

The development of children's advance planning scope in sentence production: Eye tracking evidence from 5- and 7-year-old children

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Speakers usually do not plan full utterances before speech onset, but prepare them incrementally. While the size of planning increments can vary based on a variety of factors, adult speakers routinely employ a phrasal planning scope that encompasses lexical retrieval for all nouns in the first noun phrase (NPs; e.g., for both *the cat* and *the dog* in “[The cat and the dog] are above the mouse”). While adults show a phrasal lexical planning scope, it is unknown at what age children learn to plan ahead in an adult-like manner. Previous work on children’s sentence production has focused on offline measures (such as priming, e.g., Tafuri & Messenger, 2025). However, these offline measures are only informative about the outcome but not the process of sentence planning, as they do not capture the temporal dynamics of preparing to speak. Since the neural domain-specific selectivity of syntax (Skeide et al., 2014) and word production processes (e.g., Laganaro et al., 2015) develop at least until late childhood, it is plausible to assume that the ability for advance planning has a long developmental trajectory, too.

We present a preregistered eye-tracking study on the development of the dynamics of online incremental sentence planning in children: We tested whether 5- and 7-year-old German-speaking children ($n = 41$ and $n = 29$) exhibit a phrasal planning scope, like adults ($n = 42$). Participants described arrays of animal pictures with sentences starting with either simple or complex NPs (e.g., “[The cat] moves above the dog and the mouse” vs. “[The cat and the dog] move above the mouse”). A phrasal planning scope predicts longer speech onset latencies and more fixations on the second noun for sentences with complex first NPs, indicating lexical retrieval of all nouns within the first phrase before speech onset (Martin et al., 2010; Roeser et al., 2019; Wheeldon et al., 2013). By contrast, a highly incremental lexical planning scope would predict no differences between sentences with simple and complex NPs (e.g., Griffin, 2001).

Bayesian mixed-effects regressions revealed that speakers across all age groups adapted to the syntactic structure under preparation by employing a phrasal planning scope. This is evidenced in longer speech onset latencies for complex NPs than simple NPs in all age groups (probabilities of direction [pd] > 0.95; Makowski et al. 2019). However, there is a dissociation between planning scope and planning strategy between adults and children. Adults fixated on the noun referents sequentially before speech onset. Children used a more parallel strategy, already fixating on the second noun of complex NPs throughout the whole planning process, with more pronounced distributed attention between the first and second noun in 5-year-old than in 7-year-old children (Fig. 1; pds > 0.95). This difference indicates an emerging developmental shift in speaking processes, with 7-year-olds transitioning to a sequential planning strategy, possibly driven by the ongoing development of executive functions throughout childhood (Nozari & Novick, 2017; Anderson, 2010).

Understanding how children learn to become proficient adult speakers requires capturing the unfolding production process, rather than only its products (McKee et al., 2018). Here, we demonstrate that eye tracking is a versatile tool to study children’s online sentence planning, revealing qualitative differences in how children and adults prepare to speak.

References

Anderson (2010). In: *Executive Functions and the Frontal Lobes*. **Griffin** (2001), *Cognition*. **Laganaro et al.** (2015), *NeuroImage*. **Martin et al.** (2010), *Cognition*. **Makowski et al.** (2019), *Front Psychol*. **McKee et al.** (2018), In: *The Handbook of Psycholinguistics*. **Nozari & Novick** (2017), *Current Dir Psychol Sci*. **Roeser et al.** (2019), *J Exp Psychol Learn Mem Cogn*. **Skeide et al.** (2014), *NeuroImage*. **Tafari & Messenger** (2025), *J Child Lang*. **Wheeldon et al.** (2013), *Q J Exp Psychol*.

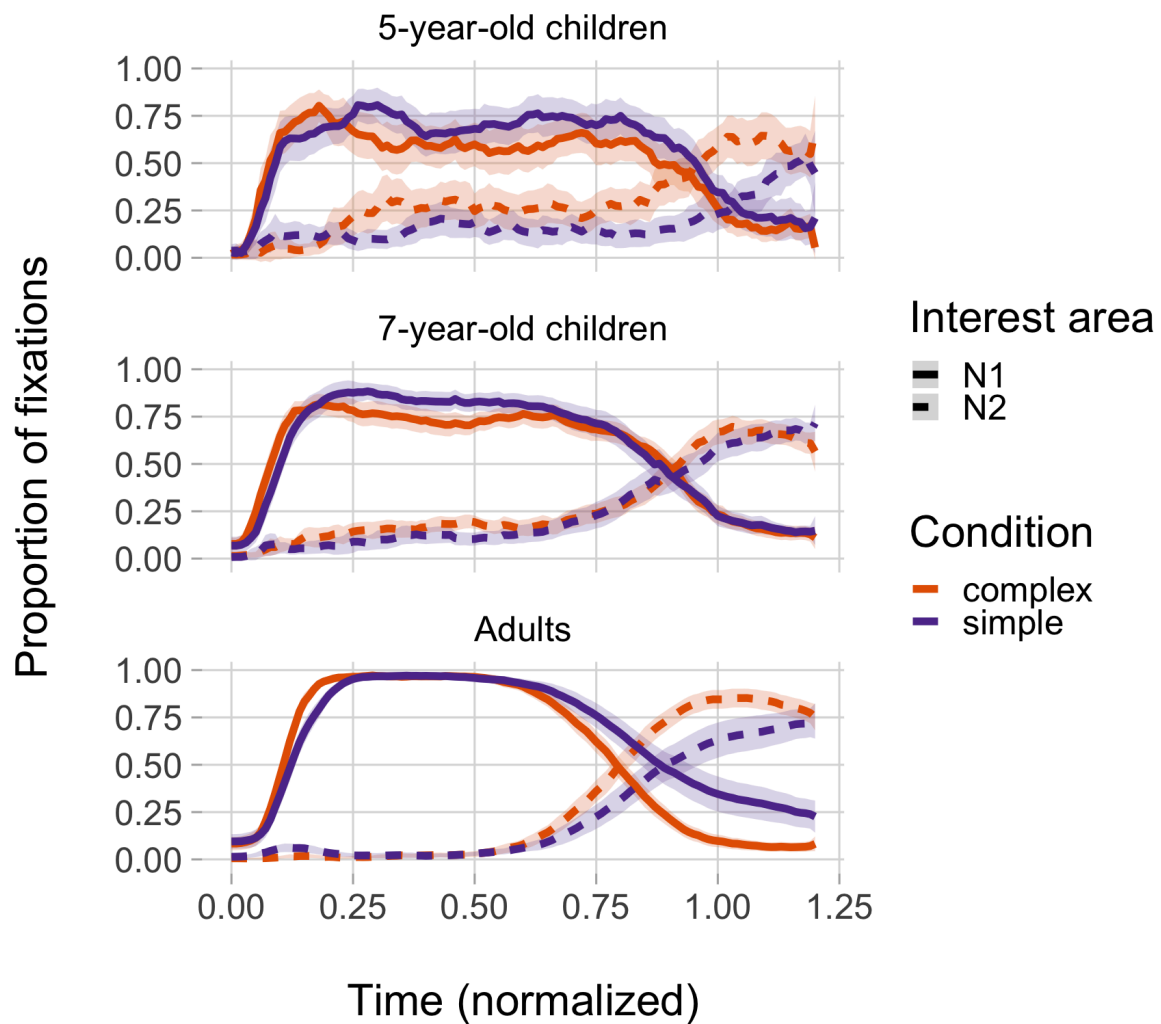


Figure 1: Grand mean proportions of fixations to first and second noun referents during sentence planning in adults and 5- and 7-year-old children for sentences beginning with simple and complex (coordinated) noun phrases ("[The cat] moves above the dog and the mouse" vs. "[The cat and the dog] move above the mouse"). Time is normalized by speech onset for each trial (t_0 = stimulus onset, t_1 = speech onset). Ribbons indicate one standard error of the mean, based on by-participant means.