



# The Auditory Sensory Hypothesis of the Early Left Anterior Negativity

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## Introduction

○ ELAN is associated with syntactic processing and characterized by a negative-going wave in left anterior electrodes 120–200ms after an unexpected word category [1].

- In a serial processing model [2], ELAN is generated by left-anterior regions in the early *syntax-only phase* when an unexpected word interferes with phrase structure building.
- It remains to be explained how ELAN is generated by frontal regions in the same time range as early sensory processing [3].
- Recent work [4] has led to a hypothesis that the ELAN has a greater basis in sensory processing than previously assumed.

The present study aims to test this sensory hypothesis in the auditory domain using EEG.

## Sensory ELAN Hypothesis

○ Dikker *et al.* [4] demonstrated that the visual magnetic equivalent of ELAN (M100) is generated by (1), but not (2), demonstrating an effect of closed-class functional morphology (CCM).

- (1) \* The discovery was in the *reported*
- (2) \* The discovery was *report*

○ ELAN also occurs for phonologically typical (3) vs. less typical (4) nouns with no additional effect of CCM, suggesting CCM increases category typicality [5].

- (3) \* The strongly *garlic* was used
- (4) \* The thickly *forest* was logged

○ Effects were generated in visual cortex, suggesting ELAN reflects unexpected visual properties of words in the context of a top-down anticipation of category.

- If auditory cortex responds to form typicality, ELAN will occur for targets with CCM (5).
- Targets without CCM (7) will not elicit ELAN, and instead elicit a later component (e.g. LAN, P600).
- If ELAN indexes general failure of syntactic structure building, a similar response to each target is expected.

## Experiment 1

○ Filled-gap sentences previously shown to elicit ELAN [6] were synthesized using ModelTalker TTS [7]. Sentences were followed by 2AFC comprehension questions.

- (5) \* The dog that the cat kissed *the* turtle on the nose ran far away
- (6) The day that the cat kissed *the* turtle on the nose, they ran far away

○ 128-channel 250Hz EEG; OBJECT (5, ~%15) vs. ADJUNCT (6) conditions compared, synced to onset of *the*.

## Experiment 2

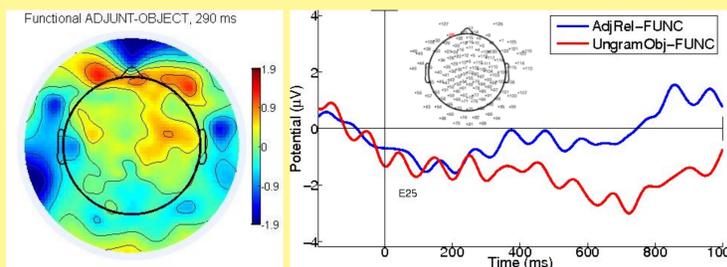
○ Sentences were nearly identical to Experiment 1, with plural NP targets instead of *the* NP (7–8).

- (7) \* The dog that the cat kissed *turtles* on the nose ran far away
- (8) The day that the cat kissed *turtles* on the nose, they ran far away

○ Targets contain the plural morpheme, but during auditory presentation this is not encountered until the end of the word.

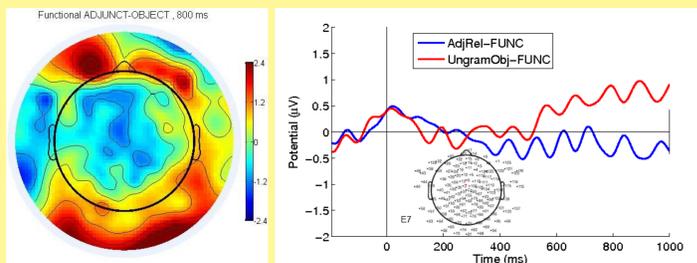
## Results

### Experiment 1



#### LAN

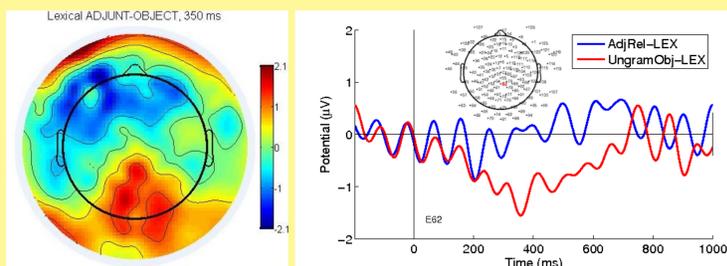
○ indicates error computing syntactic dependency between gap and filler.



#### P600

○ indicates syntactic reanalysis and repair following uncomputable dependency.

### Experiment 2



#### N400

○ indicates semantic processing of plural NP targets.

## Discussion

○ Lack of ELAN in Experiment 1 could be due to synthetic speech, which modulates attention to stimuli.

- Also, targets are not violations of *strictly local* phrase structure.

○ N400 suggests difficulty incorporating the 'extra' NP into argument structure; our speculation:

- CCM allows form-based recognition of the NP targets; parsing is abandoned immediately (LAN).
- Category of bare NPs cannot be determined until whole word is heard; argument structure integration proceeds anyway (N400).

## Conclusions

○ Filled-gap NPs introduced by CCM elicit syntactic components, while filled-gap NPs without CCM elicit a semantic component.

**Results support components of the sensory ELAN hypothesis in the auditory domain to the extent that:**

1. Syntactic errors are detected when targets are introduced by an acoustically salient functional category.
2. A qualitatively different component is elicited when the target cannot be diagnosed based on form.

## References

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