Try not to think about what you're doing: Frontal theta reflects changes in outer-loop processing during serial and normal typing

Lawrence P. Behmer Jr. & Matthew J. C. Crump
Brooklyn College of The City University of New York

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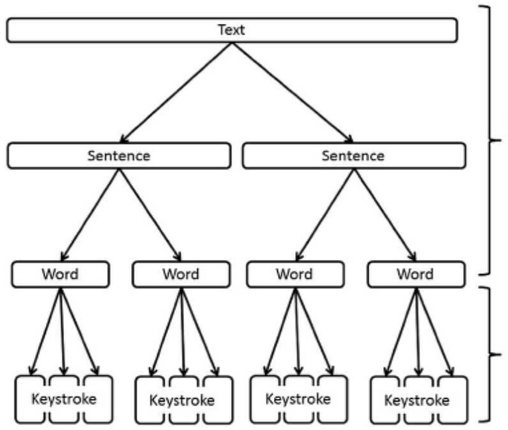
The Two-loop Theory of Typewriting



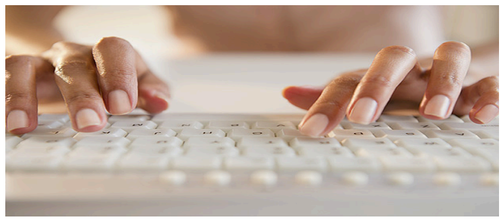
Two independent loops

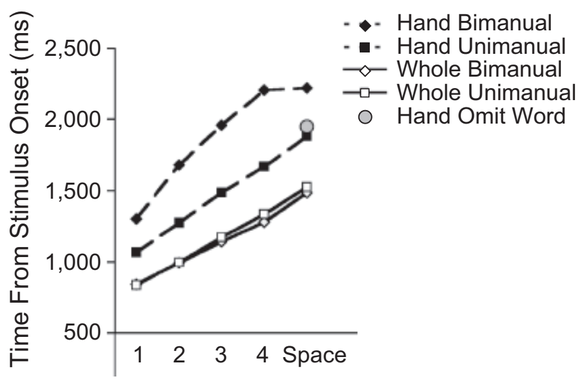
Outer-loop
- Language comprehension
- Generates words to be typed

Inner-loop
- Begins with a word to be typed
- Ends with a series of keystrokes

Words are the interface where the two loops meet

The outer-loop does not know what the inner-loop is doing



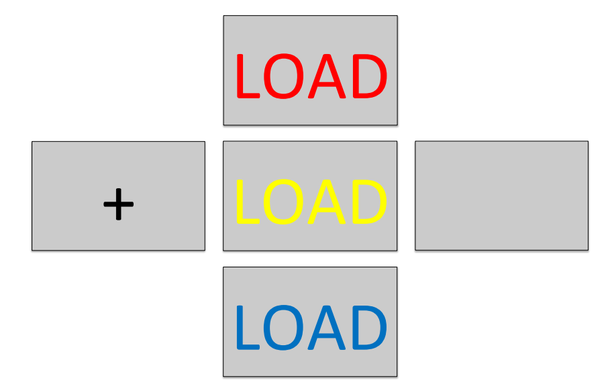


Can EEG be used to measure disruptions in outer-loop performance?

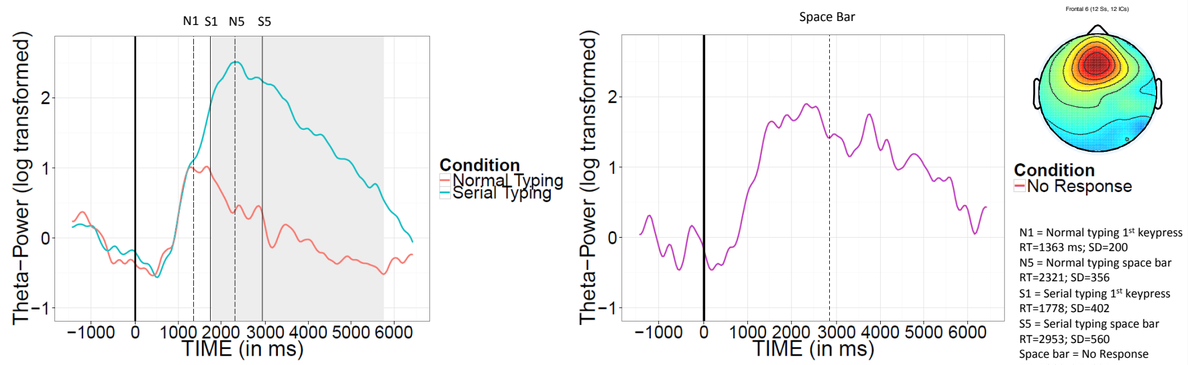
- There is a lack of EEG papers using EEG to investigate typing performance
- Tasks investigating cognitive control (flanker, task switching, etc.) have observed frontal-midline theta-ERS
- Forcing the outer-loop to attend to letter-level output may show increased theta-ERS compared to normal typing

Methods

- N=16
- 64-channel BIOSEMI Active II
- Each trial started with a fixation cross for 2000 ms, followed by a 4-letter word
- Color of word cued type of response
- RED = Type letters on left side
- YELLOW = Type letters on right side
- BLUE = Type all letters
- Pressed space bar when finished typing
- Used DIPFIT to cluster ICs for EEG analysis

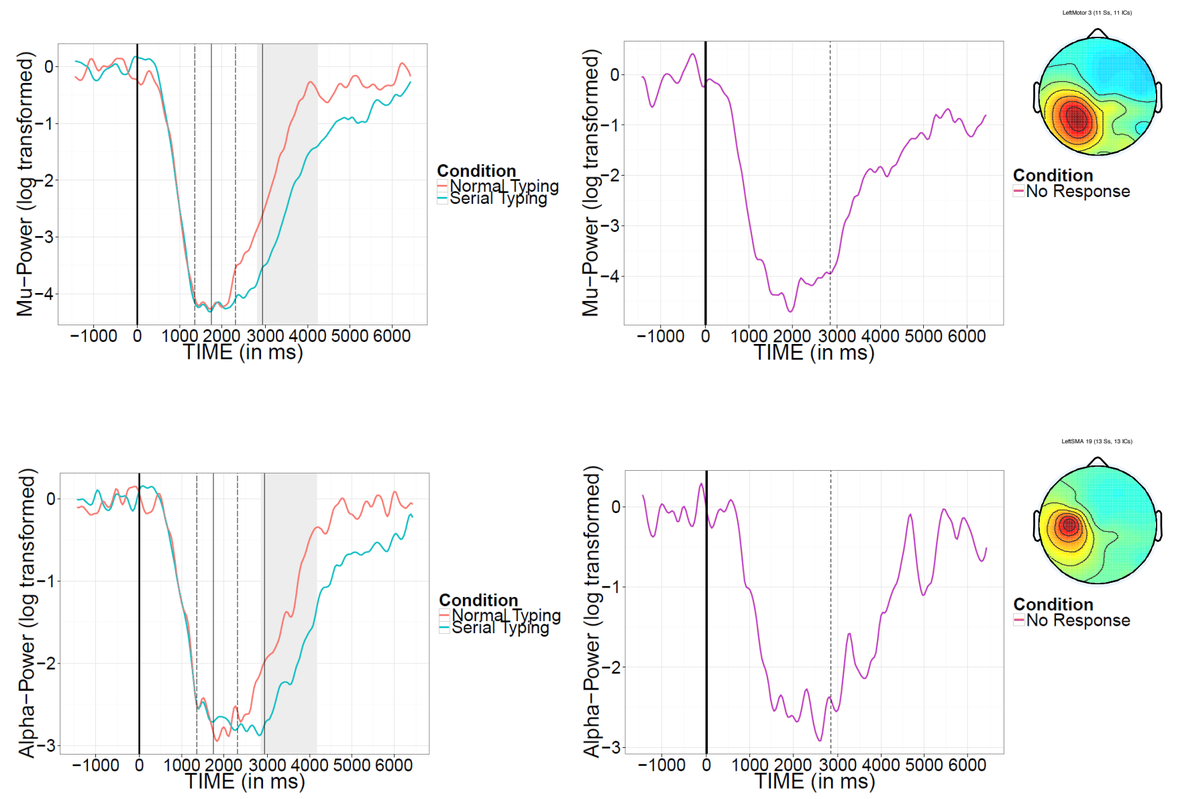


Frontal-midline Theta-ERS is greater during serial typing vs normal typing



Shaded area in gray shows p<0.05

Late differences in Motor and SMA clusters during rebound



Frontal-midline theta-ERS is a marker for outer-loop monitoring

- Changes in frontal-midline theta-ERS are indicative of increased outer-loop monitoring when participants are forced to attend to typing output at the letter-level, as opposed to word-level as with normal typing
- Participants were faster for normal vs serial typing
- Early theta-ERS during normal typing suggests that some level of outer-loop processing is occurring during normal typing
- Conversely, during serial typing, theta-ERS remains robust well after participants finished typing
- As expected, theta-ERS was robust even when participants were not required to respond
- Rapid rebound for normal typing reflects differences in response times