



**Background:**

The majority of patients with schizophrenia suffer from frontal executive dysfunction. Executive functions consist of various subcomponents as planning, strategy use, anticipation of incoming consequences or initiation of inhibition. Especially the latter two functions seem important to successfully delay gratification. Delay of gratification means that an individual is able to resist an immediate reward in favor of a later but greater reinforcement.

Recently, the dichotomy of "hot" versus "cold" executive functions was introduced with "hot" ones affectively loaded and "cold" ones primarily cognitively operated. Accordingly, delay of gratification involves "hot" executive functioning.

➔ Therefore, we hypothesize that delay of gratification is impaired in individuals with schizophrenia, and that this impairment is associated with poor outcome in overall executive functioning.

**Materials and method:**

29 patients who met DSM-IV criteria for schizophrenia participated in the study. Patients were receiving stable antipsychotic medication. Symptoms were measured by the Brief Psychiatric Rating Scale (BPRS). 23 healthy subjects matched for age, sex and educational level were examined as a control group.

For the assessment of **delay of gratification** a board game was designed referring to Mischel and Ebbesen (1970), Wulfert et al. (2002) and Shybut (1968). On designated fields (70 % of all fields) patients and healthy subjects had to decide whether they choose an immediate small amount of reinforcement (2 pieces) or whether they continue playing and get twice the amount in the end of the game. The outcome measure was the number of decisions in favor of delay divided by the total number of all decision fields (provided in per cent). In addition, the board game was cut into its three thirds according to the number of fields to obtain the delay measures for every third of the game.

**Executive functioning** was assessed by the BADS (Behavioural Assessment of the Dysexecutive Syndrome) (Wilson et al., 1996). The higher the score the better the executive functioning.

**Results:**

**Comparisons of patients vs. controls**

Patients scored significantly lower in the introduced paradigm for delay of gratification than the control subjects (t-test for independent samples;  $p \leq .05$ ) (see figure 1).

Moreover, patients neither decreased nor increased the percentage of their decisions in favour of delay while the game went on and the time span until delayed reinforcement was achieved diminished whereas the controls increased impressively their scores towards the end of the game (t-tests for independent samples;  $ps < .05$ ).

Furthermore, patients performed significantly worse in the BADS than the controls did (t-tests for independent samples,  $p < .01$ ) (see figure 2).

**The paradigm**

There was a significant positive relationship between overall executive functioning (BADS) and the percentage of positive decisions in favour of delaying gratification (Pearson correlation  $\rho=0.271$ ;  $p < .05$ ) (see figure 3). So, the better the executive performance, the more positive decisions for a delay of gratification were made.

However, when calculated separately for the patients and controls, there was no significant association between executive functioning and percentage of decisions in favour of delay.

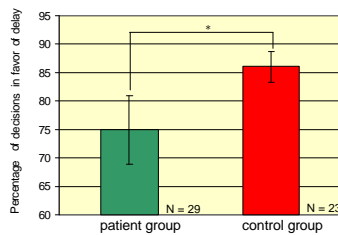


Fig. 1: Mean percentage of decisions in favor of delay of gratification

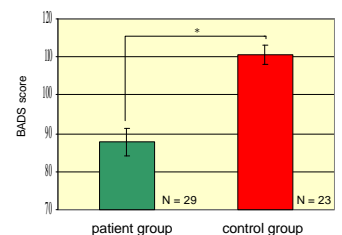


Fig. 2: Mean BADS scores for patients and controls

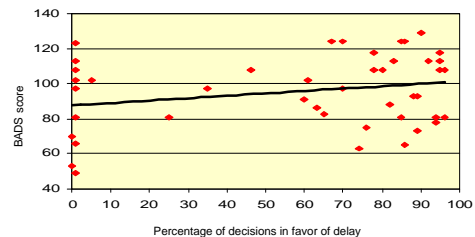


Fig. 3: Correlation BADS and Delay of Gratification

**Discussion:**

Schizophrenic patients demonstrated an impairment of the ability to delay gratification as measured by our board game. Especially in the middle and last third of the board game when the time to wait for the reinforcement was short, the patients preferred the immediate gratification much more than the controls did. They did not realize that the "costs" for a greater benefit were getting lower towards the end of the game. This is a prominent example for deficits in executive optimization of behaviour.

Furthermore, the patient group demonstrated significant deficits in executive functioning compared to matched controls.

In this pilot study we found an association between the overall executive functioning in the BADS and the performance in our delay of gratification paradigm which was not found when calculated separately for the two groups. This can be explained by the fact that the patients performed worse in the board game and the BADS than the controls. Therefore, when analysing the two groups separately, one does not incorporate the whole range of performance. Taking this into account we hence conclude that executive functions are essential for successful performance in delay of gratification tasks. Deficits in one or more executive components might be responsible for the impairment in the capacity to delay reinforcement in schizophrenic patients.

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