Looking for the Phonological Mapping Negativity (in all the wrong places)

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Section 1

Introduction

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Four years ago

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It was a dark and stormy night in Manchester, England

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[**It obviously really wasn't**]

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Event-related potential components are measured with electro-encephalography (**EEG**) equipment.

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The original goal of my thesis was that to **design** a handful of **ERP experiments to investigate lexical feedback** and top-down processes of speech perception. But how?

Introduction

- Mismatch Negativity (**MMN**)

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- **P600**

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In the aud- itory domain, a deviant stimulus can be identified by differences in pitch, duration, stress and frequency range (Erlbeck et al., 2014)

N400

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nurse

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- Other paradigms include cloze-probability mismatch (e.g. Connolly and Phillips 1994)

P600

Phonological Mapping Negativity

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others (e.g. Newman & Connolly) report that the PMN is a **marker of acoustic and pre-lexical information**.

Connolly and Phillips (1994)

Event-Related Potential Components Reflect Phonological and Semantic Processing of the Terminal Word of Spoken Sentences:

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- The piano is out of

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- The piano is out of tune

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- The piano is out of tune (no mismatch)

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- The piano is out of pizza (N400 and PMN)

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- The piano is out of tune (no mismatch)
- The piano is out of tuna (N400)
- The piano is out of pizza (N400 and PMN)
- ...

Newman et al. (2003)

Phoneme deletion task to study the PMN:

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Delete /k/ from the word “clap”

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- aap

Newman et al. (2003)

Phoneme deletion task to study the PMN:

Delete /k/ from the word “clap”

- lap
- aap
- dog

Phonological Mapping Negativity

Lewendon et. al (2020) suggest that the possibility exists that the PMN is an extension of either the Mismatch Negativity (**MMN**) or **N400** components

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  - Some studies report discovering the PMN in frontal and central sites, ohers in parietal / mid-line / evenly spread across the scalp.

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- Methodological limitations:
  - Few participants (usually < 10)
  - Few trials (usually < 40)
  - Confounding variables

Research questions

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- **Is the PMN in response to acoustic, phonetic, phonological, lexical mapping and mismatch, none or a combination of all?**

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- **Is any other ERP component found in response to acoustic, phonetic and phonological mismatch in place of / together wih the PMN?**

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Why the PMN..

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- The PMN might play an important role in future investigations of architectures of grammar (placed in between acoustic and lexical processing)

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Why the PMN.. *and why now?*

- The PMN might play an important role in future investigations of architectures of grammar (placed in between acoustic and lexical processing)
- Clinical studies have used the PMN as a *marker of phonological processing abilities* (Robson et al. 2017). However, it is not clear what processes sexactly the PMN stands for.

Section 2

Methods

Experimental design

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Three neuro-imaging experiments designed to introduce new contexts in which to probe the elicitation of the PMN ERP component.

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Experiments **1**, **2**, and **3** were designed to simultaneously work independently while also being fully comparable.

Equipment

Hardware:

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- 64 active pin-type **BioSemi** electrodes / **ActiView**

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- Neurobehavioral Systems' **Presentation**

Equipment

Software:

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- MATLAB (2018b; 2019a; 2019b)
- EEGLAB (Delorme & Makeig 2004)
- ERPLAB (Lopez-Calderon & Luck, 2014)
- R (4.1) (R Core Team 2021)

Equipment

Statistical analyses:

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- Exploratory channel-level multivariate testing with package `ERP` (Causeur et al. 2020) and the Adaptive Factor Adjustment (AFA) procedure (Sheu et al. 2016)

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- Exploratory channel-level multivariate testing with package `ERP` (Causeur et al. 2020) and the Adaptive Factor Adjustment (AFA) procedure (Sheu et al. 2016)
- Mean amplitude modelling with mixed-effect models & package `lme4` (Bates et al. 2015)

Equipment

Data visualisation:

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- Grand-Average / difference ERP plots with `ggplot2` (Wickham 2016)

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- Grand-Average / difference ERP plots with `ggplot2` (Wickham 2016)
- Cubic spline interpolation scalp maps with package `akima` (Akima and Gebhardt 2020)

Reproducibility

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Data, code and model summaries are freely available on GitHub at the repository `mcanzi/phd_codedata`

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PhD thesis has been submitted and *will available through open access* following thesis defense (in August) and corrections.

Section 3

Experiment 1

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- During EEG data collection, stimuli were played back to participants during a passive listening task, however..
  - In 33% of total trials, the first syllable of the second nonce-word of each pair would be manipulated to break expectations

Stimuli

pitabu

Stimuli

pitabu dipida

Stimuli

pitabu dipida

pitabu

Stimuli

pitabu dipida

pitabu **ba**pida

Stimuli

pitabu dipida

pitabu **ba**pida

pitabu

Stimuli

pitabu dipida

pitabu **ba**pida

pitabu **bu**pida

Stimuli

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- Vowel, syllable and word length were controlled for (each syllable was 200 ms long)

Stimuli

pitabu dipida

pitabu **ba**pida

pitabu **bu**pida

- Stimuli were synthesized using Mac OS Text-to-Speech
- Vowel, syllable and word length were controlled for (each syllable was 200 ms long)
- Speaker and pitch contours were the same for all stimuli.

Participants

22 Participants (F = 13) took part to the experiment.

- 22 right-handed adults

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- 22 right-handed adults
- 22 BrE speakers

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Participants

22 Participants (F = 13) took part to the experiment.

- 22 right-handed adults
- 22 BrE speakers
- Age (M = 22, 18-25)
- Normal or corrected to normal vision and hearing
- No reported use of psychoactive medications

Results

Results

Discussion

Discussion

Section 4

Experiment 2

Methods

-
-
-
-

Methods

Results

Results

Discussion

Discussion

Section 5

Experiment 3

Methods

-
-
-
-

Methods

Results

Results

Discussion

Discussion

Section 6

General Discussion

Thank you!

References

Questions?