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Cognitive estimation in aged patients with major depressive disorder

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ABSTRACT

In everyday life, we often estimate rather than know. It was the goal of this study to assess the effect of depressed mood on cognitive estimation in old age. Cognitive estimation was performed in 44 subjects with major depressive disorder (MDD; DSM-IV) and 48 age-matched healthy subjects (HS). Severity of depressive symptoms was rated with the Montgomery–Åsberg Depression Rating Scale (MADRS, mean = 18.6 ± S.D. 4.85). Estimation tasks comprised the dimensions length (coin diameter), weight (pile of paper), quantity (number of marbles in a glass jar), and time (estimation of time it takes for a marble to roll down a marble track both before and after having observed it). Other than the procedure followed in previous tests on cognitive estimation, the tasks were performed by observing objects rather than pictures thereof. MDD patients overestimated time (before and after observation) and underestimated quantity. Cognitive estimation was not correlated to measures of frontal functioning or semantic knowledge. We conclude that MDD patients in old age are impaired to some extent in cognitive estimation and in the ability to correct themselves, deficits that are likely to affect the performance of everyday activities.

1. Introduction

Major depression is characterized by deficits in cognitive domains such as attention, executive function, processing and motor speed (Drevets et al., 1992; Beats et al., 1996b; Baune et al., 2006; Jaeger et al., 2006). Impaired cognition in patients with depressive disorder is associated with dysfunction of the frontal cortex (Baker et al., 1997; Bench et al., 1992; Dolan et al., 1994; Davidson et al., 1999). The cognitive deficits contribute to the disability of patients with depressive disorder in everyday life (Jaeger et al., 2006) as they affect the patient's ability to respond to demands such as temporal processing. Recently, it was reported that patients with depression have a poorer discrimination of time intervals (Sevigny et al., 2003), i.e. something they cannot know or measure with their senses.

Cognitive estimation is understood as a process of generating an answer when exact knowledge is not readily available. Various decisions in everyday life are made based on estimates. For example, we need to anticipate the speed of cars when crossing the road or the amount of pasta we need for a two-person dinner. It is presumed that cognitive domains, such as working memory, executive functions and declarative long-term memory (semantic memory, general knowledge), are involved in the process of estimation (Brand et al., 2003).

The first scale to assess cognitive estimation in controls and patients was the Cognitive Estimation Test (CET) (Shallice and Evans, 1978). Shallice and Evans (1978) found that most estimation tasks required intact executive function and that estimation tasks were impaired by lesions of the frontal cortex. However, results in the CET were confounded by general knowledge and moderately associated with semantic memory performance (Shallice and Evans, 1978; O'Carroll et al., 1994; Mendez et al., 1998). The latter finding, however, was not confirmed in a more recent study (Gillespie et al., 2002). The importance of the frontal cortex in cognitive estimation was concluded from a significant correlation between the CET and verbal fluency in a group of patients with frontal lesions (Shoqeirat et al., 1990). In contrast, a study with non-demented Parkinson patients found no evidence for the involvement of the frontal cortex in cognitive estimation (Appollonio et al., 1994). The necessity of integrity of the frontal cortex for cognitive estimation was also questioned by a study in patients with different cortical lesions—impairment of cognitive estimation was the same in patients with anterior and posterior lesions (Taylor and O'Carroll, 1995).

Beyond cognition and mood, per se, the general approach to and impression of the environment is influenced by our predispositions, cognitions and mood, and thus likely affects estimation tasks. With the CET, only negligible effects of mood on cognitive estimation tasks were found (Freeman et al., 1995). In the CET and other previous tasks of cognitive estimation, however, subjects make estimates based on pictures of objects, e.g. they estimate the size of a building by looking at a picture of it. We hypothesized that this indirect method of observation obscures the task of estimation. Therefore, in the present study, subjects were asked to make estimates based on direct

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Table 1
Characterization of study sample.

	HS	MDD	*P*
Gender (male/female)	17/31	17/27	0.753
	Mean ± S.D.	Mean ± S.D.	
Age (years)	62.5 ± 7.8	63.7 ± 11.0	0.552
Education (school years)	13.7 ± 3.3	11.3 ± 3.4	0.001

observation (e.g., duration of time by observing a marble rolling down a marble track) or experience (e.g., weight).

2. Methods

2.1. Patients

Ninety-two consecutive subjects (48 controls and 44 patients with major depressive disorder, MDD) seeking first-time advice on subjective memory complaints in the outpatient Memory Clinic of the Department of Psychiatry, Charité Universitätsmedizin, were assessed. They were investigated with standardized cognitive screening tests and extensive clinical, neuropsychological, radiological, and laboratory investigations. Major depression was diagnosed according to DSM-IV criteria, and its severity was measured by the Montgomery–Åsberg Depression Rating Scale (MADRS) (Montgomery and Åsberg, 1979). Subjects had a mean score of 18.6 ± S.D. 4.85, reflecting a mild to moderate depressive episode. It was ruled out by extensive clinical and neuropsychological methods that subjects met criteria for mild cognitive impairment (Petersen, 2003) or dementia (DSM-IV). Subjects were considered as healthy subjects (HS) when neuropsychological, clinical, radiological and laboratory investigations were normal and medical history was free of psychiatric or neurological disease. Mean age, gender and education (number of school years) of the two groups are shown in Table 1. There was no significant difference in age and gender ($P>0.05$), but the two groups did differ in level of education ($P=0.001$).

2.2. Cognitive tests

Beyond tests performed to rule out neurodegenerative or other causes of dementia, standardized cognitive screening tests were administered to the study group. The battery comprised the Mini Mental State Examination (MMSE) (Folstein et al., 1983), a short version of the Boston Naming test for assessment of language processing/visual object confrontational naming (Kaplan et al., 1993), processing speed (Trail Making Test A, TMTA) (Lezak, 1995), working memory and attention (Letter Sorting Test, LST) (Beinhoff et al., 2005), episodic memory (Memory Impairment Screen, MIS) (Beinhoff et al., 2005), executive function/cognitive flexibility (semantic verbal fluency; Trail Making Test B, TMTB) (Lezak, 1995) and visuo-constructional abilities (Clock Drawing Test) (Shulman, 2000). For all tests German versions used in prior investigations (Gron et al., 2002; Bittner et al., 2005; Beinhoff et al., 2005) were used.

Fig. 1. Jar filled with glass marbles ($N=120$) was shown to subjects in a distance from 70 cm to 100 cm.

2.3. Cognitive estimation tasks

The estimation tasks were the same as in a previous report on cognitive estimation in patients with Alzheimer's disease (Barabassy et al., 2007). Cognitive estimation included items referring to four dimensions "length", "weight", "quantity" and "time," and required only numerical answers. Time estimation was performed by presenting a marble together with part of a marble track. Subjects were asked to estimate the time the marble would take to roll down the track (Marble track A; 3 s). Thereafter subjects were asked to watch the marble roll down and re-estimate the time needed (Marble track B; 3 s). Estimation of weight and length was assessed by having subjects lift a pile of paper and estimate its weight (2.5 kg) and judge the diameter of a 2 € coin (2.5 cm). Estimation of quantity was performed by showing a glass jar filled with marbles and having the subject estimate the amount of marbles in the jar ($N=120$; Fig. 1). Estimation of distance and speed was performed by asking for the distance between Rome and Madrid (1400 km) and the speed of a galloping horse (35 km/h) without presenting a map or the image of a horse to the subjects.

2.4. Statistics

All statistical analyses were carried out using the statistics program SPSS (SPSS 13.0 for Windows, SPSS Inc., Chicago, IL). Except for age, semantic fluency and estimation of the speed of a galloping horse, all variables were not distributed normally (Kolmogorov–Smirnov Test < 0.05). For the investigation of group differences, the Mann–Whitney *U*-test was used. In exploratory analysis, the significance of group comparisons did not change when parametric tests were performed with education in school years as a covariate. To assess whether the distribution of subjects with severe errors (more than 40% of true value) was different in MDD than in HS, we created a crosstabs table and calculated the chi-square test. For correlation analyses, the Spearman correlation coefficient was calculated.

3. Results

3.1. Cognitive tests

Table 2 presents the results of the neuropsychological test battery. Compared with healthy subjects, patients with MDD were impaired in the Letter Sorting Test (Mann–Whitney $U=794.5$, $P=0.035$), in semantic verbal fluency (Mann–Whitney $U=549.0$, $P<0.001$), in the Memory Impairment Screen (Mann–Whitney $U=597.0$, $P<0.001$) and in Trail Making Test B (Mann–Whitney $U=506.5$, $P<0.001$). Moreover, patients with MDD had lower scores on the MMSE (Mann–Whitney $U=302.0$, $P<0.001$). Thus, compared with HS, patients with MDD were impaired in measures of working memory, episodic memory and executive functions. Processing speed, however, was similar in the two groups (Trail Making Test A; Mann–Whitney $U=818.5$, $P=0.089$) as were visuo-constructional abilities (Clock Drawing Test, Mann–Whitney $U=1011.0$, $P=0.849$) and language (BNT, Mann–Whitney $U=926.0$, $P=0.352$).

Table 2
Cognitive performance of study sample.

	HS	MDD	*P*
	Mean ± S.D.	Mean ± S.D.	HS vs. MDD
Cognitive testing			
MMSE (score)	29.1 ± 1.1	27.4 ± 1.6	<0.001
LST (score)	2.9 ± 0.2	2.5 ± 0.7	0.035
MIS (score)	7.6 ± 0.5	6.5 ± 1.6	<0.001
TMT A (s)	38.6 ± 13.1	45.4 ± 19.4	0.089
TMT B (s)	76.6 ± 27.1	112.8 ± 50.7	<0.001
Semantic fluency (score)	26.3 ± 6.4	20.7 ± 6.4	<0.001
BNT (score)	14.8 ± 0.3	14.3 ± 1.1	0.352
Clock drawing test (score)	1.3 ± 0.6	1.6 ± 0.9	0.849