A wandering mind is not a good comprehending mind: Evidence from brain oscillations
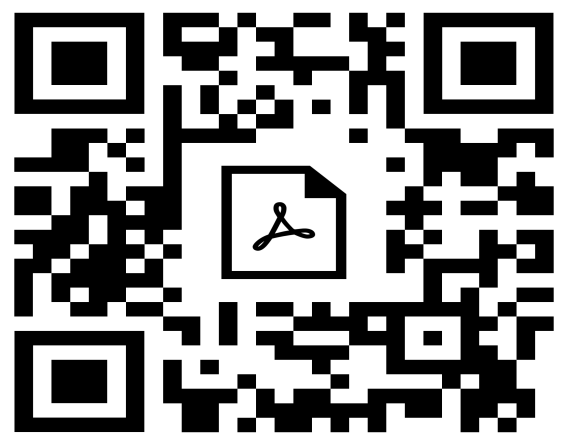
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Introduction

- Mind Wandering (MW) has been defined as the moment in which people's attention unconsciously drifts away from the current task content (Christoff et al., 2016)

- A few studies to date have investigated mind wandering and its effects on reading, and nearly all of them have relied on readers' self-report or thought probes to identify mind wandering moments during reading (Smallwood et al., 2008; McSpadden, & Schooler, 2008; Reichle et al., 2010; Smallwood, 2011; McVay & Kane, 2012; Unsworth & McMillan, 2013)

Research goals:

1. Develop a method to automatically detect MW without interrupting the ongoing reading task
2. Explore relationship between MW ratio and reading comprehension
3. Explore the relationship between MW ratio and executive function

Methods

Participants: 67 monolingual English speakers (51 females) aged between 18-31 (mean =21)
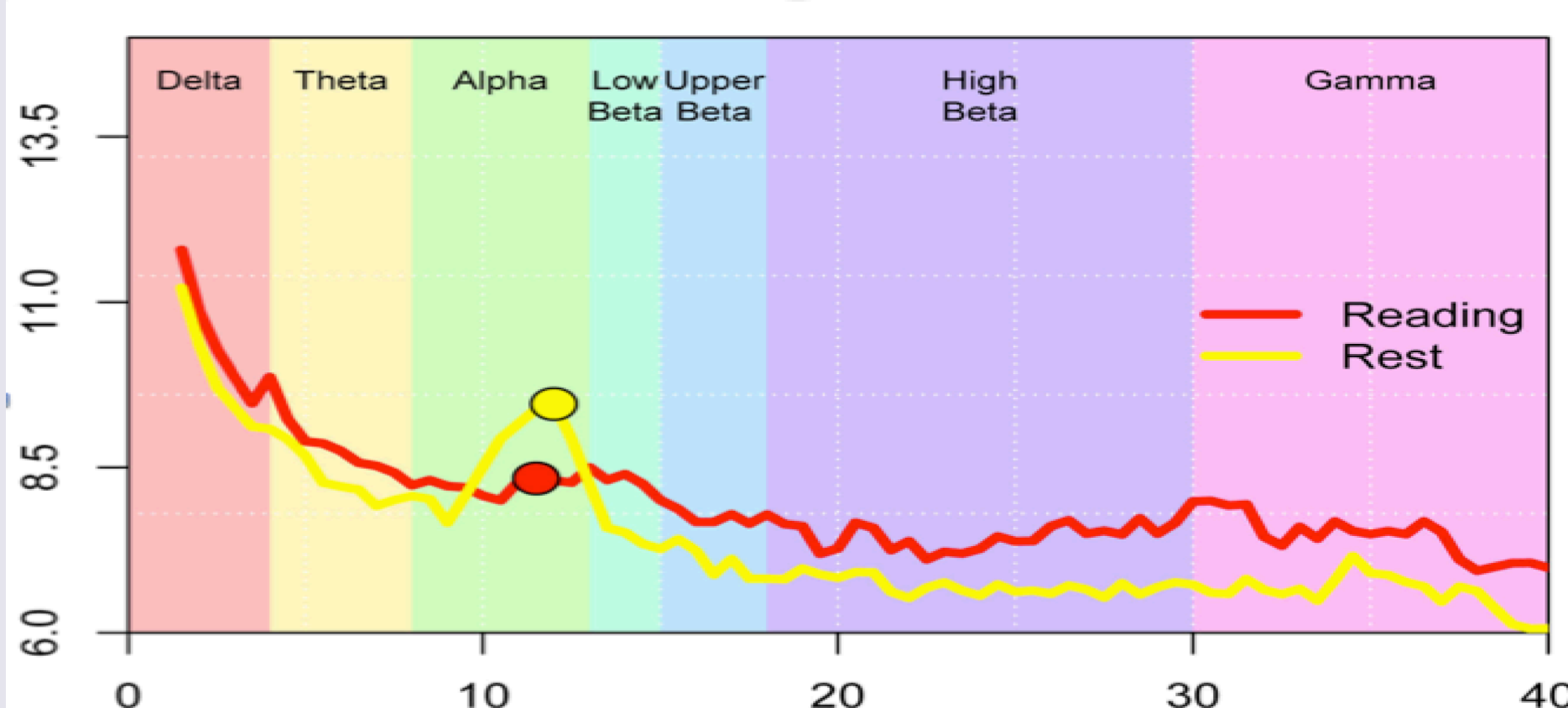
Materials: Nelson-Denny Comprehension Test; Simon Task

EEG Recording Procedure:

- 5mins resting state
- 5mins reading EEG 128Hz sampling rate
- Emotiv headset

Spectrum Similarity Analysis (SSA):

- SSA compares a segment of resting state EEG to a segment of reading EEG

Results

- Participants showing an average Simon Effect of 57.47ms (range = -30.39 to 147.22ms, SD = 37.39ms)

- Comprehension accuracy was significantly correlated with their reaction times of the Simon Effect (r (65)= -0.38, p < 0.01)

- Total peaks ranged from 0-28 (Mean = 15, SD = 7)

- N of MW peaks ranged from 0-28 (Mean = 7, SD = 8)

Good — Proficient readers at 99th percentile
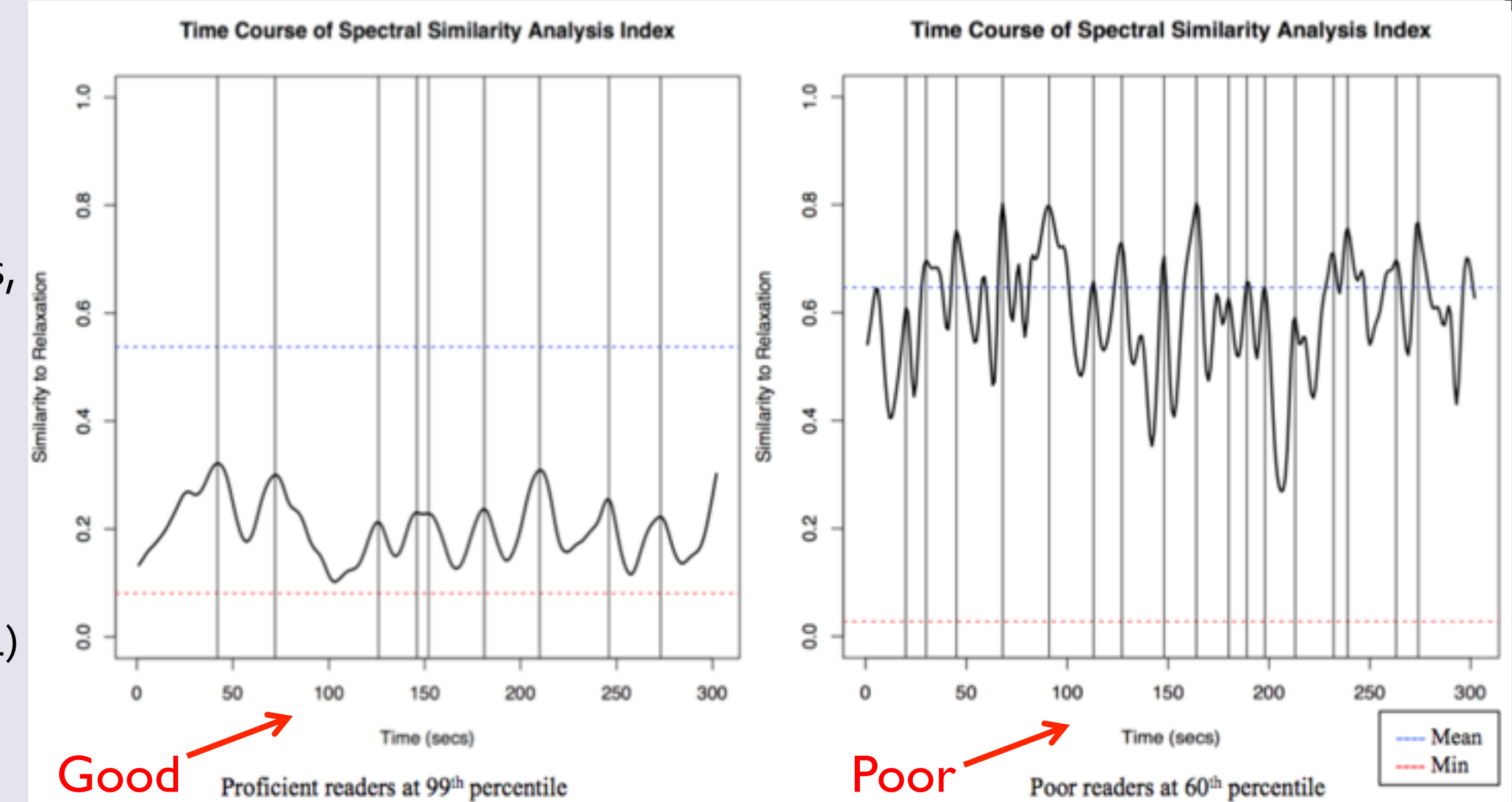
Poor — Poor readers at 60th percentile

Figure 1. The similarity of spectral composition between resting state qEEG and Nelson-Denny reading task qEEG of a proficient reader at 99th percentile (left) and a poor reader at 60th percentile (right)

- MW ratio is significantly correlated (r (65) = -0.31, p< 0.05) with Nelson-Denny comprehension accuracy at O1; MW ratio is significantly correlated (r (65) = -0.4, p< 0.05) with the Simon Effects (Incongruent RT- Congruent RT)
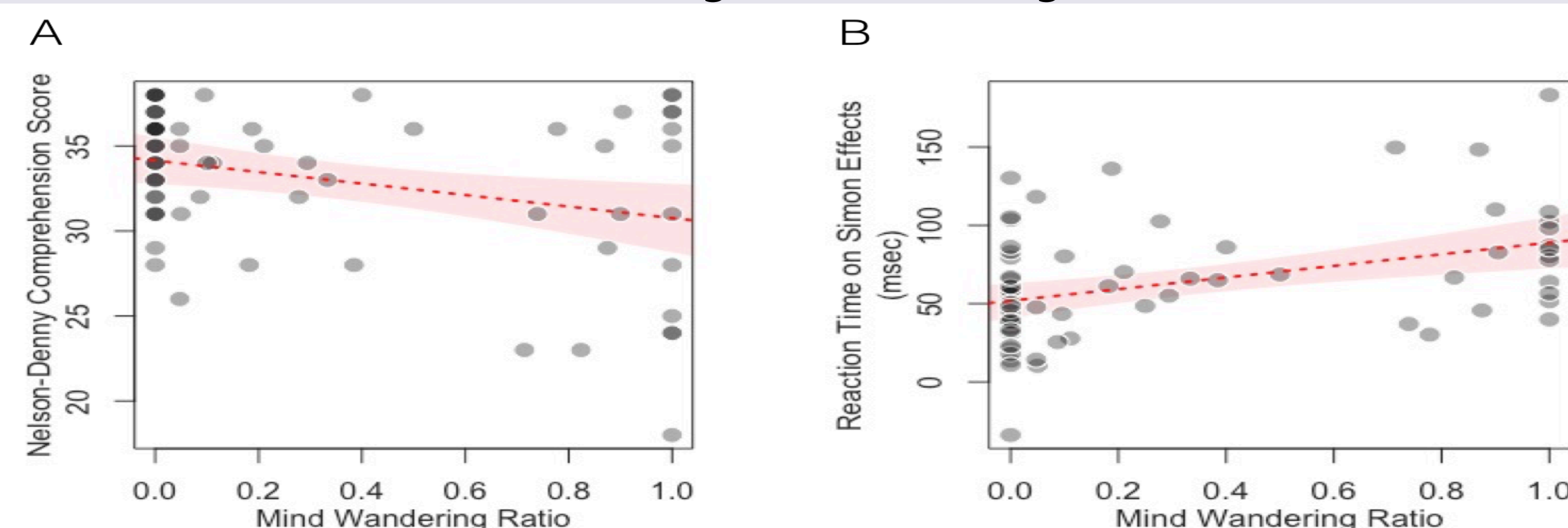

Figure 2. The scatterplot between MW ratio and Nelson-Denny Reading Comprehension accuracy (A) and response times on Simon effects (B) at O1 channel.

Discussion

- This method detects MW automatically without disrupting the natural reading process

- Readers with high MW ratio have worse comprehension of the text, which replicated previous findings (Feng et al, 2013; Scholar et al, 2004)

- Readers who had smaller Simon Effects (better executive control) showed fewer MW moments, which is consistent with the results reported by McVay et al (2012), showing that mind wandering was a significant mediator between reading and attention control, and that frequency of mind wandering was significantly correlated with both.

- Significant correlations at O1, because larger alpha peaks often show in posterior regions during eyes-closed resting state (Ray & Cole,1985) and alpha power is related to mind wandering and attentional engagement disengagement (Macdonald et al., 2011)

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