Exploring heterogeneous P600 satiation in an attempt to reveal N400s in semantic P600 sentences

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Introduction

- Semantically anomalous, but syntactically well-formed, sentences have been shown to elicit P600 effects (1) (Kim & Osterhout 2005, a.o.).

(1) The hearty meal was devouring the kids for breakfast. P600 N400

- These *semantic P600 sentences* have been used to argue for an independent semantic analyzer.
  - But arguments for an independent semantic analyzer crucially assumes that the P600 effect is the *only* effect elicited by semantic P600 sentences.
- We want to know whether semantic P600 sentences elicit an N400 effect in addition to the P600 effect (which may be obscuring it).
  - Hahne & Friederici (1999) have shown that P600 effects disappear with extreme repetition (a "satiation" effect), specifically 80% violation and 20% non-violation in the experiment, but only with a single violation type.
  - We design a heterogeneous environment of distinct syntactic violations to try to satiate the P600 effect in semantic P600 sentences.

Materials & Method

Violation Type	Example
Phrase Structure	*The boys enjoyed Ed's about stories the battle.
Agreement—Type 1	*The agents discovers Fred's tobacco from Cuba.
Semantic P600	*The hearty meal was devouring by the kids.

- We focused on three distinct violation types, each taken from the P600 literature (Neville et al. 1991, Newman et al. 2007, and Kim & Osterhout 2005, respectively).
- Our overall goal of the design was to have **80% violation** at every "time block" in the experiment.

	Time Block 1	Time Block 2	Time Block 3	Total Items
No. of Phrase Structure	**30**		**30**	**60**
No. of Agreement – Type 1	**6**	**18**	**6**	**30**
No. of Semantic P600		**24**	**8**	**32**
No. of Case	6	18	6	30
No. of Subjacency	6	18	6	30
No. of Agreement – Type 2		66		66
No. of *Controls* for Phrase Structure/Agreement – Type 1	12	12	6	30
No. of *Controls* for Semantic P600		24	8	30
Total No. of Test Items	60	180	70	310
No. of Violations	48	144	56	248
No. of Controls	12	36	14	62
Ratio of Violations to Control	**80%/20%**	**80%/20%**	**80%/20%**	**80%/20%**

Pre/Post design for the phrase structure violations:

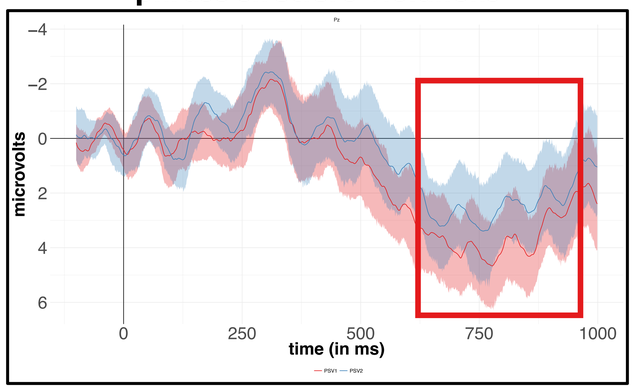
- Of the 60 total phrase structure violation items, the first half of the items were concentrated at the beginning of the experiment (i.e. Time Block 1) and the latter half were at the end (i.e. Time Block 3).
  - Time Block 2 contained violations and filler items that were *not* phrase structure violations.
- **If satiation occurred** for the phrase structure violations and was maintained throughout the experiment, we should expect to see no P600 effects for the phrase structure violations in Time Block 3 when compared to the phrase structure violations in Time Block 1.

Results

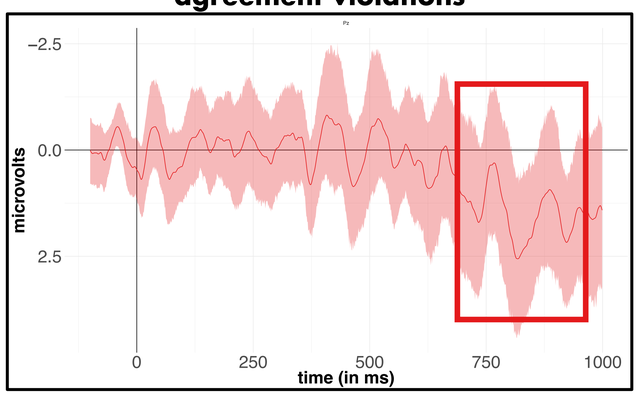
Complete satiation did not happen

- The plots below show difference waves between violations and their grammatical controls at Pz with 95% bootstrap confidence intervals (i.e. the shaded area).
- P600 effects can be seen within the red box as a positive deflection after 600 ms.
- For the phrase structure violations, there are two difference waves for the first 30 items (in red) and the last 30 items (in blue).
  - Both difference waves show P600 effects in the red box.

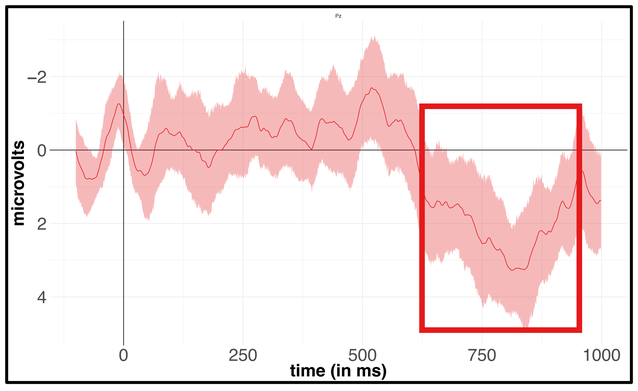
phrase structure violations



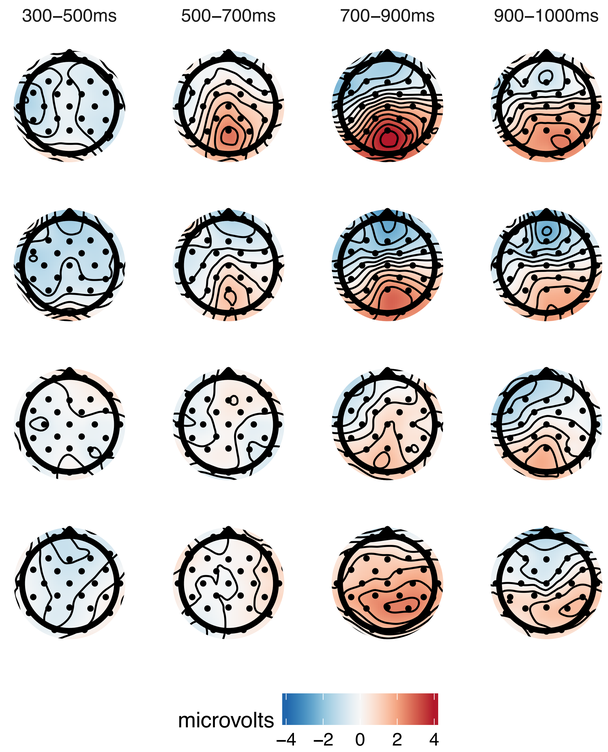
agreement violations



semantic P600 sentences



P600/SPS effects were distinct across conditions



- The figure above show scalp maps for the conditions of interest.
  - This is intended to compare the scalp distribution of the P600s.
- P600 effects were observed for the phrase structure violations, agreement violations, and semantic P600 sentences.
  - Pre-test (PSV1) and post-test (PSV2) phrase structure violations have P600 effects that are similar in latency and scalp distribution.
  - Semantic P600 sentences have P600 effects that have a broader scalp distribution.
- Acceptability judgments were recorded for every test item and the percentage of correct responses are show to the right of the scalp maps.

General Discussion

- We found P600 effects for all three violation types, suggesting that distinct violations do not satiate in a heterogeneous context.
- These results suggest that the P600 effects to phrase structure violations, agreement violations, and semantic P600 sentences are distinct in several dimensions: **latency** and **scalp distribution**.
- Also, because we are unable to induce heterogeneous satiation in this experiment, we are unable to answer our original question regarding semantic P600 sentences.

Conclusion

- If the P600 is an indicator of syntactic revision, then this is evidence for distinct violations triggering distinct reanalysis processes.
- While satiation does not occur when there are multiple violations that are very distinct from each other, the next step would be to compare violations that share an underlying syntactic violation to different degrees, but are distinct on the surface.
  - –e.g. *wh*-islands versus *whether*-islands.

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