Evaluating Unsupervised Word Segmentation in Adults: A Meta-analysis

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Introduction

- Humans, even from infancy, are capable of unsupervised ("statistical") learning of linguistic information.
- It is unclear which of the myriad algorithms for unsupervised learning captures human abilities. This matters because unsupervised learning algorithms vary greatly in how much can be learned how quickly.
- As a step towards more precisely characterizing human unsupervised learning capabilities, we quantitatively synthesize the literature on adult unsupervised ("statistical") word segmentation.

Methods

Eligibility Criteria
- Empirical studies examining statistical word segmentation of auditory words
- Participants: typically-developing adults
- Stimuli: an artificial language consisting of a pauseless speech stream
- Test: a binary response task measuring ability to discriminate trained words from foils

Information Sources
- Previously compiled lists based on prior knowledge and community listservs
- Google Scholar
- Literature reviews on statistical learning (Frost et al., 2019; Saffran & Kirkham, 2018)
- Forward and backward citation searching

Final sample
- 130 studies (ea. containing multiple experiments)
- 367,821 unique observations from approx. 11,000 participants

Data Analysis

- Single-sample effect sizes were coded as the primary outcome measure
- We additionally coded information concerning 19 of the most frequently manipulated modulators of learning (See Table 1)
- Two-stage meta-analysis using linear meta-regression
  - Stage 1: All predictors except for native language and prosodic manipulations
  - Stage 2: Native language and lexical stress

Results

STAGE 1: Significant Intercept
- Participants perform above chance when:
  - The words of the language are defined by high TPs between adjacent syllables
  - The foils presented are non-words
  - Performance is significantly impaired when:
    - The "words" are defined by high TPs between non-adjacent syllables
    - Test items are "rule words," novel items constructed based on some pattern consistent with the familiarized words
    - The foils are "part-words," or strings that straddle the boundaries of statistical words.

STAGE 2:
- English speakers performed better when lowered pitch coincides with word-final syllables
- French speakers performed better when the last syllable rose in pitch

Conclusions

- Few robust effects and large confidence intervals are consistent with prior evidence that unsupervised learning studies are substantially underpowered.
- This calls attention to the need for higher-powered studies in order to test theoretical proposals about what types of unsupervised learning humans are capable of.

References