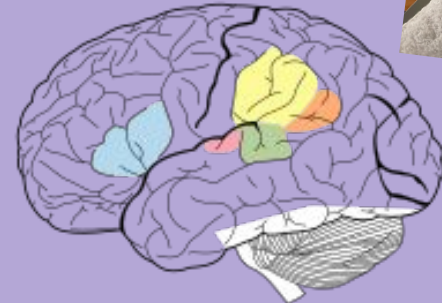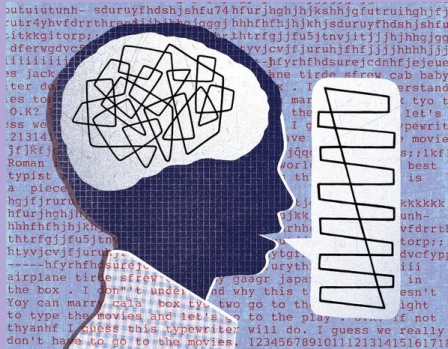# Left-handedness and language: A brainwave analysis of semantic processing and familial left-handedness

Rabia Gondur
Dr. Sarah Grey
NEUR4900

Contents

Introduction

1. What is morphosyntactic information?
   a. Information that relates to morphology and syntax.
2. What is semantic information?
   a. Information that relates to the meaning of sentences and words.
3. What is familial sinistrality?
   a. Having a left-handed blood relative

Theoretical Perspectives on Handedness

- Self or familial left-handedness is related to increased reliance on lexical/semantic information rather than grammar-based, structural information during sentence comprehension.

- ERP research shows that left-handers (self or familial) are more likely to show an N400 ERP response – a brainwave correlate of lexical/semantic processing – during grammar processing (e.g., Grey, Tanner, & Van Hell, 2017).

- Non-left-handers, in contrast, tend to show a P600 ERP response – a brainwave correlate of structural linguistic processing.

Introduction

1. Why is it important to investigate the effects of familial sinistrality on semantic processing?

    a. Studying left-handers or familial sinistrals can contribute to the advancement of knowledge about the neurocognition of language
    b. Studying left-handers or familial sinistrals can display the potential differences in language processing patterns (Grey, Tanner, & Van Hell, 2017, p.28)

Hypothesis:

- Based on the theoretical perspectives, we expect to see a more robust N400 response on familial sinistrals and smaller N400s or P600s on non-familial sinistrals during semantic processing

Methods

- 25 native English speakers, all right-handed (Mean age 19.9 years, 18 females, 7 males)
  - 18 non-familial sinistrals
  - 7 familial sinistrals
- 3 linguistic tasks that in total included 240 sentences, 40 correct per conditions, 40 error per condition
- EEG acquisition
  - 32 scalp electrodes (ActiCap)
  - 3 time intervals: 300ms-500ms, 500ms-800ms, and 800ms-1000ms
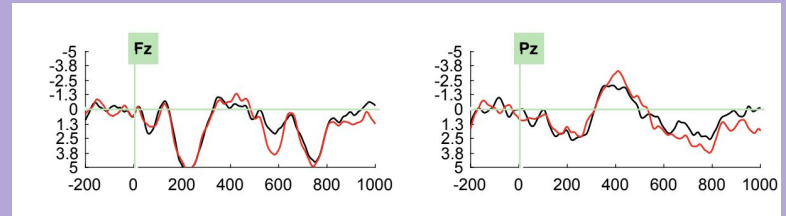- ANOVA
  - Repeated Measures ANOVA

Data Analysis

- Repeated Measures ANOVA for 300ms-500ms, 500ms-800ms, and 800ms-1000ms for:
  - The general participant group (n=25)
  - Familial sinistrals (n=7)
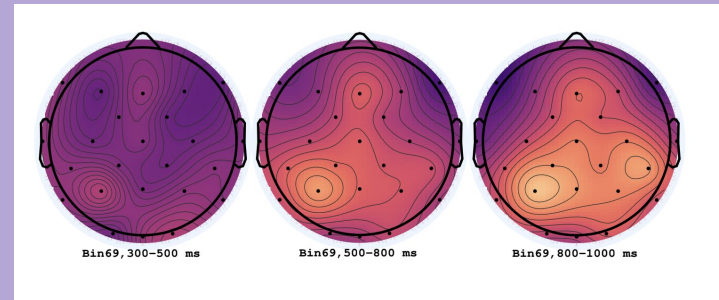 - Non-Familial sinistrals (n=18)

Familial Sinistrals (FS+)
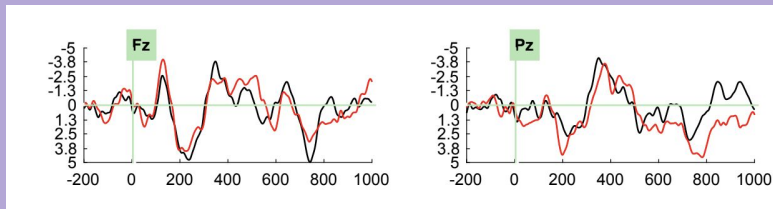
Non-Familial Sinistrals (FS-)

Results

- ANOVA Results:
  - 500-800 ms, 1 significant result ($p<0.05$) in error-anterior-posterior
  - 800-1000 ms, 1 significant result ($p<0.05$) in error-anterior-posterior
- No statistically significant relationships were found for the small group of FS+ individuals
- However, FS- group continued to elicit a P600 ERP response (with late positivity) during semantic processing
  - This suggests that FS- group uses a different linguistic mechanism, structural linguistic mechanism, to process semantic information.

Bin69,300-500 ms   Bin69,500-800 ms   Bin69,800-1000 ms

Discussion

1. Theoretical and Empirical Interpretation of the Results:
   a. The result from this research displays the potentially different way of processing semantic information in non-familial sinistrals even in a small group of participants.
   b. Furthermore, the findings from this research suggests that non-familial sinistrals use a structural linguistic mechanism to process semantic information.
   c. These results align with the previous theories on stronger P600 ERP response during sentence comprehension on non-familial sinistrals.

Discussion

1. Limitations:
   a. Small participant pool
   b. Small familial sinistral participant population
2. Suggestions for future studies:
   a. Expanding the amount of participants
   b. Looking into the effects of ambidexterity on language processing
   c. Looking into the semantic processing differences between left-handed people and non-left-handed people

Thank you for listening!

Special thanks to Dr. Grey and members of the ELM Lab for all of their help.

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