An ERP Study of Inhibitory Response During Cell Phone Use

Nicole A. Scott, Victor M. Magaña, Ekarin E. Pongpipat, Nathan L. Salehi, Toppacio Rodriguez, Vanessa Camacho, Emilio A. Valadez, Jeremy Neswald, & Jose P. Abara
The Neuroscience Lab - Department of Psychology, California State University, Northridge

INTRODUCTION

Recent studies have argued that cell phone use could compromise the ability to attend and concentrate on task demands such as those relating to driving (Kemker et al., 2009). Included in those task demands is the requirement of executive control of attention such as effortful processing of incoming information, detection of correct and incorrect choices, and the ability to withhold responses. Inhibition of responses is argued to be an important function of executive control (Norman & Shallice, 1986). The P3 generated by a NoGo task is reported to relate to inhibition of responses (Stikl, Fallgatter, Brandeis, & Pascual-Marqui, 1998). A study using a stop-signal task revealed that P3 components differ in scalp topography depending on whether the participant was successful or unsuccessful in inhibiting their response. Successful trials had a fronto-central maximal amplitude while unsuccessful trials showed a more classic P3 topography with greatest parietal amplitude (Kok, Ramautar, De Ridder, & Band, 2004). Additionally, the NoGo P3 showed greater amplitude for successful inhibition relative to unsuccessful inhibition trials. These findings suggest that the P3 component elicited by successful performance was related to efficient inhibition of a motor response.

This study examined the brain electrical activity pattern for inhibitory responses between control and cell phone conditions. The inhibitory responses under control and cell phone conditions were compared using electroencephalography (EEG) procedures during a continuous performance task (CPT).

HYPOTHESES

1. The topography of the P3 amplitude for the NoGo stimulus is expected to follow an anterior maximal distribution.
2. The parietal P3 amplitude is expected to be attenuated following a NoGo response, in comparison to anterior leads.
3. The topographical pattern for NoGo P3 amplitudes are expected to differ between control and cell phone conditions.

METHODS

Participants
- 14 CSUN college students
- EEG Data
- 1500 ms duration for each stimulus
- Number of Stimuli: 387 stimuli; 40 NoGo letter sequences
- Electrode Placements: Fz, Cz, Pz, O2
- Reference to linked earlobes with a forehead ground
- Processing Parameters: Low frequency filter = 0.1 Hz; High Frequency filter = 100 Hz
- VEOG and Horizontal (HEOG) eye movements were recorded

Processing Parameters
- Epoch = 1700 ms
- Baseline Correction = 300 ms pre-stimulus onset
- VEOG Correction = method suggested by Semlitsch, et al. (1986)

Peak Identification
- Based on the grand average of the ERPs during NoGo responses (see Figure 1)
- Figure 1. Grand average waveform at Fz, Cz, and Pz for no cell phone (NC, red) and cell phone (C, green) conditions.

RESULTS

P3 Amplitude and Topography
- Non-Significant Interaction Effect of Condition (C, NC) by Lead (Fz, Cz, Pz)
- F(2, 26) = 431, p = .049
- No significant difference in P3 latency between cell phone use and no cell phone use irrespective of leads

Table 3. P3 latency means and standard error for conditions across leads

Condition | M (SE) | M (SE) | M (SE)
---|---|---|---
NC | 315.31 (11.37) | 331.23 (10.09) | 321.92 (7.15)
C | 316.85 (10.52) | 324.15 (8.04) | 321.08 (6.80)

Figure 4. P3 latency across leads.

CONCLUSION

The present study examined the effects of cell phone use on the P3 for an inhibitory response. The results show a central maximal distribution of the P3 amplitude. This topographical pattern was observed for both conditions. As for the P3 amplitude, it did not differ between control and cell phone conditions. Analyses of the P3 latency, however, yielded difference between conditions. The cell phone use condition produced a delayed P3 latency compared to the P3 latency for the control condition. This difference in the P3 latency pattern suggests that cell phone use affects the processing time of the neural network for an inhibitory response.

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