



EEG correlates of intentional ignoring

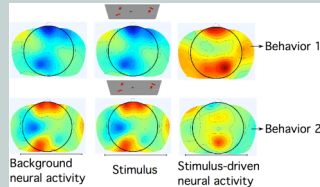
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INTRODUCTION

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., Hillyard and Anillo-Vento, 1998). We explore the idea that ongoing background neural activity may impact stimulus processing, as schematized in the figure. Background neural activity just prior to the time of stimulus presentation could affect subsequent stimulus-driven neural activity and behavior.

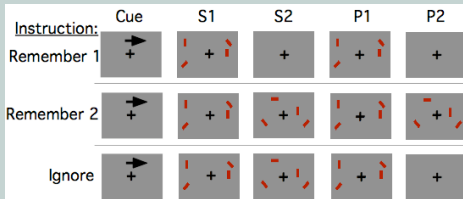


Remember/Ignore Task

Subjects performed three tasks in blocks of 60 trials each. The **Remember 1** condition involved observing a display of oriented bars (2 on each side of fixation), and detecting whether a probe (P1) is different. This task is similar to the change detection task used by Vogel and Machizawa, 2004.

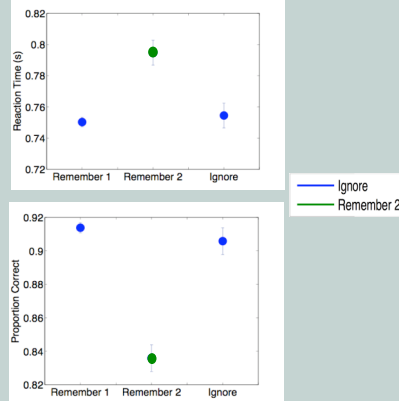
The **Remember 2** condition is similar to Remember 1, but subjects must remember two stimulus arrays (S1 and S2), presented sequentially. Subjects respond to sequentially presented probes (P1 and P2).

The **Ignore** condition stimuli are identical to Remember 2, but subjects are not tested on S2, and are instructed to ignore it (Yotsumoto and Sekuler, 2005).



Random delays of 700 to 1200 ms between stimuli onsets. S1 and S2 are on the screen for 100 ms each. P1 and P2 are on the screen until response or 2000 ms.

Ignoring stimulus 2 overcomes interference



23 Subjects performed well on the **Remember 1** condition, with high proportion correct and low reaction times. When required to **Remember 2** stimuli, the second stimulus interfered with the memory for the first, resulting in poorer performance: lower proportion correct ($p < 0.01$) and slower reaction times ($p < 0.01$).

When subjects **Ignore** stimulus 2, they can overcome this interference. Reaction time and proportion correct are statistically indistinguishable from Remember 1 condition (but variance is greater).

How do subjects overcome interference?

EEG methods

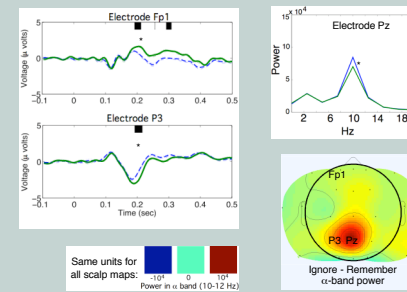
6 subjects performed the Remember/Ignore task while EEG data were collected using a 128 electrode net from EGI systems. 240 trials of each condition were performed in blocks of 60 trials of a given instruction. After pre-processing, trials with blinks or other artifacts were removed from further analysis, leaving at least 100 trials per subject, per instruction condition.

Data were collected at 250 Hz, hardware filter high pass at 0.1 Hz, low pass at 100 Hz. Data pre-processing: High pass filtered at 1 Hz, low pass filtered at 20 Hz. Data averaged to 27 electrode array.

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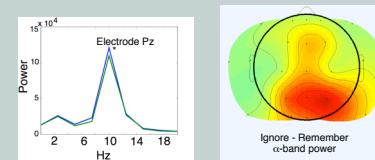
Stimulus-driven activity

ERP and α -band power reflect decreased attention to ignored stimulus



Stimulus-driven ERPs for S2 are larger for **Remember 2** than **Ignore** trials. Power in the α band (around 10 Hz) is larger in **Ignore** trials, consistent with literature (e.g. Hillyard and Anillo-Vento, 1998, Klimesch, 1999, Thut et al., 2006). Bars and * indicate significant differences at $p < 0.05$. ERP was baseline corrected and multiple comparison corrected using bootstrap methods.

Pre-stimulus activity



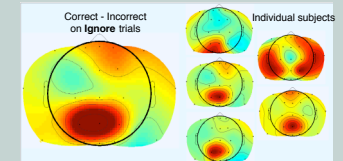
Before presentation of S2, power in the α band is larger in **Ignore** trials, consistent with preparation to ignore the stimulus.
* indicates significant differences at $p < 0.05$. ERP multiple comparison corrected using bootstrap methods.

Does this pre-stimulus activity impact behavior?

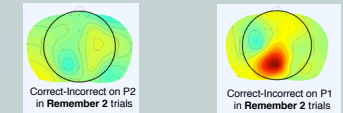
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Pre-stimulus activity may predict "successful" ignoring

High α -band power before to-be-ignored stimulus predicts correct memory for a different stimulus.



Pre-stimulus activity in electrode Pz predicts whether the subject will effectively ignore the stimulus (trend in 5 subjects. $p = 0.064$). In **Ignore** trials, higher α -band power before the to-be-ignored stimulus for correct trials than error trials. Only 5 of 6 subjects made enough errors in this condition to compare correct and incorrect trials.



Pre-stimulus activity does not predict performance on the to-be-remembered stimulus in the **Remember 2** task. Interestingly, pre-stimulus alpha activity during S2 correlates with better performance on memory for the other stimulus even when subjects try to remember both.

CONCLUSIONS

Ignore/Remember task provides a behavioral assessment of the "degree of ignoring" of a given stimulus.

- Ignoring a second stimulus overcomes the interference from that stimulus (Proportion correct and RT).
- No need for explicit test of ignored stimulus.

Intentional ignoring manipulates the attention system.

- Variations in stimulus-driven EEG power and ERPs consistent with attentional literature.

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