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"Before" and "after": investigating the relationship between temporal connectives and chronological ordering using event-related potentials

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Background

- Temporal clauses with *before* often elicit a sustained negativity relative to temporal clauses with *after* (Müntz et al., 1998)

1st Clause 2nd Clause

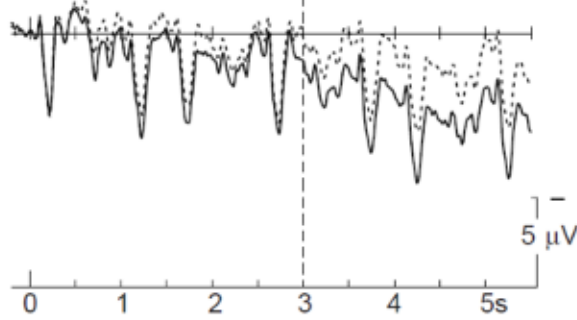


Figure adapted from Müntz et al. (1998)

— 'After' the scientist submitted the paper, the journal changed its policy
 - - - 'Before'

- Two potential accounts for this effect:

- Temporal ordering:** "Before X, Y" is hard because the two events are not mentioned in the same order that they occurred in (Müntz et al., 1998, and behavioral work)
- Veridicality presupposition:** "Before X, Y" is hard because it is temporarily ambiguous regarding whether the temporal clause event (X) happened (e.g., "Before the bomb exploded, the police evacuated the building safely") or did not happen (e.g., "Before the bomb exploded, the police defused it") (Xiang et al., 2014; see also Beaver & Condoravdi, 2003; Heinämäki, 1972)

The present study

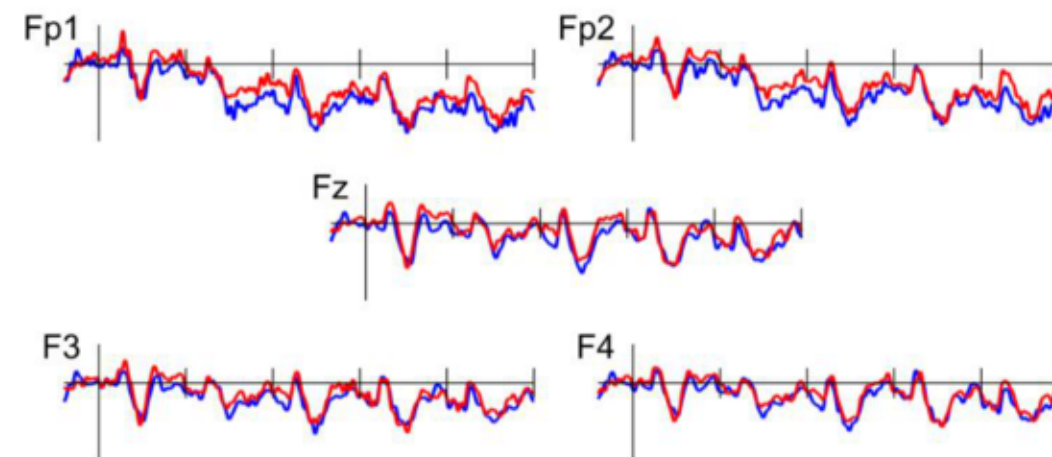
- Previous ERP studies have only tested sentence-initial temporal clauses (i.e., "Before X, Y" and "After X, Y"), not sentence-final clauses (i.e., "X before Y", "X after Y")

Predictions:

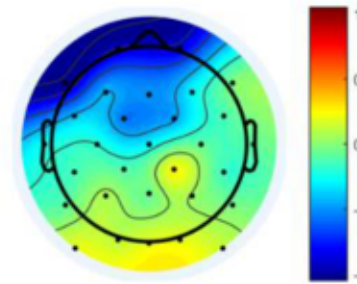
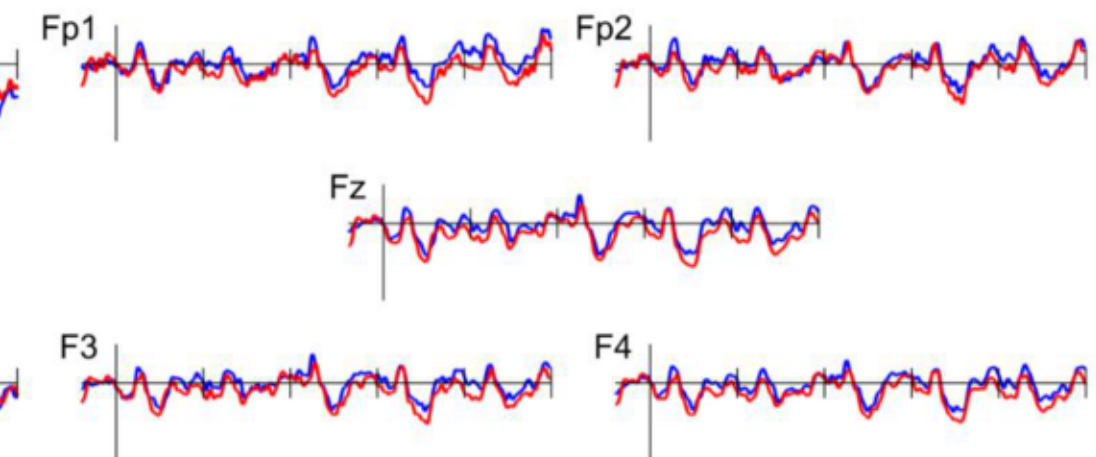
- Temporal ordering:** The effect will reverse in sentence-final temporal clauses (i.e., "The journal changed its policy before the scientist submitted the paper" will elicit more **positive** ERPs than "The journal change its policy after the scientist submitted the paper").
 - This pattern has been seen in most behavioral studies (Clark & Clark, 1968; Mandler, 1986; Natsopoulos & Abadzi, 1986 child data)
- Veridicality presupposition:** The effect will not reverse
 - This pattern has been seen in Natsopoulos & Abadzi's (1986) adult behavioral data

Results (N = 20 native English speakers; 158 items, serial visual presentation)

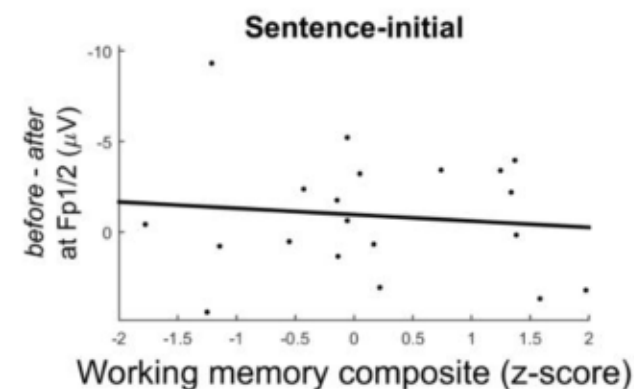
Sentence-initial temporal clauses



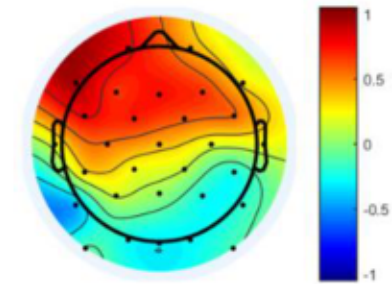
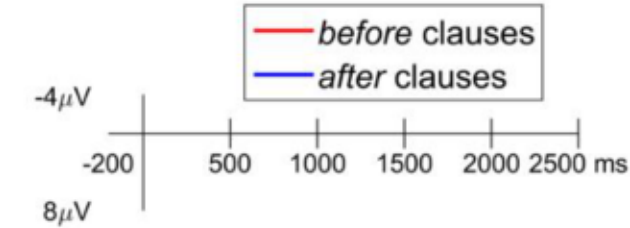
Sentence-final temporal clauses



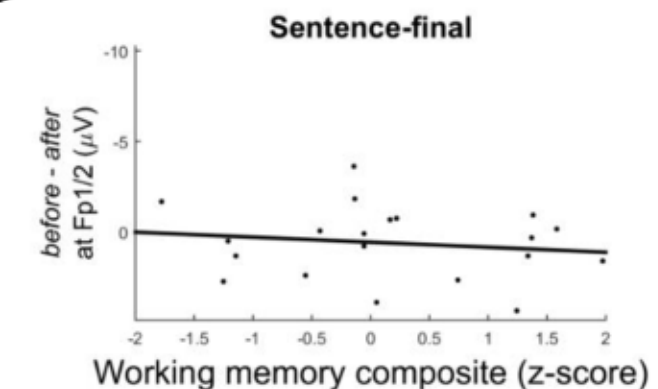
before - after (sentence-initial)
200 - 2000 ms



$$b=0.35, R^2=.01, F=0.22, p=.64$$



before - after (sentence-final)
200 - 2000 ms



$$b=0.28, R^2=.02, F=0.41, p=.53$$

Discussion

- Negativity** (marginal) for *before* relative to *after* in **sentence-initial** temporal clauses
 - Replicates Müntz et al. (1998) and Xiang et al. (2014)
- Positivity** (significant) for *before* relative to *after* in **sentence-final** clauses
 - Consistent with the temporal ordering account of Müntz et al. (1998), and with behavioral studies (Mandler, 1986; Clark & Clark, 1968)
- Previous ERP studies (Müntz et al., 1998, and Xiang et al., 2014) found that the effect was modulated by individual differences in working memory; this effect was not replicated
- Surprising finding: more artifact (mainly EOG), and more variance in ERP amplitude, in first clause than second clause

References

- Beaver & Condoravdi (2003). *Semantics and Linguistic Theory XIII*.
 Clark & Clark (1968). *Q. J. Exp. Psych.*
 Heinämäki (1972). *Proc. 8th Regional Meeting of the Chicago Linguistic Society*.
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 Müntz, Schiltz, & Kutas (1998). *Nature*.
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