

Indexing Moment-by-Moment Learning of Statistical Regularities Using Event-Related Potentials

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Introduction

- There is considerable evidence demonstrating that listeners can segment fluent speech using only the transitional probabilities between syllables (e.g.: Saffran et al., 1996).
- ERP studies of statistical learning have reported N100 and N400 components (Sanders et al. 2002, Cunillera et al. 2006) indexing word segmentation, and a P200 component indexing word identification (Cunillera et al. 2006)
- Reported ERP studies examining statistical language learning have focused on measurement of ERPs after exposure to an artificial language, which does not measure the process of on-line statistical learning
- We examined how neural responses varied on-line as a function of exposure to a novel language, over the duration of the exposure period

Method

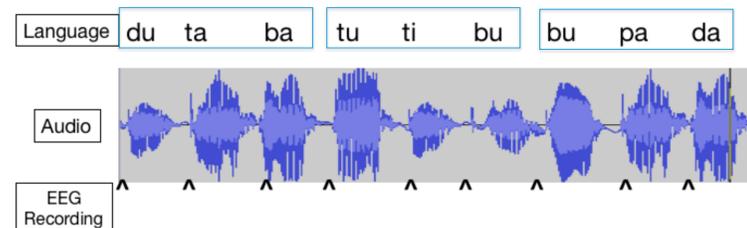
Participants

24 English monolingual ($M_{age} = 20.03$); normal hearing/vision

All above chance on 2AFC task following language exposure

Artificial Language Stimuli

6 tri-syllabic “words”, structured unsegmented stream (e.g.: Saffran et al., 1997)



Procedure

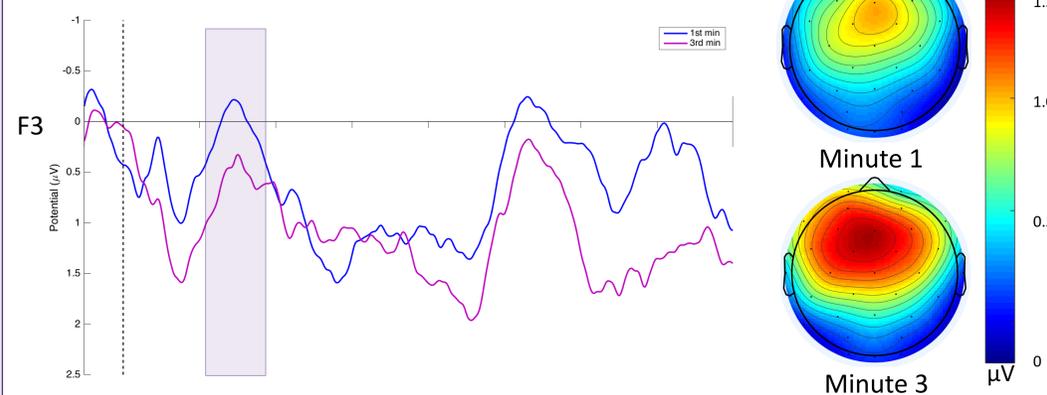
- 21 minutes of exposure to the artificial language
- ERPs measured at the onset of *each* syllable over the duration of exposure phase
- ERP responses binned separately for each minute of exposure phase (~103 words/min)

Analyses

- Compared N100 component at word-onset syllables early in exposure phase (minute 1 vs. minute 3)
- Compared P200 component at word-final syllables early in exposure phase (minute 1 vs. minute 3)

Results

Word-initial syllable – N100 effect (50-110ms)



N100 response to word onset syllables larger for 1st vs 3rd minute of language exposure. Effect is distributed across midline and left fronto-central electrodes.

Word-final syllable – P200 effect (220-280ms)



P200 response to word-final syllables larger for 1st vs. 3rd minute of language exposure. Effect is distributed across middle left and central and posterior central and right regions.

Conclusions

- Word onsets elicited an N100 component early in language exposure period
- Response quickly attenuated
 - May reflect a pre-attentive auditory evoked response, with sensory responses decreasing over continuous presentation (Budd et al., 1999)
 - Perhaps not an index of word segmentation as previously reported (Sanders et al., 2002; Cunillera et al., 2006)
- P200 component emerged for word-final syllables by 3rd minute of exposure
 - May reflect extraction of the transitional probabilities within the language (de Diego Balaguer et al., 2007)

Summary

- Overall, using ERPs during artificial language exposure may provide indices of the cognitive processes involved in online word segmentation
- Indexes of extraction of statistical regularities (Thiessen et al. 2014)
- Our on-line approach may be more informative than post-exposure behavioural tests of word recognition

References

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