

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

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June 24 2021

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Introduction

Four years ago

Introduction

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It was a dark and stormy night in Manchester, England

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Me:

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Me: “What if we used ERP to help settle the decade-long debate of feed-forward vs interactive speech perception? It sounds fairly straightforward!”

[It obviously really wasn’t]

Introduction

Event-related potentials (**ERP**) are measured brain responses that are direct result of a **sensory, cognitive** or motor event (**Luck 2005**)

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

Introduction

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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.

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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**)

* Originanly named Phonological Mismatch Negativity

Introduction

- Mismatch Negativity (**MMN**)
- Phonological Mapping* Negativity (**PMN**)

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- Mismatch Negativity (**MMN**)
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- **N400**

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- Mismatch Negativity (**MMN**)
- Phonological Mapping* Negativity (**PMN**)
- **N400**
- **P600**

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Phonological Mapping Negativity

The Phonological Mapping (or Mismatch) Negativity, **PMN** is an event-related potential component hypothesized to index phonological mismatch and mapping

Phonological Mapping Negativity

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Phonological Mapping Negativity

However, while some studies (e.g. Connolly and Phillips 1994) have linked the PMN to phonological mapping during the lexical selection stage of speech perception..

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.**

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

Phonological Mapping Negativity

Lewendon et. al (2020) also report that the majority of the literature on the PMN is characterized by contradictory findings and methodological limitations, e.g.

- Contrasting theories of the PMN

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- Contrasting theories of the PMN
- Mixed topographical locations:
 - Some studies report discovering the PMN in frontal and central sites, others in parietal / mid-line / evenly spread across the scalp.

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- Mixed topographical locations:
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- Methodological limitations:
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 - Few trials (usually < 40)
 - Confounding variables

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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?

Research questions

- Is the PMN in response to acoustic, phonetic, phonological, lexical mapping and mismatch, none or a combination of all?
- Is any other ERP component found in response to acoustic, phonetic and phonological mismatch in place of / together with the PMN?

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Research questions

Why the PMN..

Research questions

Why the PMN.. *and why now?*

Research questions

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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 exactly the PMN stands for.

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Experimental design

Experimental design

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

Experimental design

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

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

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Equipment

Hardware:

Equipment

Hardware:

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

Equipment

Hardware:

- 64 active pin-type **BioSemi** electrodes / **ActiView**
- Neurobehavioral Systems' **Presentation**

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Equipment

Software:

Equipment

Software:

- MATLAB (2018b; 2019a; 2019b)

Equipment

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- EEGLAB (Delorme & Makeig 2004)

Equipment

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- ERPLAB (Lopez-Calderon & Luck, 2014)

Equipment

Software:

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

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Equipment

Statistical analyses:

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Statistical analyses:

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

Equipment

Statistical analyses:

- 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)

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Equipment

Data visualisation:

Equipment

Data visualisation:

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

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Data visualisation:

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

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Reproducibility



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Reproducibility



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

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Reproducibility



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

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

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Questions?