Early morphological decomposition: MEG evidence from Fast Periodic Visual Stimulation

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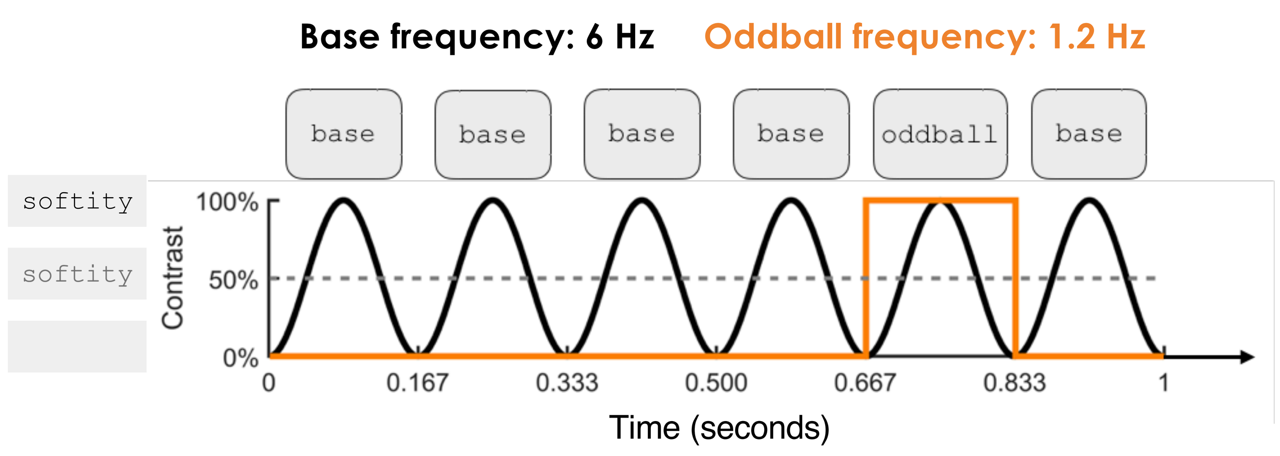
Introduction

- Morphemes: smallest linguistic units that carry meaning. A complex word such as *artist* has a stem, ***art-***, and a suffix, ***-ist***.
- Reading development benefits from the morphological structure of words, especially from the presence of stems [1]. Behavioural evidence for decomposition of complex written words into constituent morphemes [2].
- EEG evidence for selective word [3] and morpheme [4] representations in the brain.

AIM: to investigate **selective neural responses to morphemes** embedded in pseudowords.

Method

Fast Periodic Visual Stimulation (FPVS) with an oddball paradigm [3] and MEG recording (160-channel Yokogawa system).



Stimuli: 72 unique pseudoword combinations of: 12 stems (e.g., *soft*), 12 suffixes (e.g., *ity*), 12 non-stems (e.g., *trum*) and 12 non-suffixes (e.g., *ust*).

Stem detection

Condition 1:
stem+suffix *in non-stem+suffix*
*trumess joskive molpory firnure **softity** berfise*

Condition 2:
stem+non-suffix *in non-stem+non-suffix*
*trumust joskune molpute firnint **softert** berfere*

Suffix detection

Condition 3:
stem+suffix *in stem+non-suffix*
*stopust helpune parkute lastint **softity** townere*

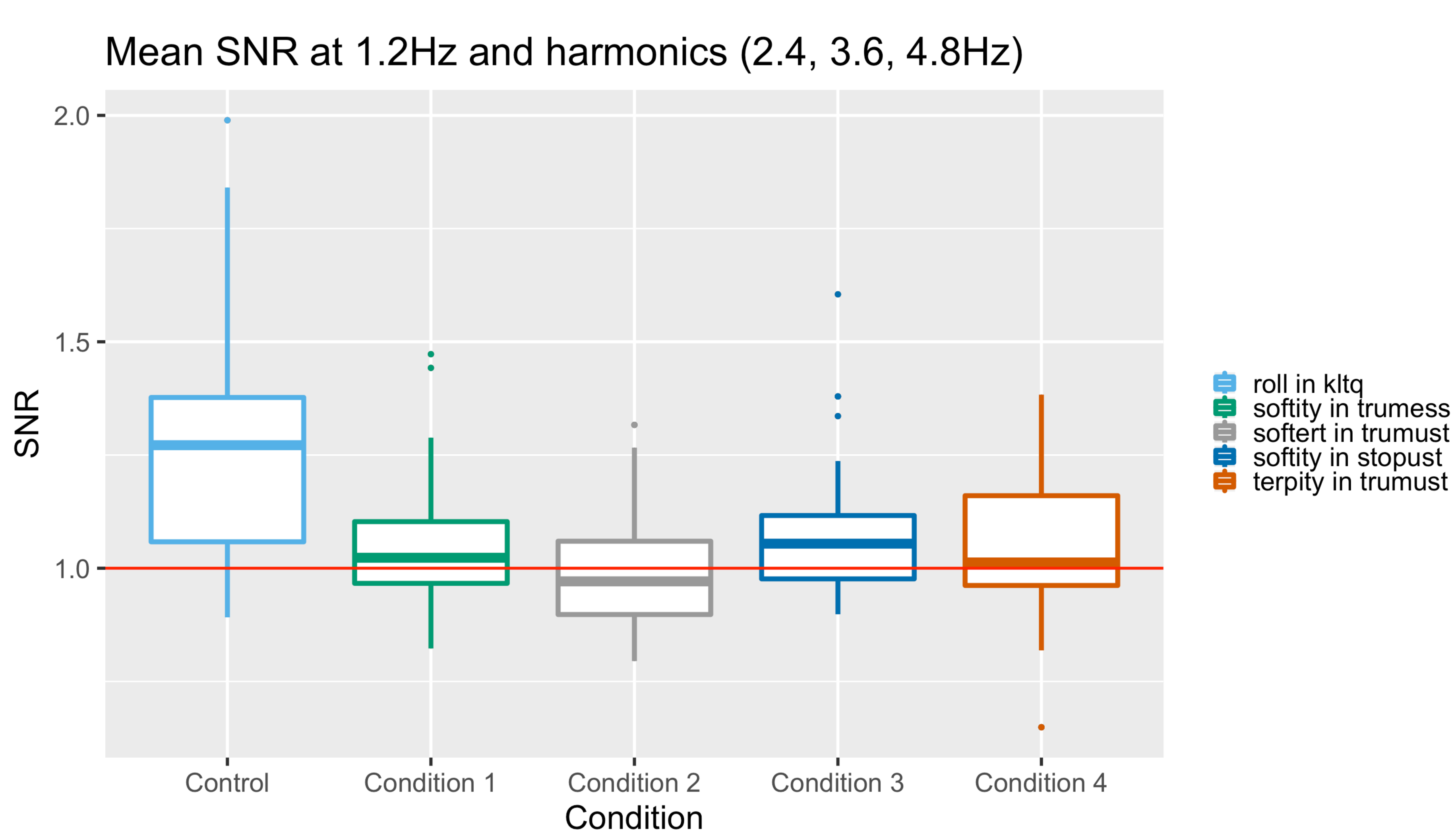
Condition 4:
non-stem+suffix *in non-stem + non-suffix*
*trumust joskune molpute firnint **terpity** berfere*

Control condition:
words *in non-words*
*kltq rdsc fgnl pdrk **roll** tmkj*

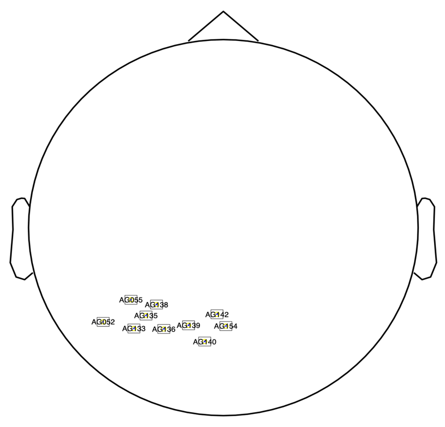
Predictions: MEG response at oddball frequency and its harmonics if morphemes are identified. Discrimination responses across conditions would reveal detection of stems (conditions 1 and 2) and suffixes (conditions 3 and 4).

Participants and task: 28 English native speakers (age: M = 22.93, SD = 6.38) monitored a central fixation cross and responded to colour change.

Results



Sensor-level ROI: based on signal-to-noise ratio (SNR) on grand averaged response across conditions to first oddball frequency harmonic (2.4Hz, the most prominent).



Statistical analysis: one tailed t-test performed on mean SNR at oddball frequency (1.2 Hz) and its first three harmonics (2.4, 3.6, 4.8 Hz) in left occipital sensor-level ROI.

Control condition: mean SNR = 1.29, $t(27) = 5.22$, $p < .001$
Condition 1: mean SNR = 1.06, $t(27) = 1.93$, $p = .03$
Condition 2: mean SNR = 0.99, $t(27) = -0.06$, $p = .52$
Condition 3: mean SNR = 1.08, $t(27) = 2.68$, $p = .006$
Condition 4: mean SNR = 1.03, $t(27) = 0.93$, $p = .18$

Discussion

- **Stems** and **suffixes** were successfully **discriminated** from non-stems and non-suffixes only when presented in **fully decomposable pseudowords** (conditions 1 and 3).
- This provides evidence for **automatic morpheme identification** and is in line with accounts of morphological decomposition [1,5,6]. Critically, these findings suggest that morpheme identification can be modulated by the **context** in which the morphemes appear.
- Sensor-level analysis shows discrimination response to morphemes in left occipito-temporal regions. Further analyses (source analysis, cluster-based permutation) will provide more refined spatial information and help shed light on the brain mechanisms underpinning morpheme identification. Particularly, involvement of the occipito-temporal cortex will be explored, in line with previous literature [7,8].

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