

What features of predictions are reflected in the sustained anterior negativity?

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Evidence from ERP suggests that a sustained anterior negativity (SAN) reflects maintenance of predicted information in working memory, but much research has focused on predicted structural complexity^[1:5]. We tested whether the SAN also reflects maintenance of specific word features using filler gap dependencies such as *The reporter who the senator attacked*. The relativiser (*who*) prompts readers to predict a gap at the downstream verb (*attacked*) where the filler (*reporter*) will be retrieved^[6]. Evidence that specific features of the filler are also maintained in memory is seen in slower reading times at intervening nouns that match the features of the filler in filler gap vs. non-filler gap constructions^[7]. We therefore used the design of [7] with German object relative clauses (ORCs) and manipulated animacy of the filler to either match or not match the animacy of a distractor noun (**Ex. 1**). We contrasted the ORCs with ellipsis constructions where no gap prediction is necessary. If the SAN reflects prediction maintenance, it should be more negative from the ORC relativiser onwards than in ellipsis sentences. If the SAN reflects maintenance of specific word features, the distractor noun should further increase negativity in the animate filler gap sentences, assuming that the matching feature interference increases memory load.

Methods/results. N=52, 80 items (**Ex. 1**), single-word presentation, comprehension question each sentence. DV: Mean amplitude in left anterior electrodes from 100-500 ms relative to a common baseline. Bayesian maximal linear mixed effects models indicated more negative amplitude in the animate condition, regardless of sentence type, $\hat{\beta} = -1.52, 95\% CrI [-3.09, 0.06], P(\beta < 0) = 0.97$, but not a larger animacy effect at the distractor NP vs. the preceding region, $\hat{\beta} = 0.76, 95\% CrI [-0.64, 2.16], P(\beta > 0) = 0.85$ (**Fig.1**). Statistically, the animacy effect had resolved by both resolution sites: filler gap, $\hat{\beta} = -0.97, 95\% CrI [-3.94, 2.00], P(\beta < 0) = 0.74$; ellipsis, $\hat{\beta} = -2.08, 95\% CrI [-5.14, 1.01], P(\beta < 0) = 0.90$; but see **Fig.2**. In centro-posterior electrodes at the resolution site, there was a larger P600 in the animate condition of filler gap sentences, $\hat{\beta} = 0.76, 95\% CrI [0.06, 1.47], P(\beta < 0) = 0.98$, but no other effects. **Conclusions.** The SAN was sensitive to word features but not predicted information. The animacy effect may reflect richer memory encoding of animate objects^[8,9]; this encoding was robust to interference from the distractor NP^[cf.7]. The visual change in SAN around the filler gap resolution site could relate to processing of the filler at the (anticipated) verb, but its appearance is curious. The P600 at only the animate filler gap resolution site suggests more difficulty integrating the animate object. Our lack of a predictive SAN effect could suggest previous findings arise from comparison of different words (esp. in English). Our SAN was either not sensitive to the filler gap prediction, or to the type of memory where the prediction was stored.

Ex. 1. Example experimental item. Bold blue text indicates the filler-gap filler / ellipsis antecedent. The section before the blue filler/antecedent (| |) shows the common baseline used for the SAN (for illustration only, not seen by participants). Amplitude was averaged in three separate regions for the analysis: The relativiser + 6-7 words (mustard text); the distractor NP (red underlined text); the resolution site (bold green text). Commas were deliberately not used to increase similarity between sentence types.

- Ellipsis, animate/inanimate:

Der Astronaut begutachtet den | **Sohn/Bericht** des erschöpften Kosmonauten aus der Heimat des **Laborpartners** während der Mission aber nicht den **des Kommandanten** da er...

*The astronaut assesses the **son/report**, of the exhausted cosmonaut from the homeland of the lab partner during the mission but not that _____, of the **commander**...*

- Filler gap, animate/inanimate:

Der Astronaut begutachtet den | **Sohn/Bericht** den der erschöpfte Kosmonaut aus der Heimat des **Laborpartners** während der Mission auf der Anlage **gesehen** hatte als wäre...

*The astronaut assesses the **son/report**, that the exhausted cosmonaut from the homeland of the lab partner during the mission in the facility **saw** _____ ...*

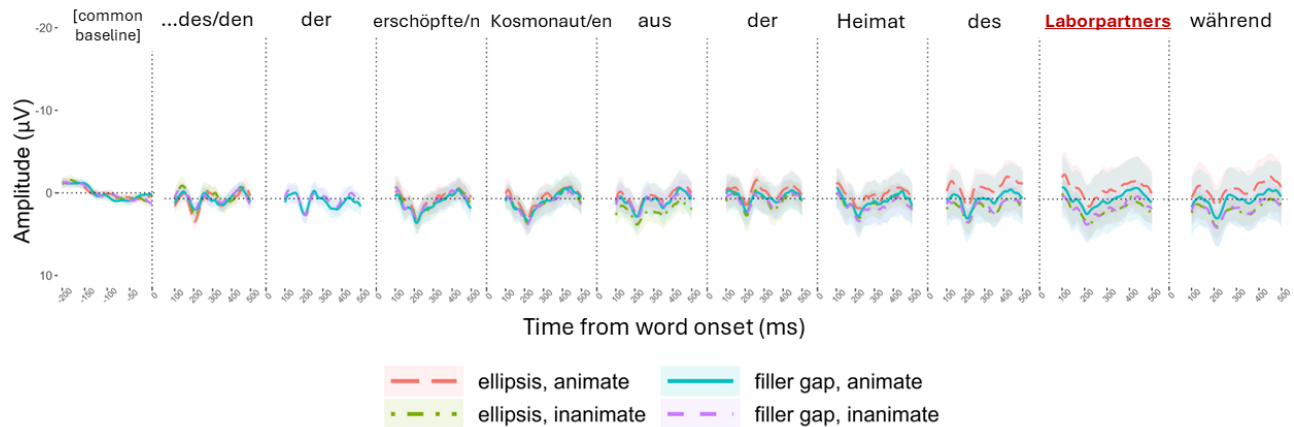


Fig. 1. The SAN across the sentence computed relative to the common baseline, beginning at the relativiser and ending on the last common word between sentence types.

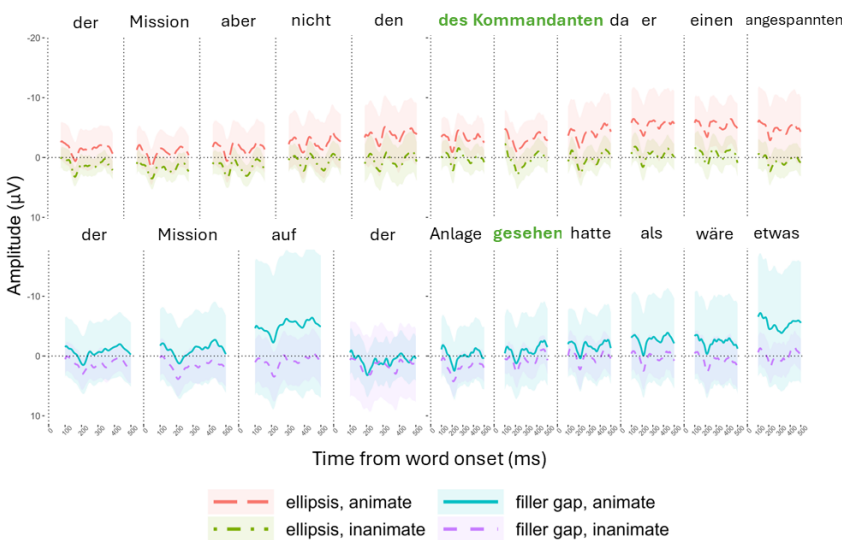


Fig. 2. The SAN relative to the common baseline for regions where words were not *always* matched across sentence type (note that the example used does have additional matched words).

References. [1] King & Kutas, 1995 *J Cog Neuro* [2] Cruz et al., 2022 *Neurobiol Lang* [3] Fiebach et al., 2002 *JML* [4] Phillips et al., 2005 *Cog Brain Res* [5] Hagiwara et al., 2007 *J Cog Neuro* [6] Clifton & Frazier, 1989 [7] Ness et al., 2018 *LCN* [8] Gelin et al., 2017 *Memory* [9] Rawlinson & Kelley, 2021 *Mem & Cog*