Do children predict grammatical gender of nouns?

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During language comprehension, readers anticipate upcoming words, including morpho-syntactic features such as grammatical gender [1, 2]. When reading gender-marked pre-nominal articles or adjectives that are not consistent with their prediction, young-adult readers normally incur a processing cost [2, 3], generally thought to indicate switching or updating costs. Crucially, gender prediction has been demonstrated for children too [4-7], often with the implication that predictive processing is more likely to emerge in children with above-average performance in tests of receptive and productive vocabulary [8, 9]. However, many developmental studies up to date cannot dissociate whether individual differences in predictive processing emerge as a consequence of facilitation for predictable target words or slowed reading for unpredictable target words.

We present data from an online at-home self-paced reading experiment investigating whether children aged 8-12 years (n=36) incur a processing cost when reading prediction-inconsistent gender-marked articles and adjectives. Stimuli were German sentences such as (translated), "When Paul finally got his driver's license, he was constantly driving around with the (German "dem") neuter/dative. old but reliable car / the (German "der") feminine/dative old but reliable group of friends", where the gender marking of the definite article and the spill-over region ("old but reliable") foreshadowed whether the most predictable noun would come up or not. Offline cloze probability ratings from 55 young- and old-adult speakers of German (ratings on children are being collected) showed high and low cloze probabilities for predictable and unpredictable gender-marked nouns and articles (> 0.8 vs < 0.01, respectively). Sentences were presented word-by-word; participants controlled their own pace during reading. After the self-paced reading task, all children completed a standardized measure of receptive vocabulary, the German version of the Peabody Picture Vocabulary Test (PPVT) [10].

We found no evidence for disconfirmed predictions at prenominal targets when examining the full sample of 36 children (see Table 1). However, when vocabulary skill was entered into the models as an interaction variable, there were significant interactions between predictability and the scaled continuous variable of the PPVT score at the level of the second and third spill-over word after the article ($b = 237.6$, $SE = 104.7$, $t = 2.27$, $p = .03$; $b = 237.2$, $SE = 103.1$, $t = 2.30$, $p = .03$). Children with higher vocabulary skills showed effects of disconfirmed predictions prenominally, whereas children with lower vocabulary skills scores did not (Figure 1).
In order to examine whether these effects were driven by facilitation or slowing for predictable and unpredictable targets, respectively, we ran follow-up models that estimated the contribution of vocabulary score separately for reading times of predictable and unpredictable items. According to these models, children with high PPVT scores showed slowed reading times for unpredictable items (both at the second and third spill-over word: $b = 250.9$, $SE = 118.2$, $t = 2.12$, $p = .04$; $b = 244.9$, $SE = 116.6$, $t = 2.10$, $p = .04$), but not for predictable items ($b = 143.1$, $SE = 92.1$, $t = 1.3$, $p = .1$; $b = 157.8$, $SE = 89.9$, $t = 1.6$, $p = .09$).

Our data suggest that German-speaking primary and middle-schoolers, especially those with high vocabulary skills, actively anticipate predictable continuations based on preceding gender-marked definite articles and adjectives (in line with adult reader findings [1-3]). These effects appear to reflect the cost of disconfirmed predictions for unpredictable target words, as opposed to a facilitation for highly predictable targets. Our outstanding goals are to substantiate previous findings arguing that especially receptive (but not productive) vocabulary skills determine prediction costs in children.

	the	*old*	*but*	*reliable*	*car*
b	8	9	52	57	114
SE	10	14	37	36	22
p	.8	.5	.2	.1	< .001

Table 1. Parameter estimates (*b*'s), standard errors (SE) and *p*-values from models estimating the RT difference (in ms) between unpredictable and predictable target words in the full sample of 36 children.
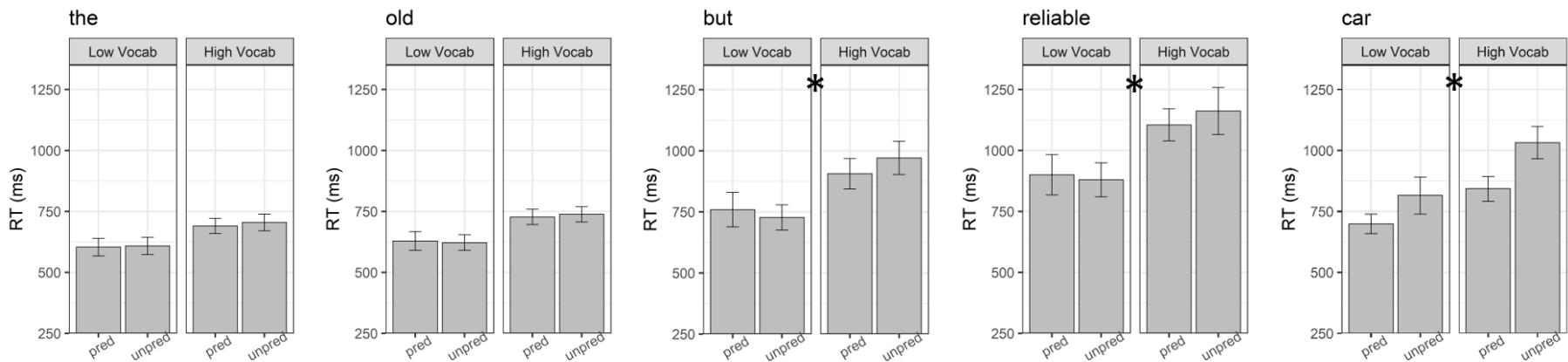

Figure 1. Average RTs (± SE) on target words in predictable and unpredictable items in children with low and high vocabulary scores, based on a median split of their PPVT scores (all statistical models were run with the scaled continuous variable). Asterisks indicate statistical significance at $p < .05$.

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