TRAVELING BACK IN TIME: HOW DO TEMPORAL TERMS SHAPE OUR EXPECTATIONS FOR THE UNFOLDING LINGUISTIC INPUT?

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BACKGROUND & QUESTIONS

Object states

- Instantiations of an object in its different states need to be maintained during sentence comprehension for further selection of the relevant state, e.g. *The chef will chop the onion. And then, she will smell **the onion.*** vs. *The chef will chop the onion. But first, she will smell **the onion.*** - "the onion" refers to distinct states of the same onion, depending on the temporal connective.
- Distinct state representations are transiently reactivated and compete for selection upon the object's subsequent mention (Altmann & Ekves, 2019).
- In scenarios with minimal change events such as *The chef will weigh the onion. And then / But first, she will smell **the onion.*** - the state of the object being acted upon remains intact, "the onion" refers to perceptually indistinguishable states of the same onion, regardless of the temporal connective.

Order of events

- Processing events introduced out of order is generally more effortful (Mandler, 1986; Nieuwland, 2015).

Does switching the focus to the initial state of a changed object come at a cost?

METHOD

dEEG (256 channels) was collected while participants (N=26, all students at the University of Connecticut) read sentences presented to them one word at a time with an SOA of 600 ms (300 ms per word). Analysis was performed using FieldTrip (MATLAB software toolbox):

- 0.1 Hz high-pass and 55 Hz low-pass filters
- re-referenced to the global average
- time-frequency analysis
  - 500 ms moving window, 10 ms steps
  - -600 -300 ms baseline
- statistical analysis (cluster-based random permutation test):
  - all channels
  - min number of channels per cluster - 3
  - time-windows time-locked to the final determiner and noun

DISCUSSION

- The effect was found at the final determiner, suggesting that it reflects anticipation of the final word (or object state).
- Stronger alpha/beta power decreases before the target word have been found in more, compared to less, constraining contexts (Piai et al., 2014; Piai et al., 2015; Rommers et al. 2017; Li et al., 2017); our data may therefore suggest that we more strongly expect the noun to be repeated if it participated in the state change event and if the event described in second sentence follows the event described in the first sentence.
- However, at the moment it is impossible to determine whether the effect reported here reflects anticipation of just a lexical item or of an event which involves an object in a certain state: i.e., state-change events might constrain real-world continutations more so than events which don't result in state change, and perhaps objects involved in such events are more likely to be mentioned again.
- This effect could be modulated by the change in the order of the described events.

MATERIALS

- 160 experimental sentences in 4 conditions (2 x 2 design):

Condition	Example Sentence
Substantial change, "and then"	The chef will **chop** the onion. **And then**, she will smell the onion.
Minimal change, "and then"	The chef will **weigh** the onion. **And then**, she will smell the onion.
Substantial change, "but first"	The chef will **chop** the onion. **But first**, she will smell the onion.
Minimal change, "but first"	The chef will **weigh** the onion. **But first**, she will smell the onion.

- 160 filler sentences (without repetition of the noun phrase)
- 12 percent comprehension questions

RESULTS: OSCILLATORY ANTICIPATORY EFFECT AT THE FINAL DETERMINER

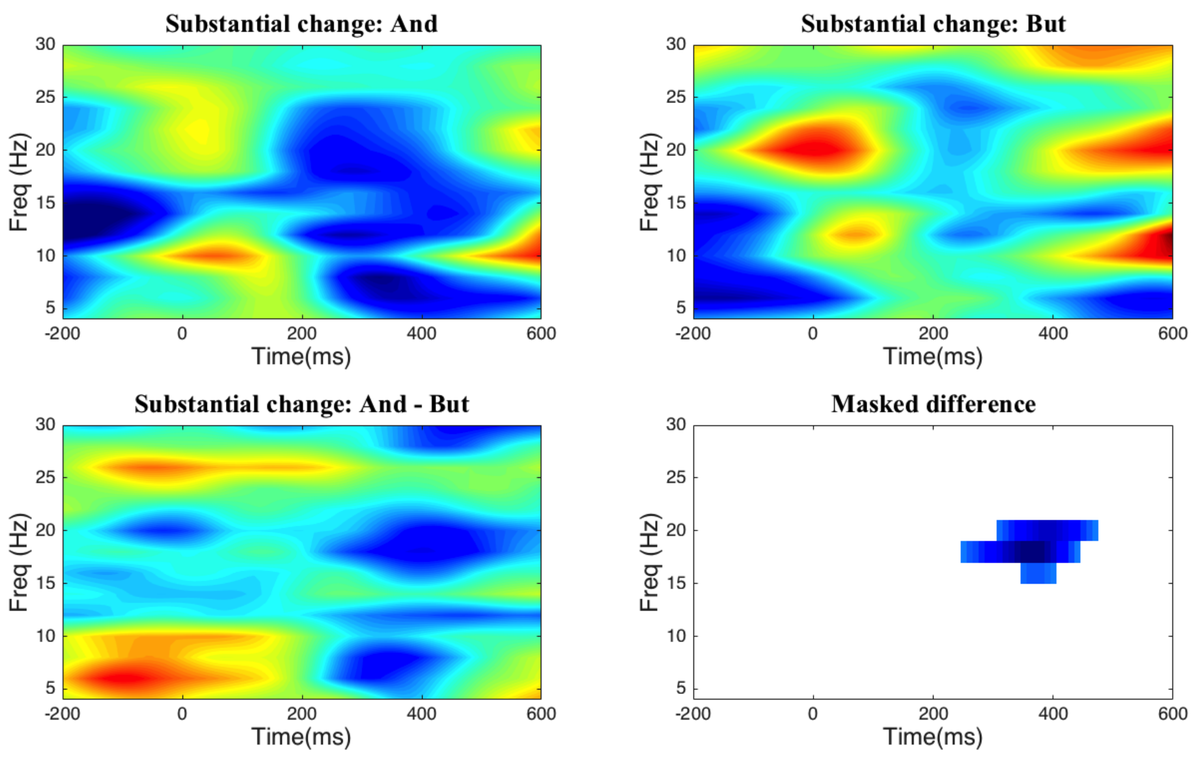

Figure 1. Top: Grand-average TF representations for conditions with state change verbs. Bottom: TF representations for the raw (left) and masked (right) difference between the state change conditions. All plots are for a single representative electrode E149. Time 0 is the onset of the final determiner.

This set of results shows a significant beta decrease in *Substantial change: And* condition relative to *Substantial change: But* condition. This effect might reflect differences in the degree of sentential constraint rendered by the termporal connective.

Figure 2. Topographies showing beta power in the 16-22 Hz frequency and 250-500 ms time window for all conditions. Time is relative to the onset of the final determiner. The scale here applies for Figure 1 as well.

This set of results shows that the locus of the effect is over the posterior electrodes. Such topography is in line with other studies which found decreased beta power in more relative to less constraining contexts. Also notice no difference between *Minimal change: And* and *Minimal change: But* conditions.

RESULTS: ERP EFFECT OF TEMPORAL CONNECTIVE

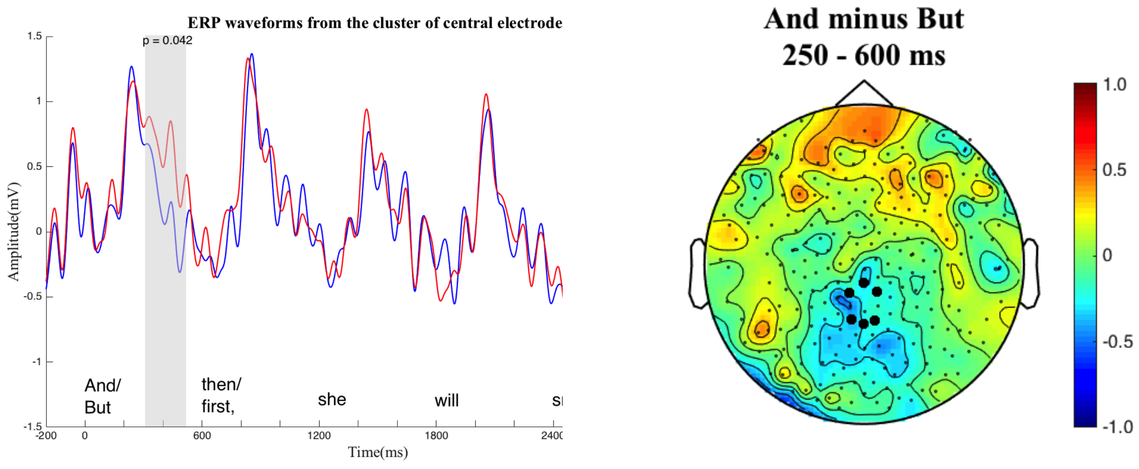

Figure 3. ERP waves time-locked to the onset of the second sentence (left); Difference topography (right).

The present study didn't find sustained negativity associated with events described in reverse order (e.g. Nieuwland, 2015; Munte et al., 1998).

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