ERP evidence for long-distance lexical predictions in German particle verb constructions

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1. What did we do?

- Many German verbs take particles (e.g. to ***fill*** something ***out***), which can be separated by long distances; much longer than English.
- But the meaning of the verb cannot be fully interpreted until the particle is seen, unless it is predicted in advance.

Hypothesis: Readers will predict the verb particle in advance, but only when they are very certain of its identity.

Prediction: Violating a lexical prediction will result in greater processing difficulty (larger N400) than when no specific prediction has been made.

2. Design

- Particle verb sentences constrained for either 1 particle, or at least 2 competing particles.
- ERPs measured at *ungrammatical* particles to test for prediction failure.

Example item, shortened for brevity:

*Der Angtragsteller **füllte** das Formular [...] sehr vorsichtig...*

a. ... ***aus**, um den kleinen...* (Grammatical, 1-particle)
b. ... ***an**, um den kleinen...* (Ungrammatical, 1-particle)

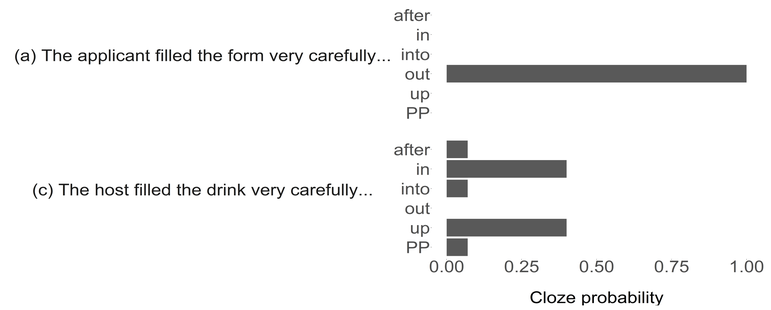
The applicant **filled** the form [...] very carefully **out/*at**, in order to...

*Der Gastgeber **füllte** das Getränk [...] sehr vorsichtig...*

c. ... ***auf**, um den kleinen...* (Grammatical, 2+particles)
d. ... ***an**, um den kleinen...* (Ungrammatical, 2+particles)

The host **filled** the drink [...] very carefully **up/*at**, in order to...

Cloze test results:



- Only ungrammatical conditions (b/d) analysed as (a/c) not matched.
- Grammatical conditions (a/c) presented, but only used as a sense-check.
- Particles in (b/d) are equally implausible, so any difference should reflect the state of the parser *before* this point.
- Matched pre-critical regions mean that any prediction must have been made prior to the matched region.

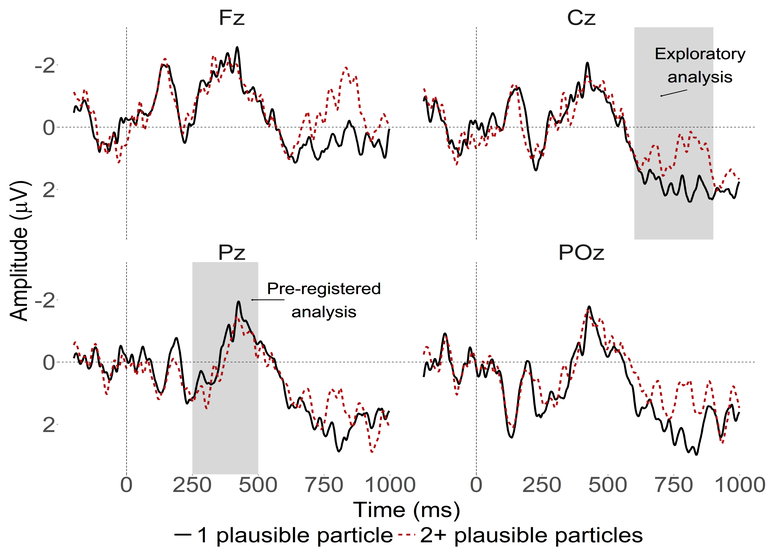


Figure 1. ERPs elicited by ungrammatical particles. The windows of statistical analysis are shaded.

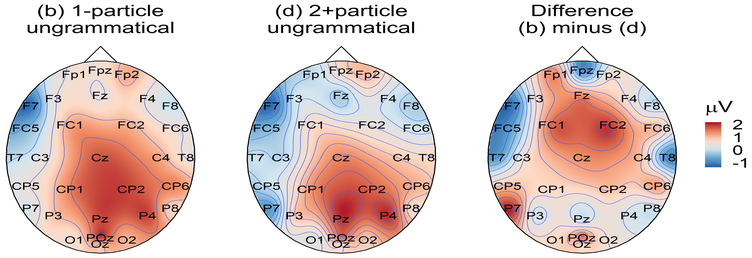


Figure 2. Topographical plots of the two ungrammatical conditions, 600-900 ms.

3. Methods

- 32-channel EEG
- 50 participants
- 44 target items
- 62 filler sentences

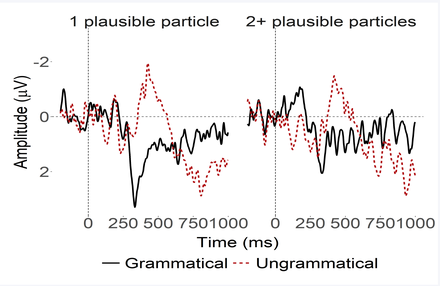
- RSVP 190 ms/word + 20 ms/letter; target particle 700 ms; 300 ms ISI
- Comprehension questions after each sentence
- Bayesian LMM with maximal random effects structure modelled by-trial mean amplitude 250-500 ms at electrode *Pz*.

Exploratory analysis:

- The same LMM was fitted to mean by-trial amplitude 600-900 ms at electrode *Cz*.

4. Results

- Deviations from the pre-registration: 10 extra subjects (no data were analysed prior to extending recruitment); no Bayes factors used due to vague priors.
- A visual check established that violations elicited the expected N400 and late positivity (grammatical vs. ungrammatical particles):



- No evidence of an N400 difference between ungrammatical conditions (b vs d), $\hat{\beta} = -0.25\mu V$, 95%CrI $= [-1.21, 0.72]\mu V$, $\Pr(\beta < 0) = 0.71$.
- Larger late positivity for 1-particle than 2+particle violations (b > d), $\hat{\beta} = 0.96\mu V$, 95%CrI $= [-0.20, 2.11]\mu V$, $\Pr(\beta > 0) = 0.95$.

5. Conclusions

We propose that:

- When there was only 1 plausible continuation (a/b), a lexical prediction was triggered.
- This prediction enabled a richer representation of the sentence to be built.
- When the violation was encountered, attempts at integration or repair were made [7, 10, 11].
- The late positivity reflects this cost.

Tentatively: German native speakers make long-distance lexical predictions if constraint is not just high but also strongly favors a single lexical item.

6. Bibliography

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