted

children's attentional responses. For the children, neither the actions nor the wiggle, by contrast, exerted a clear effect on accuracies in post-trial comprehension question (about who did what to whom), suggesting they had a momentary attentional benefit but did not result in improved comprehension. For adults, we found a marginal interaction of action and wiggle on accuracies such that the wiggle resulted in higher accuracy when the action was present (vs. absent); by contrast, wiggle presence had no positive effect on accuracy when the action was absent.

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