



Emotional information processing and executive control functions in depressive patients: An Event-Related Potential (ERP) study

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Background

Depression is associated with a number of cognitive deficits. There is evidence for abnormal pattern of emotional information processing in depressive patients (Williams et al. 1996). Beyond that depressive patients show impaired performance on a range of neuropsychological tests that measure frontal or executive functions, for example the Stroop Color-Word interference Test (SCWT) or Go/Nogo task (Kaiser et al. 2000; Trichard et al. 1995). Executive control is involved in cognitive processing when learned routines are not available or are ineffective for task performance (Norman & Shallice 1986). Prefrontal brain regions and anterior cingulate cortex have been repeatedly associated with executive functions (Peterson et al. 1999). The neural circuits involved in emotional perception and response consists of several interconnected areas such as the orbitofrontal cortex, the dorsolateral prefrontal cortex, the cingulate cortex, the ventral striatum, the amygdala, and the posterior parietal cortex (Davidson et al. 1999). To analyze the neural basis of a cognitive system such as the emotional information processing or executive functions, we must identify not only the participating brain regions but also the time course of neuronal activation. Event-Related Potentials (ERPs) possess a very good temporal resolution, but only a coarse spatial resolution. Spatial resolution of ERP can be improved by the use of high-density electrode arrays and source analysis.

Objective

The aim of this study is 1) to determine whether depressive patients show a specific impairment of executive control in a Stroop Color-Word Test and to investigate the cortical organization of executive functions using ERPs 2) to find out whether a pattern of abnormal processing of emotional information exists in an Emotional Stroop task in depressive patients and to examine the neurophysiological correlates of this deficit using ERPs and 3) to clarify a potential role of emotions in executive functions.

Methods

Paradigms: This study will investigate the neural network subserving executive functions (SCWT) and emotional information processing (Emotional Stroop) in depressive patients and healthy control subjects using ERPs. In the SCWT subjects are required to name the color of the word which is itself the name of a color. Subjects name faster the color of the word when the color and the word are congruent (the word "RED" written in red) than when the color and the word are incongruent (the word "RED" written in green). This increased response time reflects the interference effect of the word reading and is referred to as the Stroop effect. The Emotional Stroop is an emotional analog of the SCWT. Emotional Stroop is one of the most commonly used methods for investigating attentional bias in affective disorders. In this task, participants name the colors in which words are printed. The words vary in their relevance to depression.

Procedure: Computer and manual responses were employed in both tests. There are two runs and three conditions in both tests (see figure 1): In SCWT there are neutral, congruent and incongruent conditions. One run consists of one third of each stimulus class, which are randomly presented. In Emotional Stroop test there are neutral, positive and negative conditions. Each condition contains 16 different adjectives, which are repeated four times. One run consists of one third of each stimulus class, which are randomly presented.

EEG recording: EEG is recorded using a high-resolution (64 channels) ERP-recording method including four ocular electrodes.

Statistical analysis: Repeated-measures Analyses of Variance (ANOVA) is performed with condition and run as within subject factors and reaction time as dependent variable. Newman-Keuls tests are used for post-hoc comparison.

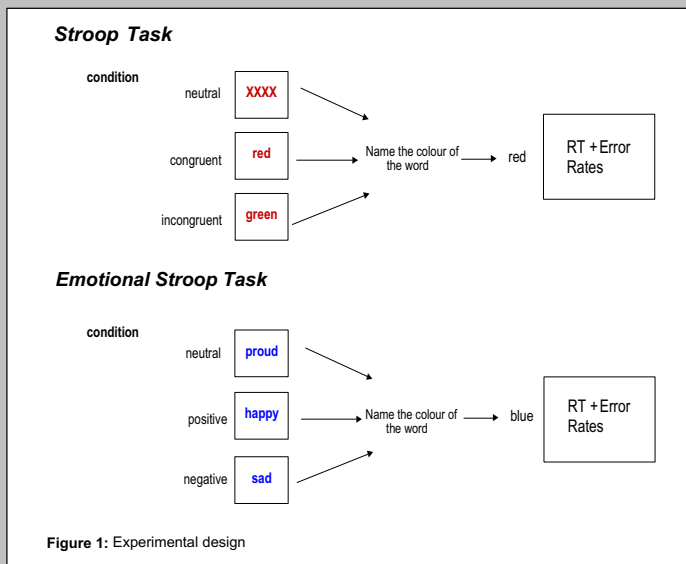


Figure 1: Experimental design

Preliminary results of the pilot study

Subjects: 11 healthy subjects (all right handed, 20-30 years old, 8 female, BDI-Score 0-5)

Behavioral data

Overall there were no differences in mean reaction times (RTs) between first and second run.

SCWT: In the mean reaction time analysis (Table 1) we obtained a robust Stroop color-word interference effect $F(2,30) = 5.65, P = 0.008$, mean effect size = 121 ms. The shortest RTs were found in the congruent condition (669 ms).

Emotional Stroop: There were no differences among positive (689 ms), negative (670 ms) and neutral conditions (688 ms).

Table 1: Mean reaction times and standard deviation for the different conditions of the SCWT

	neutral	congruent	incongruent
RT	694 (99)	669 (94)	790 (88)

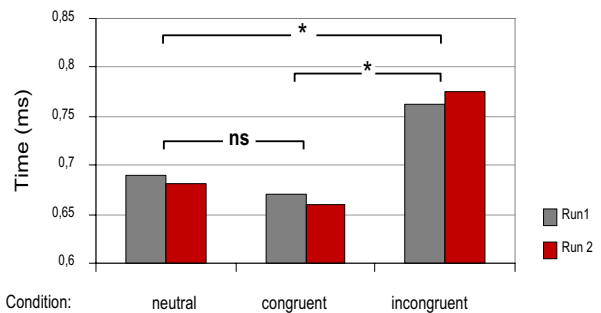


Figure 2: Summary of results of the SCWT.

State of project

The validation study of the emotional words has been completed. The selection criteria of included words were 1) relevance to the depression 2) word length and 3) word frequencies. At the moment we are collecting data for the pilot study with healthy subjects. The aim of the pilot study is to test the experimental design and to develop the model of neuronal activity in the SCWT and the Emotional Stroop test. The study with depressive patients will start in summer and will continue to the end of this year.

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References

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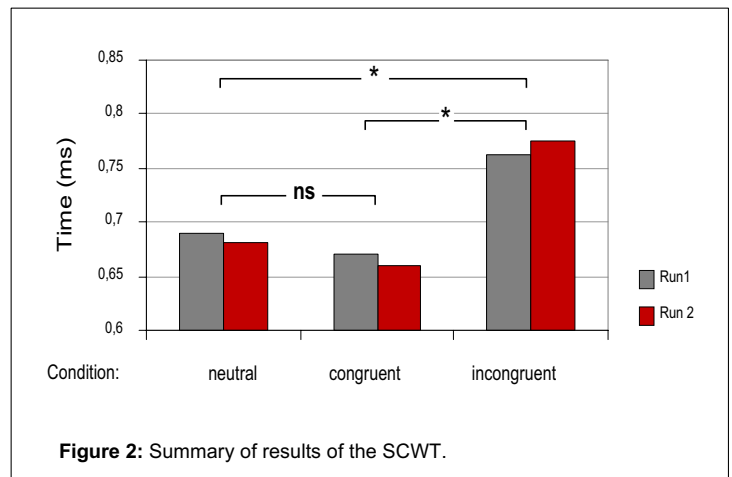


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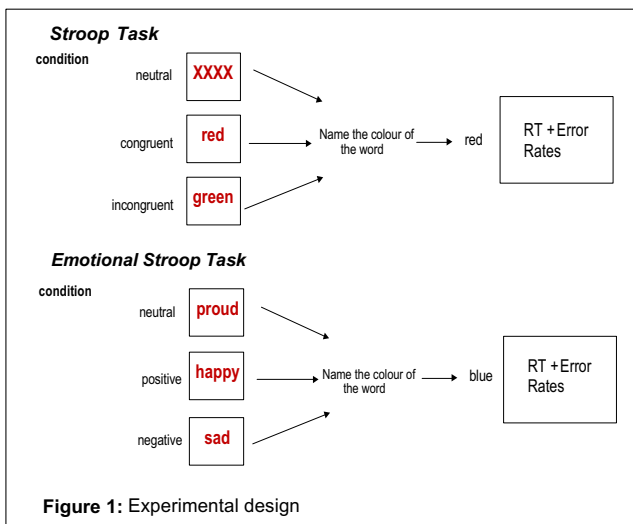


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