

# The behavioural assessment of the dysexecutive syndrome as a tool to assess executive functions in schizophrenia

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## The Behavioural Assessment of the Dysexecutive Syndrome as a Tool to Assess Executive Functions in Schizophrenia\*

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### ABSTRACT

Recent research into the cognitive dysfunctions in schizophrenia has focused on executive deficits. This study investigates performance of patients with schizophrenia on the recently developed Behavioural Assessment of the Dysexecutive Syndrome (BADs). Matched groups of 24 patients with schizophrenia and 17 healthy volunteers were administered the BADs, the Modified Card Sorting Test (MCST), the Tower of London (TOL), a test of general intelligence, and measures of daily functioning. Performance of the schizophrenic group was significantly below that of the control group on the BADs and the MCST, but not on the TOL. The BADs correlated weakly with the MCST. Both tests showed a modest correlation with daily functioning. The BADs appears to offer a useful contribution to the assessment of executive deficits in schizophrenia.

Recent accounts of the cognitive dysfunctions in schizophrenia focus on executive deficits, such as lack of volition, impaired planning, and disturbed self-monitoring (Frith, 1992; Krabbendam et al., in press; Morice & Delahunty, 1996). Theoretically, these deficits can be explained as a failure at the level of the Supervisory Attentional System (SAS; Norman & Shallice, 1986). The SAS normally comes into action when the routine control of behaviour is unsatisfactory, for example, in novel situations or in situations that require the suppression of dominant or habitual responses. The SAS may be compromised in other neuropsychiatric disorders as well (Derix, 1994).

Dysfunctions at the level of the SAS can be observed most clearly in daily life, where novel and unstructured situations put high demands on planning capacities. They are, however, difficult to assess with formal neuropsychological testing procedures. The problem with most neuropsychological tests is that they focus on the individ-

ual components of executive functioning. Yet, what is impaired in patients with the dysexecutive syndrome is the ability to initiate, integrate, and monitor the use of these components (Shallice & Burgess, 1991). Consequently, patients with gross difficulties in daily life, may perform within normal limits on standard executive tests. The degree to which task demands correspond to the requirements of daily life is generally referred to as the ecological validity of tests. In view of the relevance of good ecological validity to the clinical use of tests, this domain has received little attention (Cripe, 1996; Green, 1996).

In the present study, a new test battery is used that requires intact functioning of the SAS for its execution. The Behavioural Assessment of the Dysexecutive Syndrome (BADs; Wilson, Alderman, Burgess, Emslie, & Evans, 1996) presents the subject with a series of unstructured tasks that are designed to reflect daily life situations. Although a recent study suggested that the

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BADS can indeed identify executive deficits in schizophrenia (Evans, Chua, McKenna, & Wilson, 1997), it remains to be demonstrated whether the test adds to the information yielded by standard executive tests and whether performance is related to daily life functioning.

## METHODS

### Subjects

Twenty-four patients with schizophrenia and 17 healthy control volunteers participated in the study. The patients were recruited from the social psychiatric service of the Regional Institute for Ambulant Mental Health Care (RIAGG) and the ambulatory service of the psychiatric hospital Vijverdal, Maastricht, the Netherlands. Patients were diagnosed according to DSM-IV criteria (American Psychiatric Association, 1994) by the psychiatrists who were in attendance. Subject characteristics are shown in Table 1. The two groups were matched for age, sex, and level of education. Psychopathology was assessed with the Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962). All patients used stable doses of antipsychotic medication, 29.2% of the patients used anticholinergics, 25.0% used antidepressants, and 16.7% used benzodiazepines.

Exclusion criteria for both groups were: (1) heavy use of alcohol or drugs in the past year; (2) any history of neurological disease; and (3) a history of head injury causing unconsciousness for more than 1 hr. Additional exclusion criteria for the control group were any history of psychiatric symptoms, and use of psychoactive medication. Voluntary informed consent was obtained from all subjects.

### Procedure

The following tests of executive functions were administered to all subjects: Tower of London (TOL; Shallice, 1982), Modified Card Sorting Test (MCST; Nelson, 1976) and the Dutch version of the Behavioural Assessment of the Dysexecutive Syndrome (Wilson et al., 1996) which has recently been developed (Krabbendam & Kalff, 1998).

The BADS consists of six tasks. For each of the tasks a summary profile score is obtained (with a maximum of 4 and a minimum of zero) and these are summed to obtain a total profile score (maximum = 24). The Rule Shift Cards test examines the ability to shift from the use of a simple rule for responding to another more complex rule. The Action Program test requires the subject to remove a cork from a small tube, making use of certain tools. In the Key Search test the subject must draw the path he would take to search a large imaginary field in order to find some lost keys. In the Temporal Judgment test the subject is asked to estimate the time length of some activity. The Zoo Map test

Table 1. Subject Characteristics.

	Patient (n = 24)		Control (n = 17)		t	p
	M	(SD)	M	(SD)		
Age	30.7	(6.6)	30.6	(7.4)	.07	.95
Educational level <sup>a</sup>	3.9	(2.0)	4.2	(1.5)	-.63	.51
IQ score <sup>b</sup>	98.3	(15.3)	107.9	(11.3)	-2.29	.03
Sex (m/f)	20 / 4		15 / 2			
In/Outpatient	2 / 22		—			
Illness duration (years) <sup>c</sup>	8.2	(5.9)	—			
Age at first admission	24.9	(6.4)	—			
Total length of admissions (months)	11.4	(13.4)	—			
Brief Psychiatric Rating Scale	39.9	(11.7)	—			
Life Skills Profile <sup>d</sup>	127.2	(11.6)	—			
Dysexecutive Questionnaire <sup>e</sup>	30.7	(11.5)	—			

Note. <sup>a</sup> measured on an 8-point scale ranging from primary school to university degree.

<sup>b</sup> on the basis of a shortened version of the GIT (Groningen Intelligence Test).

<sup>c</sup> based on age at which psychiatric symptoms emerged according to the case history.

<sup>d</sup> higher scores reflect better functioning (range 39 to 156).

<sup>e</sup> higher scores reflect more problems (range 0 to 80).

examines the ability to plan a route according to several rules. The Modified Six Elements test requires the subject to organize the execution of six tasks in ten minutes according to certain rules.

A shortened form of the Groningen Intelligence Test (GIT; Luteijn, & Van der Ploeg, 1983) was administered as a measure of general ability. The GIT is a test of general intelligence that is used as much as the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955) in the Netherlands. There is general agreement on which subtests are to be used to arrive at a good approximation of a full scale IQ (Luteijn & van der Ploeg, 1983): (1) 'Doing sums' involves the correct completion of as many sums as possible in 1 min; (2) 'Mental rotation' requires the subject to indicate which two-dimensional shapes from a larger set are needed to exactly fill up a given space on the test page; and (3) 'Analogies' can be regarded as a multiple-choice version of the well-known 'Similarities' subtest of the WAIS: the task is to indicate which of five alternatives is related in the same way to a given word as two words in an example.

Problems in daily life functioning in the patients with schizophrenia were rated by a relative or caregiver using the Life Skills Profile (LSP; Rosen, Hadzi-Pavlovic, & Parker, 1989) and the Dysexecutive Questionnaire (DEX; Wilson et al., 1996) which is part of the BADS.

#### Statistical Analysis

Group differences on the executive tests were analyzed using a series of *t* tests for independent samples with Bonferroni correction for multiple comparisons. Performances on the individual BADS subtests as well as on the MCST (number of categories) were analysed using the Mann-Whitney *U* test, because of non-normal distribution. All tests were two-tailed.

To examine the degree to which performance on the BADS was related to the other executive tests and to daily life functioning, Pearson correlation coefficients were computed for each group separately. Spearman rank-order correlation coefficients were computed in case of non-normal distribution.

To control for the effects of general intellectual decline, a post hoc analysis was performed, which excluded those subjects with an IQ score below 90.

## RESULTS

Performance of the schizophrenic group was significantly below that of the control group on the BADS and on the MCST (see Table 2). No differences were found on the TOL. Nonparametric analysis of performance differences on the individual BADS tests showed significant differences on two tests, Action Program (Mann-Whitney  $U = 93.5$ ;  $p = .00$ ) and Zoo Map ( $U = 125.5$ ;  $p = .03$ ).

The age-controlled classification of performance on the BADS described in the test manual, which is derived from a sample of 216 normal control subjects, was used to classify patients as either impaired, borderline, low average, average, high average, or superior. Results are depicted in Figure 1.

Correlations between performance on the BADS and the number of errors as well as the number of categories on the MCST were nonsignificant in both groups (range of the correlation coefficients was  $R = -.30$ ,  $p = .15$  to  $R = .28$ ,  $p =$

Table 2. Performance on Executive Tests for Patient and Control Group.

	Patient ( <i>n</i> = 24)		Control ( <i>n</i> = 17)		<i>t</i>	<i>p</i> <sup>a</sup>
	<i>M</i>	( <i>SD</i> )	<i>M</i>	( <i>SD</i> )		
BADS total score	16.1	(3.8)	19.1	(2.2)	-3.13	.003
MCST number of errors	13.3	(9.6)	4.1	(3.1)	4.35	.000
MCST number of categories	4.5	(1.7)	5.9	(0.3)	-3.92 <sup>b</sup>	.001
TOL number in minimum moves	6.1	(2.4)	6.8	(1.4)	-1.15	.596

BADS = Behavioural Assessment of the Dysexecutive Syndrome; MCST = Modified Card Sorting Test; TOL = Tower of London.

Note. <sup>a</sup> following Bonferroni correction the significance level was set at .0125.

<sup>b</sup> Mann-Whitney *U* test.

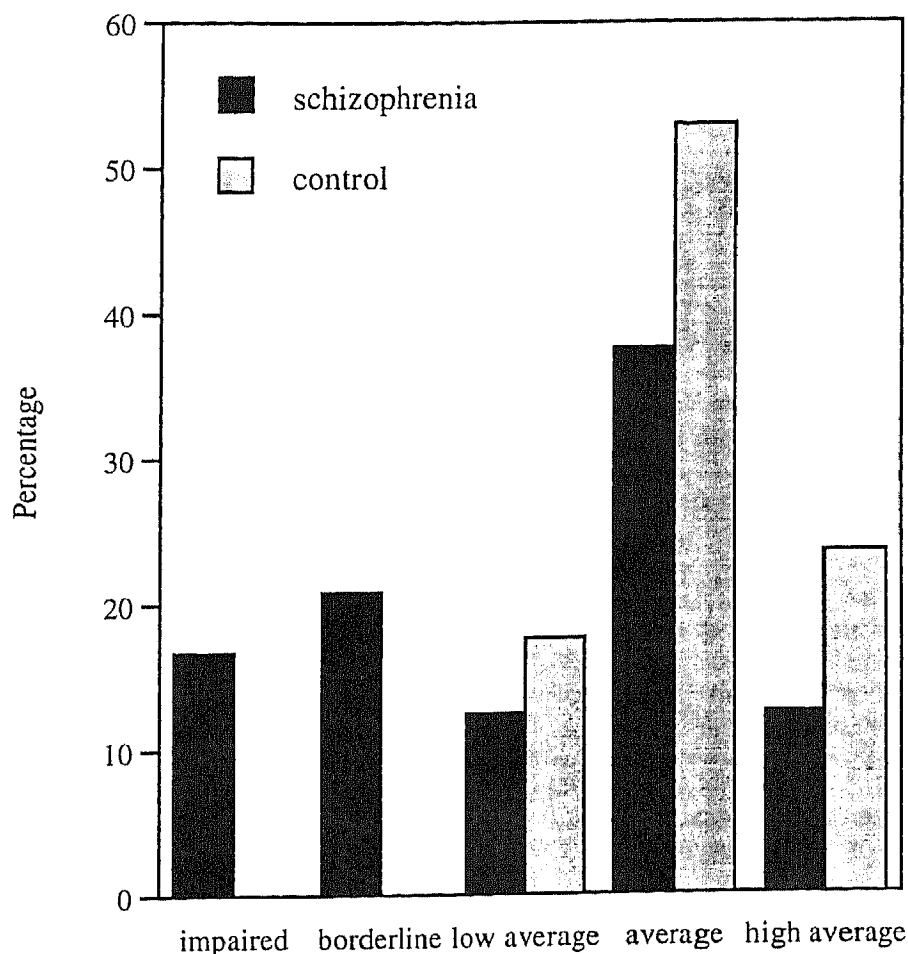


Fig. 1. Percentage of subjects in each of the Behavioural Assessment of the Dysexecutive Syndrome performance categories.

.18). In the patients with schizophrenia, performance on the BADS correlated significantly with performance on the TOL ( $R = .49, p = .02$ ) and IQ score ( $R = .65, p = .001$ ). In the control subjects, these correlations were nonsignificant ( $R = .27, p = .31$  for the BADS and the TOL;  $R = .21, p = .41$  for the BADS and IQ score).

The correlation analysis of executive test performance and daily life functioning in the patients with schizophrenia yielded significant correlations in the expected direction between BADS and LSP ( $R = .41, p = .05$ ), between MCST (number of errors) and LSP ( $R = -.40, p = .05$ ), and between MCST (number of errors)

and DEX ( $R = .46, p = .02$ ). Other correlations were nonsignificant. The correlation between IQ score and LSP was not significant ( $R = .32, p = .14$ ).

A post hoc analysis, in which 7 patients with schizophrenia with an IQ-score below 90 were excluded, yielded significant performance differences on the MCST (number of errors:  $t = 2.81, p = .01$ ; number of categories achieved:  $U = 78.5, p = .04$ ), but not on the BADS ( $t = -1.33, p = .19$ ).

## DISCUSSION

This study demonstrates that patients with schizophrenia show deficits on a series of everyday executive tasks. Deficits were also apparent on a standard executive test, the MCST. The lack of performance deficits on the TOL suggests that this test is less sensitive to executive deficits than the BADS and the MCST.

Performance on the BADS correlated only weakly with performance on the MCST. The MCST focuses on one aspect of executive functions in particular, namely, cognitive flexibility. The BADS appears to offer a more comprehensive assessment of the functions of the SAS, in that the test not only involves cognitive flexibility (e.g., the Rule Shift Cards Test), but also the planning of behaviour in novel situations (e.g., the Action Program Test), even over longer time periods and in the face of several competing tasks (e.g., the Modified Six Elements Task).

The finding that approximately half of the patient group performed in the average or high average BADS performance category calls into question the hypothesis that all patients with schizophrenia are impaired on executive tests. On the other hand, the BADS presumably does not test all possible functions of the SAS (Evans et al., 1997). In a relatively mildly impaired patient group such as we studied (e.g., outpatients), perhaps even more complex and unstructured tasks should be used (e.g., the Multiple Errands Test; Shallice & Burgess, 1991).

Two points of consideration emerge from the study. First, performance on the BADS was strongly related to general intelligence in the schizophrenic group. When the range of IQ was restricted by excluding subjects with scores below 90, group differences on the BADS disappeared. This may indicate that there is some overlap between executive functions and general intellectual ability as assessed with neuropsychological test procedures, at least in patients with schizophrenia. In particular, it is likely that deficits of executive functioning have a general negative influence on test performance, for example, as a consequence of reduced error monitoring or impaired volition. Despite this appar-

ent overlap, the BADS was a better predictor of daily life functioning than IQ score.

Second, performance deficits on the BADS as well as the MCST were related to problems of daily life functioning, but the strength of the associations was only modest. Previous studies using standard executive tests in relation to functional measures obtained figures in the same range (Brekke, Raine, Ansel, Lencz, & Bird, 1997; Velligan et al., 1997).

A possible explanation for the lack of strong relations between test performance and functional measures is that, although tests can be designed that reflect everyday activities as closely as possible, differences will remain between the demands of the test setting and those of daily life (Acker, 1990). In the context of schizophrenia, the most important difference might well be that everyday life requires self-motivation and persistence, whereas in the testing situation motivation is often aided and persistence encouraged by the examiner.

Further, the reduction of complex human actions to a numerical index will lead to a limited understanding of the reality from which the score was extracted (Cripe, 1996). According to Cripe, a better method to assess executive functions is to use both "objective qualitative and quantitative methods" (p. 194). Executive functions comprise the integration and monitoring of cognitive functions, involving how things get done rather than just what gets done. These processes are poorly assessed with quantitative methods (summary scores). Therefore, direct observation of these processes adds significant information to the assessment of executive functions.

Our clinical experience with the BADS suggests that the test yields qualitative information, which is sometimes lost when profile scores are computed. Examples of qualitative scores that can be obtained with the BADS are (a) a clearly inefficient approach to the Modified Six Elements Test, that is, continued switching between the six tasks, instead of allocating the time evenly across the tasks in a planned manner; (b) perseveration of an unsuccessful approach to the Action Program Test, that is, trying to reach the

cork in the tube with the metal rod; (c) marked hesitation to make a guess at the Temporal Judgment Test; and (d) difficulty grasping the level of abstraction that is needed in the Key Search Test, that is, to understand that the square on the paper refers to a large field. Further research should pay attention to the development of a scoring system for the BADS which is also sensitive to these qualitative aspects of the process of performance. Using the test to obtain both qualitative and quantitative information may offer a more comprehensive assessment of the functions of the SAS.

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