Pre-stimulus neural activity predicts success in ignoring

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INTRODUCTION

Stimulus processing requires two aspects of attention: ignoring irrelevant stimuli and enhancing processing of relevant stimuli. Here we exploit an intentional ignoring paradigm in order to examine how attention and ignoring are linked.

It is well known that attention alters neural processing (e.g., Hilgart and Anto-Vento, 1998). We explore the idea that ongoing background neural activity also impacts stimulus processing, as schematized in the figure.

Does background neural activity prior to stimulus presentation affect subsequent stimulus-driven neural activity and behavior?

Remember/Ignore Task

Subjects performed three tasks in blocks of 60 trials each. In the Remember condition subjects view a display of colored bars (2 on each side of fixation), and judge whether a subsequently presented probe (P1) differs from that display. This task resembles Vogel and Machizawa’s (2004) change detection task.

The Remember condition is similar to the Remember condition, but subjects must remember sequentially-presented stimulus arrays (S1 and S2). Subjects then respond to sequentially presented probes (P1 and P2). The Ignore condition is similar to Remember 2, but here subjects are not tested on S2, and are instructed to ignore it (Yotsuji and Sekuler, 2006).

EEG methods

13 subjects performed the Remember/Ignore task while EEG data were collected using a 128 electrode net from EGI systems. 240 trials of each condition were performed. After pre-processing, trials with blinks or other artifacts were removed from further analysis, leaving at least 100 trials per subject, per instruction condition. Data from 3 subjects were excluded because of poor performance or technical issues.

Data were collected at 250 Hz, hardware filter high pass at 0.1 Hz, low pass at 100 Hz.

Data preprocessing: High pass filtered at 1 Hz, low pass filtered at 20 Hz. Data averaged to 27 electrode array.

Pre-stimulus activity

Before presentation of S2, power in the α band is larger in Ignore trials, consistent with preparation to ignore the stimulus.

Significant differences at p<0.05 with 1, ERP multiple comparison corrected using bootstrap methods. Within-subject error bars. Pre vs post-stimulus activity shows alpha suppression

Does this pre-stimulus activity impact behavior?

CONCLUSIONS

Remember/Ignore task provides a behavioral index of ignoring’s effectiveness.

- Ignoring a second stimulus overcomes the potential interference from that stimulus (Proportion correct and Reaction time).

This task alleviates need for explicit test of ignored stimulus.

Intentional ignoring manipulates the attention system.

- Variations in stimulus-driven EEG power and ERPs are consistent with previous findings in the attention literature.

Dynamic changes in α power are associated with ignoring.

- Preparatory activity predicts subsequent accuracy in memory for a different stimulus.

- “Good ignoring” (as defined by high α-band power) predicts ability to overcome interference (defined by behavior).

In this paradigm, transient, α-band power is associated with good performance, due to suppression of interfering information.

Consistent with role of α in active inhibition, not “idling.”