Journal of Affective Disorders 119 (2009) 92–99

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research report

Abnormal response to failure in unmedicated major depression ☆

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ARTICLE INFO

Article history:
Received 13 January 2009
Received in revised form 19 February 2009
Accepted 21 February 2009
Available online 13 March 2009

Keywords:
Depression
Neuropsychology
Cognitive impairment
Working memory
Reaction time
Psychomotor performance

ABSTRACT

Background: An aspect of neuropsychological impairment which has been linked specifically to depression is an abnormal response to failure. That is, a rapid deterioration of performance after receiving feedback that an error was made on the previous task. We aimed to examine this phenomenon in unmedicated, depressed outpatients.
Methods: Forty-four patients meeting DSM-IV criteria for major depression, all psychotropicmedication-free for at least six weeks, and 44 demographically matched, healthy control participants completed a computerised simultaneous/delayed matching-to-sample task (S/DMTS).
Results: Patients with depression were significantly less accurate than controls on the S/DMTS task. Both groups augmented their performance after an error had been made. The probability of making an error following an error was significantly greater in depressed compared with control participants, even when total number of errors was controlled for. Response latencies reduced significantly after an error had been made for both groups.
Limitations: Both groups made relatively few errors. This reduced the power of analysis particularly when examining the effect of delay.
Conclusions: The abnormal response to negative feedback previously identified in depressed samples was replicated in the current unmedicated, less severely depressed group. The impairment shown in the depressed sample may be due to a reduction in the motivating effect of an error compared with healthy controls. This has possible relevance to both neurobiological and psychological theories of depression.

1. Introduction

Major depression is regularly accompanied by cognitive impairment in domains such as verbal and non-verbal memory, attention, executive functioning and psychomotor speed (Austin et al., 1999; Elliott et al., 1997a; O'Brien et al., 2004; Porter et al., 2003; Sheline et al., 2006). These deficits can cause difficulties in psychosocial wellbeing, as well as social and occupational functioning (Withall et al., 2008).

An aspect of neuropsychological impairment associated with depression may be an 'abnormal response to negative feedback'. Beats et al. (1996) first coined the term 'catastrophic response to failure' to describe this phenomenon. Using the Tower of London task, they found that elderly depressed patients exhibited deterioration of performance after receiving feedback that that they had made an error on the task (Beats et al., 1996). Elliott et al. (1996) replicated this finding in a younger sample of depressed patients using the simultaneous/delayed matching to sample task (S/DMTS). In this paradigm the participant must recognise a previously presented stimulus item from among four very similar stimuli

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doi:10.1016/j.jad.2009.02.018

after a delay of 0, 4 or 12 s, or during simultaneous presentation. Subsequent studies, using a variety of cognitive measures, have replicated this phenomenon in adult (Elliott et al., 1997b, 1996; Taylor Tavares et al., 2008) and older (Steffens et al., 2001) depressed samples, even when the overall error rate is taken into account. Healthy controls, on the other hand, have been found to respond to negative feedback by improving their performance on the following trial (Elliott et al., 1997b). Thus, it has been suggested that depression is associated with either an enhanced effect of negative feedback or loss of a normal motivating effect.

As well as occurring in adult and elderly depressed samples, this abnormal response to negative feedback has been found to be specific to depression. The phenomenon has not been replicated in any other clinical group tested including patients with Parkinson's disease, schizophrenia, and patients with neurosurgical lesions of the frontal or temporal lobes (Elliott et al., 1997b). Furthermore, it is consistent with Beck's cognitive theory of depression, which states that depression is maintained through distorted negative interpretations of environmental information that develop during childhood and adolescence (Beck, 1967).

Data regarding this issue has not, however, been entirely consistent. A more recent study suggested that those with depression were only impaired by incorrect and misleading negative feedback, while performance on tasks using informative negative feedback remained intact. This indicated that feedback can have different effects depending on the situation (Murphy et al., 2003). Another study has also found no evidence of an abnormal response to negative feedback, nor any support that controls augmented their performance subsequent to an error during the S/DMTS task (Shah et al., 1999). Differing clinical factors between the discussed studies may be the reason for the inconsistent findings (such as differences in medication status and the use of inpatients versus outpatients). In addition to these clinical factors, the statistical tests that Shah et al. (1999) employed were particularly problematic for the data set. The 'runs' test, a statistical test that compares the pattern of responses between two groups, is not a sensitive test when the number of errors made in a task is low (Bellini and Figa-Talamanca, 2005), as was the case in the S/DMTS.

A possible limitation of previous studies in the area is that the probability of making an error could vary depending on the interstimulus delay and this factor has never been taken into account. In addition, it cannot be determined whether controls are enhancing their performance after an error or depressed participants are responding negatively to the feedback unless the probability of making an error after a correct response is included. Finally, few studies have analysed the latency of responses. This is of interest because it has been found that healthy controls display increased accuracy but slowed reaction time in response to errors, a reaction known as the Rabbitt/Laming effect (Laming, 1979; Rabbitt, 1966).

Therefore, in this analysis, we examined the relationship between group and probability of an error following an error or a correct response on the S/DMTS with delay (simultaneous, 0 s, 4 s and 12 s) as an additional variable. We also analysed latency of response data following an error or correct response. A unique feature of the current study was that the sample had been drug-free for at least six weeks prior to testing and 26 patients were entirely drug naive. This meant that depressive symptomatology was the only difference between the control and depressed sample, which is a major point of difference from the previous studies discussed.

We hypothesised that the results would replicate Elliott et al. (1996) and Beats et al.'s (1996) findings concerning overall performance on the S/DMTS task and the probability of making an error after an error but that this could depend on the delay condition. Data on the overall performance on the S/DMTS task in this sample has been presented previously (Porter et al., 2003).

2. Methods

2.1. Participants

Patients aged 18–65 years with a DSM-IV (American Psychiatric Association, 1994) confirmed diagnosis of major depressive disorder (single episode or recurrent) were recruited from general practice clinics in the Tyne and Wear region of the United Kingdom. Patients had been entirely psychotropic medication-free for at least six weeks before recruitment and were excluded if currently taking other medication active in the central nervous system (CNS-active) including beta-blockers or St John's wort, or if there was a comorbid medical or psychiatric diagnosis including manic episodes, or a recent history of alcohol/substance misuse.

Severity of depression was assessed using the Montgomery–Asberg Depression Rating Scale (MADRS: Montgomery and Asberg, 1979), the 17-item Hamilton Rating Scale for Depression (HRSD17: Hamilton, 1960) and the Beck Depression Inventory (BDI: Beck et al., 1961). DSM-IV criteria for melancholia were noted and the Newcastle Scale (Carney et al., 1965) was completed. The Modified Mini-Mental State Examination (3MS: Teng and Chui, 1987) was administered to screen for dementia and the National Adult Reading Test (NART: Nelson, 1982) was used to assess premorbid verbal IQ.

The control group consisted of participants who were psychologically and physically fit (verified by examination) and had no recent history of illicit drug use or alcohol misuse. Controls were excluded if they had a history of psychiatric illness (personally or in a first-degree relative) or a BDI score of more than seven. Current alcohol intake was less than 28 units per week for males and 21 units per week for females.

Patients and controls were matched for age, gender, premorbid IQ (NART), years of formal education and season of testing. Females were matched for phase of menstrual cycle (see Table 1). All participants had English as their first language. Participants were tested as soon after recruitment as possible to minimise delay in treatment and in all cases treatment was commenced within one week of the initial assessment. The study was approved by the Newcastle and North Tyneside Health Authority Joint Ethics Committee and all participants gave written informed consent.

2.2. Neuropsychological testing

In the original study (Porter et al., 2003) a comprehensive neuropsychological testing battery was conducted on the