Falling for the grammaticality illusion? Individual differences in the susceptibility to the missing-VP effect in German

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Investigations of sentence processing effects sometimes yield inconsistent results; e.g. observations of the missing-VP effect differ across and within languages. In part, such inconsistencies relate to individual differences. We present an eye-tracking study that investigates individual parsing strategies for reading complex sentences involving multiple center-embeddings.

In the experiment, 96 German native speakers read complex sentences as in Table 1. The sentences involved center-embedding of three verb-final clauses resulting in a series of three verbs. Grammatical sentences included all three verbs, ungrammatical sentences lacked either VP2 or VP1. In addition, we varied the number specification of the highest embedded subject (NP1) and the corresponding VP1 (both singular or both plural) to see whether number agreement marking can facilitate the processing of complex sentences. In order to assess peoples parsing strategies and a potential link to their individual reading capacity we collected participants' thoughts about the experiment in a post-experiment questionnaire. Furthermore, we assessed the reading span level [3] for half of the participants. They read sentences and single words and named all single words they could recall at the end of each block. The number of sentences varied from block to block. Scores are computed by determining the proportion of correctly recalled words.

Based on answers in the questionnaire, we defined two groups for later analyses. Answers of the first group (N=47) suggest that they noticed the incompleteness of ungrammatical sentences. We therefore label this group "noticed". Answers by the other group ("not noticed") suggest that they were unaware of incomplete sentences or unable to describe the problem. This group only mentioned complexity, length and the like. Interestingly, the group difference is reflected in reading times and correlates with reading span score. Participants in the "noticed"group achieved higher reading span scores than participants in the "not-noticed" group (t = 2.07, $p <$.05), see Figure 2.

Analyses of the reading times show a main effect of Grammaticality but no main effect of Number. Late measures (regression-path, total reading, rereading times) show prolonged reading times for ungrammatical sentences (missing VP2 or VP1) compared to grammatical (=complete) sentences on multiple interest areas. Including Group as a third factor reveals an interaction with Grammaticality (longer reading times with ungrammaticals in "noticed" group) as well as a three-way interaction with Grammaticality and Number (t = -2.05, $p <$ .05).

While Number had no effect in the "not-noticed" group, it interacts with Grammaticality in the "noticed" group. For this group, both types of ungrammatical sentences with a singular NP1 have longer reading times than the grammatical conditions. For the plural conditions, in constrast, the increase is restricted to the missing VP1 condition while there is no difference between the grammatical and the missing VP2 condition (Figure 1). This interaction suggests that for plural ungrammatical conditions, even readers who reported to have noticed the incompleness of some sentences were likely to miss the ungrammaticality of the missing VP2 at least temporarily. However, they noticed the lack of VP1 for the plural and singular conditions.

Based on the findings we conclude: (i) Readers differ in their use of morpho-syntactic cues such as number. (ii) Morphosyntactic cues can help to navigate memory demanding structures, but they also make the parser susceptible to intrusion effects [5], here leading to a missing-VP2 effect in plural sentences. (iii) While there is a link between an individual's reading span score and their ability to keep track of structural dependencies, it remains open whether this is a permanent feature of a person (grounded in memory capacity or reading ability/experience) or a situation-dependent factor (attention, committment to the task, depth of reading).

Table 1: Structure and example of the experimental stimuli

Structure

[matrix clause [$_{CP1}$ NP1$_{sing/plu}$ [$_{CP2}$ NP2$_{sing}$ [$_{CP3}$ NP3$_{sing}$ . . . VP3$_{sing}$] (VP2$_{sing}$)] (VP1$_{sing/plu}$)] adv clause]

Example

Es	wurde	öffentlich,	dass	der/die	Kellner,	den/die	ausgerechnet	der	Manager,
it	became	public	that	the.SG/PL	waiter(s)	who.SG/PL	just	the	manager

bei	dem	das	Geld	gefunden	wurde,	(beleidigt	hat),	(geklagt	hat/haben),	nachdem
at	who	the	money	found	was	(insulted	has)	(litigated	has/have)	after

ein	Zeuge	aufgetaucht	war
a	witness	appeared	has

'It became public that the waiter who only that manager with whom the money was found has insulted has litigated after a witness had appeared.'

(Condition 'missing-VP2' lacked the material in red parentheses, condition 'missing-VP1' lacked the material in violet parentheses.)

Figure 1. Rereading times in NP1 region (*that the waiter/s*) not noticed (left) and noticed (right)

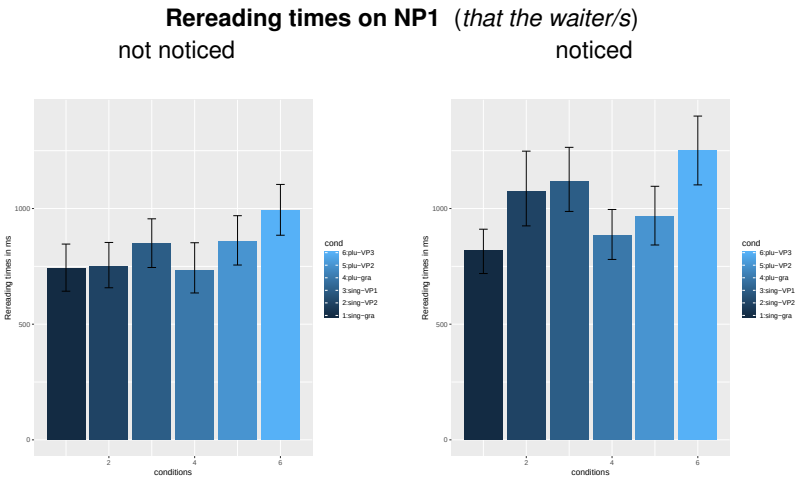
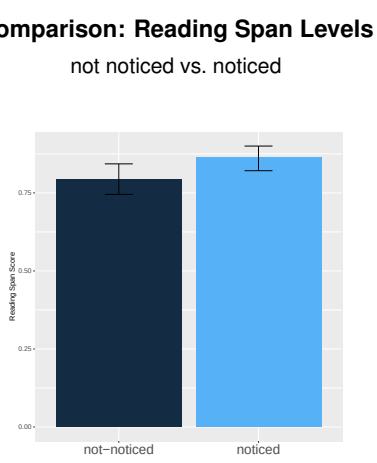


Figure 2. Comparison of Reading Span Levels



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