

P300 AMPLITUDE EFFECTS OF PERSONALLY SIGNIFICANT DISTRACTORS IN ACTIVE ODDBALL TASKS

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INTRODUCTION

Personally significant stimuli capture our attention in a similar way as instructed targets.

Studies on oddball paradigms have successfully shown that enhanced P300 amplitudes are elicited by events representing the low probability category among a set of stimuli even in absence of any detection instructions [1].

Moreover, in previous ERP studies enhanced P300 amplitudes could be observed for items with personal significance, as one's own face or face [2, 3].

We aimed to extend this research by proving this P300 effect for taskirrelevant but intrinsically significant items in an active oddball task with task instructions for arbitrary target items.

? We propose that due to their personal significance, non-targets related to oneself elicit a P300 component, for both picture and word stimuli, although attention is drawn to a designated target stimulus.

METHODS

Subjects

9 students (5 female, 4 male; mean age=22.1; range 20 - 25)

Task and Stimuli

In two separate 3-stimulus oddball tasks, we used different stimulus categories (exp. 1: symbols of car brands, Fig. 2; exp. 2: names of clothing brands, Tab. 2). Prior to the experiments, one stimulus with the highest personal significance was selected out of a stimulus pool by each subject. This personally significant item served as the task irrelevant non-target (distractor; prob. 0.14) among standard and target stimuli. One Target (prob. 0.14) was chosen out of the stimuli pool by chance and had to be detected during the experimental procedure by mental count. 6 Standards (prob. 0.72) were chosen out of the stimulus pool by the instructor. Each task consisted of 100 overall stimulus presentations in the defined probability ratio.

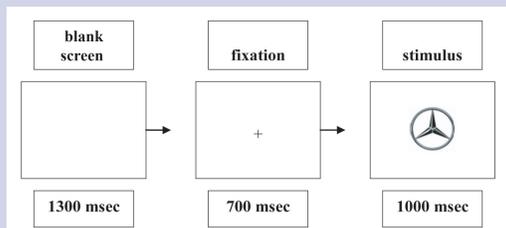


Figure 1: Trialscheme

Data analysis

EEG data were analyzed for the following 3 conditions: 1) standards, 2) targets, 3) non-targets.

Statistical analyses were separately calculated at channels P3 and P4. According to the 3 x 2 factorial design (stimulus type x stimulus format; Tab. 1), a within-subject repeated measures ANOVA was performed. Subsequent pair-wise comparisons between all factor levels were conducted.

Table 1: Linear model

variable	factor
P300-amplitude	(1) stimulus format: picture, word (2) stimulus type: standard, target, non-target

Table 2: Examples of word stimuli

Adidas	Benneton
Fila	Nike
Puma	Mexx
Esprit	Carhartt

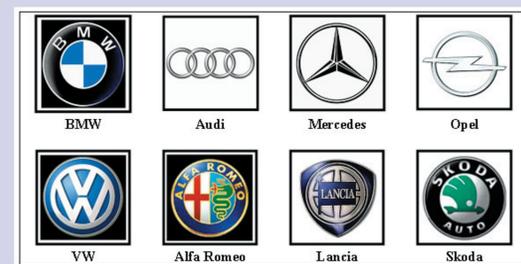


Figure 2: Example picture stimuli

RESULTS

Statistical analysis

Stimulus types varied significantly at both electrode sites P3 ($F=19.139$; $p<.001$) and P4 ($F=15.607$; $p<.001$). Largest amplitudes were elicited by targets, followed by non-targets, followed in turn by standards. Even in absence of any instructions, non-targets evoked significantly larger P300 amplitudes (P3 $p=0.001$; P4 $p=0.004$) than standards. Stimulus format (words vs. pictures) varied significantly at P3 ($F=7.688$; $p<.05$) and a trend towards significance was observed at P4 ($F=3.674$; $p<.10$). P300 amplitudes in response to picture stimuli were larger than those to word stimuli. The ratio of amplitude differences between stimulus types was about equal in both categories.

No latency effects were found.

Table 3: ANOVA

factors	P3-electrode					P4-electrode				
	df	F	p	ϵ	η^2	df	F	p	ϵ	η^2
stimulus type	1,234	19.139	.001	.617	.705	2	15.607	.000	-	.661
stimulus format	1	07.688	.024	-	.490	1	3.674	.092	-	.315
stim-type x format	2	00.570	n.s.	-	.067	2	.494	n.s.	-	.058

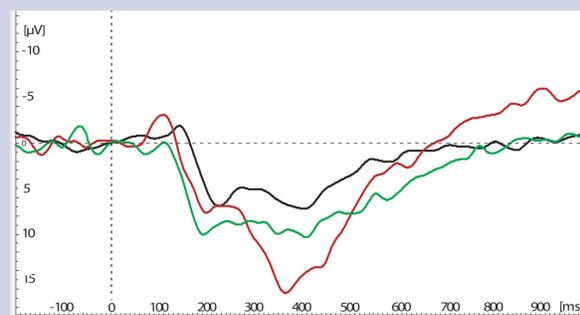


Figure 3: Grand-average ERP plots in response to picture stimuli, recorded at P3. Standards (black), targets (red) and non-targets (green)

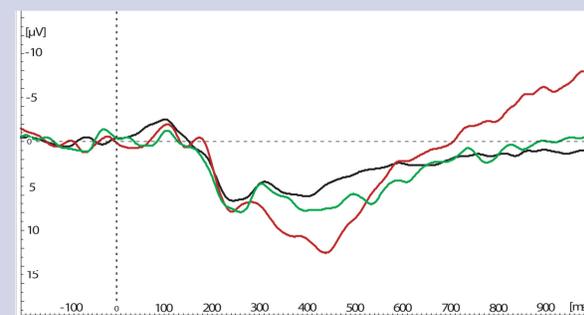


Figure 4: Grand-average ERP plots in response to word stimuli, recorded at P3. Standards (black), targets (red) and non-targets (green)

DISCUSSION

As expected, targets elicited significantly larger P300 amplitudes than standards, which is line with the idea of the standard oddball paradigm [4]. Non-Targets elicited significantly larger P300 amplitudes than standards, which is consistent with prior research results that demonstrate that deviating stimuli evoke a P300 response even if no detection instruction is given [1]. Remarkably, subjects are able to allocate attentional resources on non-targets while producing target P300's.

Our findings indicate that the parietal P300 is a sensitive indicator for automatic stimulus categorization driven by personal significance; even if such categorization is irrelevant to an actual task response. These results may be useful for future research on autobiographic memory. The parietal P300 might also serve as an instrument in a modified form of the "guilty knowledge test", see [5].

Conclusion

The outcomes demonstrate that a P300 effect for personally significant stimuli occurs even though attention is drawn toward the task instruction in an active oddball paradigm, with the same probabilities for both instructed targets and meaningful but physically equivalent non-targets.

EEG recordings and analyses

EEG was derived from 13 scalp electrodes according to the 10-10 system against linked mastoids. Recorded data (32 channel Synamp Neuroscan amplifier, 500 Hz sampling rate) were filtered (band-pass filter 0.1 - 20 Hz, notch 50 Hz) and subjected to the eye movement correction algorithm of Gratton and Coles (1983), implemented in the Vision Analyzer software (Brain Vision).

For each condition EEG averages were calculated at channels P3 and P4. P300 amplitudes were determined with a peak detection algorithm that searched for maximum amplitudes within the window of 300-600 msec after stimulus onset.

References

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