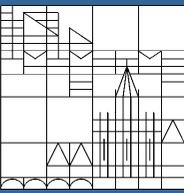# An emotional blink?

Emotional Arousal of Verbal Stimuli Modulates the Attentional Blink

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Introduction

The present series of experiments sought to determine whether emotional content modulates identification of words in an *attentional blink* (AB) paradigm.

The AB refers to a decrease in accuracy for reporting the second (T2) of two targets that are presented in close temporal vicinity (Raymond, Shapiro, & Arnell, 1992) during Rapid Serial Visual Presentation (RSVP).

Consistent with the idea of full perceptual and semantic analysis of T2 (Vogel, Luck, & Shapiro, 1998), several authors (Anderson & Phelps, 2001; Keil & Ihssen, 2004; Ogawa & Suzuki, 2004) proved that the AB with words is attenuated when *T2* denotes *affective content*. The present series of experiments aimed at extending these finding by addressing two main questions.

i) *Are there large-scale brain electric correlates of the T2 arousal facilitation?*

ii) *Is word identification during dual-target RSVP also affected by variations in the emotional intensity of the first target (T1)?*
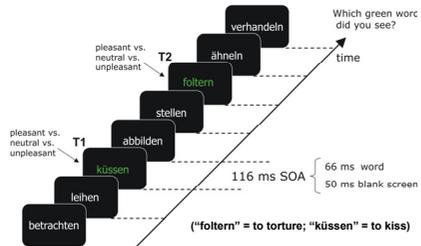
Methods

Figure 1. Schematic of one RSVP trial. Targets were green words embedded in a stream of white distractors. Two *independent variables* were introduced: i) *Relative position* of T2 after T1 (*lag 2, 4, 6*); ii) *Affective category* according to a pilot rating study (*pleasant, neutral, unpleasant*).

Behavioral task

Subjects' task was to monitor the stream of white words on two green target words and to report the identity of the targets after each trial.

EEG recording and analysis

During Experiment 1 EEG was recorded continuously using an Electrical Geodesics 128 electrodes array. Site Cz was used as the recording reference.
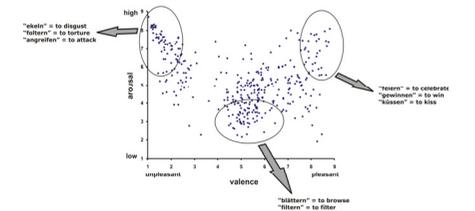

Figure 2. Selection of targets for the AB experiment was based on a pilot rating study: 370 verbs were rated on the dimensions valence and arousal. 30 high-arousing pleasant, 30 low-arousing neutral and 30 high-arousing unpleasant verbs were selected.

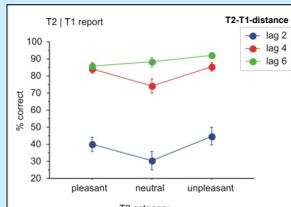## Experiment 1: T1 neutral, T2 arousing

Figure 3. T2 report as a function of lag and T2 affective category.

Results Behavior

T2 report strongly varied with lag (p < 0.001) showing higher identification accuracies at longer T1-T2-intervals. Further, T2 report was facilitated for high-arousing pleasant and high-arousing unpleasant T2s compared to neutral T2s (p < 0.001).

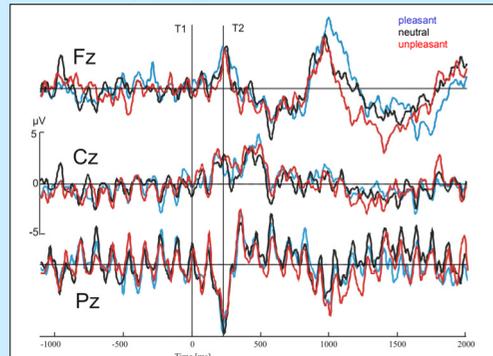### Results Electrophysiology

Figure 4. Event-related potentials showing a steady-state response in the RSVP-frequency (lag 2).

Time-frequency analysis (complex demodulation) demonstrated, that facilitatory effects for arousing T2s were mirrored electrophysiologically in an increase of energy in the 8,6 Hz-band.
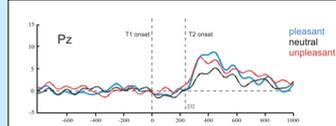

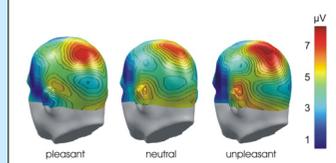**Figure 5a. Time-varying energy (8,6 Hz) at parietal sensors (lag 2).**

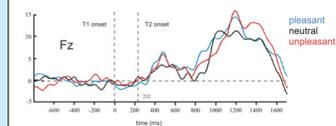**Figure 5b. ssVEP amplitude 100 – 230 ms post-T2 (lag 2).**

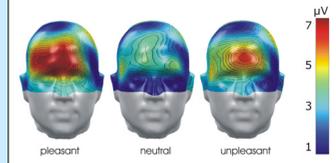**Figure 5c. Time-varying energy (8,6 Hz) at frontal sensors (lag 2).**

Figure 5d. ssVEP amplitude 200 – 330 ms post-T2 (lag 2).

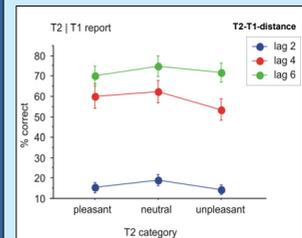## Experiment 2: T1 arousing, T2 neutral

Figure 6. T2 report as a function of lag and T1 affective category.

Results Behavior

T2 identification was not only reduced by temporal proximity to a first target (p < 0.001) but also by arousal of the preceding target (p < 0.01). Thus, the magnitude of the AB was enlarged when it was evoked by processing arousing T1s (pleasant and unpleasant) compared to processing neutral T1s.
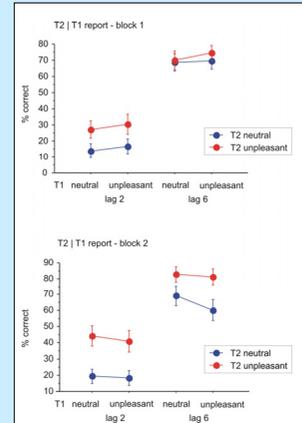
Experiment 3: T1 arousing, T2 arousing

Figure 7. T2 report in the first and second half of the experiment 3 as a function of lag, T1 affective category and T2 affective category.

Results Behavior

As a replication of our previous work (Keil & Ihssen, 2004) and Experiment 1, enhanced identification was found for arousing T2s compared to neutral T2s (p < 0.001). Facilitation was most pronounced at short T1-T2-intervals (lag 2) and larger in the second block of the experiment. Facilitation did not vary with T1 affective category.

Inhibition of T2 report by arousal of the preceding stimulus could be established only in the second block (BLOCK x T1 CATEGORY, p < 0.01).

Conclusion

Behavior

Influences of targets' emotional intensity on the attentional blink manifested two-fold:

i) *Arousal of the second target reliably facilitated conscious identification of that item.*

ii) *Arousal of the first target interfered with identification of the subsequent target.*

Both, affective facilitation and inhibition effects were demonstrated to *increase with repeated presentation of the stimulus* indicating that affective modulation effects in the AB paradigm do not habituate (see Harris & Pashler, 2004) but rather might be subject to sensitization and learning processes.

Electrophysiology

On a neuronal level, affective facilitation was reflected in *amplitude modulation of the electrocortical ssVEP* at parietal and frontal recording sites.

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