Links between children's visual attention and language production

Sarah Dolscheid, Barbara Zeyer, Martina Penke
University of Cologne, Germany

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Abstract

We investigated whether the allocation of attention can influence language production in preschool children. Children were asked to name two characters in terms of a conjoined noun phrase while their gaze patterns were monitored via eye-tracking. We manipulated children's allocation of attention by means of a brief visual cue located in the place where the left character was about to appear. Our results showed that the visual cue was highly effective in modulating children's eye gaze patterns. We also found that children were more likely to start an utterance with a character that was cued and hence in their spotlight of attention. Taken together, our results provide first evidence of close links between visual attention and language production in children.

Keywords: language acquisition, language production, attention, cueing, eye-tracking

Introduction

The way speakers produce an utterance is closely linked to their allocation of attention. For instance, when asked to describe a picture with two characters, adult speakers are more prone to start an utterance with a visually cued character which is in their focus of attention (Gleitman et al., 2007). However, while such links between attentional orienting and language production have been attested for adult speakers, little is known about this relationship in children. In one study, Ibbotson, Lieven, and Tomasello (2013) asked preschool children to describe a transitive event which was enacted with puppets (e.g., a cat hitting a dog), while the experimenter's eye-gaze was directed to one of the puppets. When attention was drawn to the patient of the event (i.e., when the experimenter explicitly looked at the 'patient puppet'), children were more likely to start their utterances with the patient, resulting in a greater propensity to produce passive structures (Ibbotson et al., 2013). However, although these findings seem to provide some first evidence for a link between attention and language production in children, a number of questions remain open: First, the manipulation of attention was operationalized in terms of a socially meaningful cue (i.e., eye gaze shifts by an interlocutor). Yet, it is unknown whether similar effects can be obtained when manipulating

attention in the absence of social interaction, as has been demonstrated for adults (see e.g., Gleitman et al., 2007). Second, although the increase of passive production in Ibbotson and colleagues (2013) is taken to reflect attentional orienting, the authors did not provide a direct measure of children's allocation of attention (e.g., by measuring children's eye gaze patterns).

To address these open issues, we tested preschool children in a picture naming task while their gaze patterns were monitored via eye-tracking. Children were asked to name two depicted characters in terms of a conjoined noun phrase (e.g., a fisher and a farmer). We manipulated children's allocation of attention by means of a brief visual cue located in the place where the left character was about to appear. The cue consisted of a small red dot, similar to previous studies manipulating attentional orienting in adults (Esaulova et al., 2019; Gleitman et al., 2007; Myachykov et al., 2012). In a first step, we sought to examine whether cueing was indeed effective in modulating children's visual attention. If this were the case, then children should be more likely to fixate a character when it had been cued. Furthermore, we reasoned that if children's language production was already sensitive to attentional orienting, then children should be more likely to first mention a character when it was visually cued. By contrast, if there was no link between attentional orienting and language production, there should be no increase of first mentioning the cued character.

Methodology

Participants

Twenty-seven German-speaking children (mean age: 4;05; range 4;00 to 5;11 years, 13 female, 14 male) were recruited and tested at various daycare centres in Germany.

Procedure

Children were first familiarized with the experimental setting and the eye-tracker (Eyelink Portable Duo). Prior to the experiment, a 5-point calibration was performed to ensure the validity of eye gaze patterns. Children were asked to name pictures of two characters presented next to one another in terms of a conjoined noun phrase. Depicted nouns were matched in terms of gender (only masculine nouns were used), syllable length, visual complexity, and frequency. Children's allocation of attention was manipulated by means of a brief visual cue presented in the place where the left character was about to appear. The cue consisted of a small, red circle presented for the duration of 700 milliseconds (see Figure 1, for illustration). In a baseline condition, no cue was presented. Two experimental lists were created, consisting of 16 items (i.e., 16 noun pairs, with 8 pairs in the cueing condition, and 8 pairs in the baseline condition). Conditions were alternated between the two lists, such that the same items served as the baseline condition in one list and as the cueing

condition in the other list. We measured children's eye gaze to the characters as well as their order of mention (i.e., whether they first mentioned the left character or not).

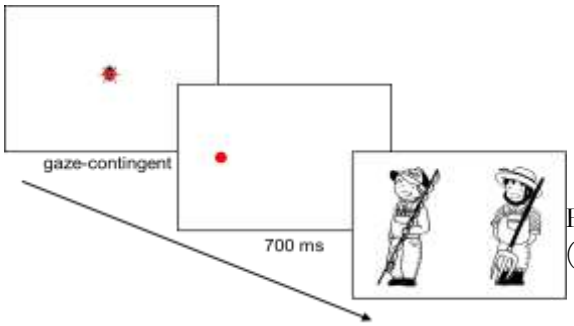

Figure 1. Example of a trial (cueing condition).

Results

A generalized linear mixed effects logistic regression model revealed that visual cueing was highly effective in modulating children's attention, as reflected by a significant increase in first fixations to cued characters compared to the baseline without cueing, z.ratio = 6.85, $p < .0001$ (cueing: 98% first fixations to cued characters vs. 59% first fixations to these characters in the baseline condition). Children were also more likely to start their utterances with the cued characters compared to baseline, z.ratio = 2.91, $p = .004$ (68% first mention of cued characters vs. 55% first mention of these characters in the baseline condition, see Figure 2 for an overview). Children's first fixations to a character also correlated significantly with their propensity to first mention that character, demonstrating that children were more inclined to produce an utterance with an entity that was in their focus of attention, r = .51, $p < .01$. Additionally, we examined whether children's first looks were predictive of their order of mention. We found that children's order of mention depended on where they looked first, as revealed by a significant influence of first fixation on children's propensity to first mention a character, $\chi 2 = 54.73$, $p < .001$.

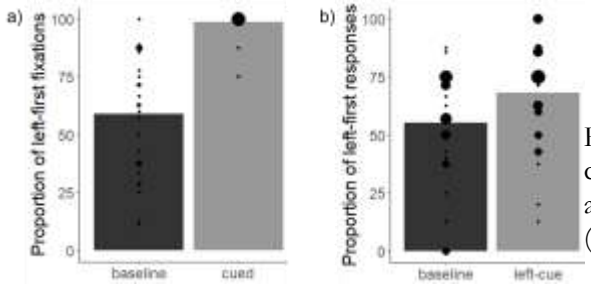

Figure 2. Effects of cueing on eye gaze (panel a) and order of mention (panel b)

Discussion

We found that a visual cue was highly effective in orienting children's attention. Thus, our findings demonstrate that children's allocation of attention can be modulated by a brief visual cue, corroborating previous findings in adults (e.g., Gleitman et al., 2007). Our results also provide novel insights concerning the interrelation of attention and language production in children: By experimentally manipulating children's visual attention, we found that children were more inclined to start an utterance with an entity that was in their spotlight of attention. Critically, unlike previous findings, our observations cannot be attributed to socially meaningful cues such as an interlocutor's eye gaze, because we manipulated attention in terms of purely visual means, devoid of any semantic or social content. These findings suggest that attention by itself – beyond joint attention – can influence language production in children. Furthermore, we found that children's first looks to a character were predictive of their order of mention. Specifically, children were more likely to first mention a character when they had also initially looked at this character. Taken together, our findings provide first evidence of close links between visual attention and language production in children.

Acknowledgements

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