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Selective attention for negative information and depression in schizophrenia

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ABSTRACT

Objectives. Depression is a frequent feature of schizophrenia but the cognitive processes involved in its development and maintenance are unclear. Recent studies have shown that clinical depression is associated with faulty inhibitory mechanisms of selective attention for negative information. The current study examined whether patients with schizophrenia also have an attentional bias towards negative stimuli. The inhibitory processes of interference control and task-shifting abilities were also examined to assess whether patients would show a selective impairment.

Method. Forty-three patients with schizophrenia and 24 healthy controls completed the Affective Shifting Task.

Results. As a group, schizophrenia patients did not show an attentional bias for negative material. However, those patients with high levels of depression demonstrated faster latencies when negative words were the targets, and higher depression scores were found to be associated with an increasing number of false alarms for negative words when they were not the targets. The results also showed that patients had impaired interference control but intact task-shifting abilities.

Conclusions. Faulty inhibitory mechanisms of selective attention for negative information are not a general feature of schizophrenia but appear to be selective to those with a depressed mood. The results highlight the need for further studies examining the exact nature of the affective dysfunction in schizophrenia and the cognitive processes supporting negative emotions.

INTRODUCTION

Schizophrenia is a common psychiatric illness, severely disrupting all aspects of functioning. The current study examined specific cognitive and affective processes in schizophrenia, and in particular: (*a*) inhibitory-dependent selective attention for affective (positive and negative) information, and (*b*) task-shifting abilities and interference control, using the Affective Shifting Task (AST; Murphy *et al.* 1999) which assesses these processes independently. These will be discussed in turn.

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Emotional dysfunction is a frequent feature of schizophrenia (McGhie & Chapman, 1961; Bentall, 1997, Birchwood, 2003) but the cognitive processes involved in the development and maintenance of negative emotions in schizophrenia are not yet known. In clinical depression and anxiety, cognitive models have emphasized the role of biases in attention, memory, perception and reasoning (e.g. Beck, 1976; see Mineka & Nugent, 1995; MacLeod & Rutherford, 1998, for reviews). In schizophrenia, there is now evidence of (*a*) some abnormalities in the processing of affective information, such as the identification of affect in speech and facial expressions (e.g. Edwards *et al.* 2002; Gooding & Tallent, 2002), (*b*) memory biases for negative information (Calev & Edelist, 1993; Corcoran

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& Frith, 2003), and (*c*) increased sensitivity to negative affective material using semantic priming tasks (Rossell *et al*. 2000, although see Suslow *et al*. 2003; Rossell, 2004).

Recent studies of clinical depression have also shown faulty inhibitory mechanisms of selective attention for negative information (e.g. Murphy *et al*. 1999; Joormann, 2004). Murphy *et al*. (1999), for instance, demonstrated an attentional inhibition deficit for negative words in depressed patients using the AST. In this task, participants are asked to respond to target words of one valence (positive or negative) as quickly as possible while inhibiting responses to words of the opposite affective category. Words are presented one by one in test blocks, and following every second block the target valence is changed. On these 'shift' blocks, participants are required to ignore previously relevant targets, shift attention, and respond to stimuli that had been distractors in the previous block. On 'non-shift' blocks, participants must continue responding to the same target valence while ignoring distractors of the other valence. The AST assesses different types of inhibitory processes which can be measured independently: (*a*) selective attention and maintenance of responding in the presence of distracting stimuli (interference control) can be assessed by examining overall performance; (*b*) reversal of association (task-shifting), that is, the ability to move flexibly from one action or thought to another, is examined by comparing performance on 'shift' and 'non-shift' blocks; and (*c*) a measure of inhibitory control over emotional stimuli of a particular valence is obtained by contrasting performance for negative and positive target stimuli. Using this task, Murphy *et al*. (1999) demonstrated mood-congruent biases in depressed patients and manic patients. Depressed patients showed an attentional bias for negative material, as demonstrated by relatively faster latencies to negative targets, and also showed an impairment in task-shifting. By contrast, manic patients had a bias for processing happy stimuli, as shown by relatively faster latencies to positive targets, and had impaired interference control. These differentiated patterns of performance for the depressed and manic patients illustrate the functional independence of these different components of inhibition.

To our knowledge, no study has yet reported an investigation of selective attention mechanisms for negative material in schizophrenia. The current study therefore examined the performance of patients with schizophrenia on the AST. If negative mood is a core component of schizophrenia, patients should demonstrate greater sensitivity for negative information.

The AST also provides an opportunity to examine the inhibitory processes of interference control and task-shifting in patients with schizophrenia. Whereas interference control has frequently been found to be impaired in patients with schizophrenia (Brebion *et al*. 1996; Boucart *et al*. 1999), studies assessing task-shifting have yielded mixed results (Elliott *et al*. 1995; Lafonte *et al*. 1998; Smith *et al*. 1998; Cools *et al*. 2000; Barton *et al*. 2002, 2005; Manoach *et al*. 2002). Manoach *et al*. (2002) speculated that significant differences between patient and control groups on the shifting component of some tasks might be the result of a combination of cognitively complex task-shifting paradigms carrying high working-memory demands, and poor working memory in the patient group. As a result, significant differences between the groups on switch trials would arise because of poor working memory in the patient group, and not because of impaired task-shifting abilities. Meiran *et al*. (2000) presented evidence supporting this proposal. By increasing the working-memory component of a task-switching paradigm, they showed that healthy participants produced a pattern of performance on switch trials resembling that of patients with schizophrenia. The authors concluded that task-shifting difficulties in schizophrenia may be the result of a failure to maintain task context information online during the task. In the current study, we examined the performance of patients with schizophrenia using the AST, which has low working-memory requirements. In this task, response options are clearly defined and limited with only instances of negative and positive stimulus words, the target category remains the same across two blocks of trials, and the only response participants are required to make is to press the space-bar of a keyboard once a target has been identified. Consequently, the AST provides an opportunity to examine the performance of

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Table 1. *Demographic and clinical characteristics (mean, S.D.) of healthy controls and patients with schizophrenia*

	Controls ($n=24$)	Patients ($n=43$)	Control–patient comparisons
Age (yr)	34·67 (8·81)	36·73 (8·41)	$t=0·95$, $p=0·34$
Education (yr)	11·75 (1·89)	10·97 (1·97)	$t=1·55$, $p=0·12$
Sex (M/F)	20 M, 4 F	35 M, 7 F	
NART	103·62 (4·75)	100·21 (9·32)	$t=1·66$, $p=0·10$
Digits Backward	6·70 (1·65)	5·54 (1·65)	$t=7·84$, $p<0·001$
BDI-II	2·04 (1·98)	12·80 (12·78)	$t=5·23$, $p<0·001$
BAI	1·54 (1·79)	9·52 (9·25)	$t=5·25$, $p<0·001$
Length of illness[a] (yr)	—	13·64 (8·14)	—
Number of admissions	—	9·35 (7·79)	—
PANSS			
Level of positive symptoms	—	19·06 (5·12)	—
Level of negative symptoms	—	12·25 (3·22)	—
Level of general symptoms	—	28·72 (5·47)	—
Chlorpromazine equivalent	—	942·78 (445·3)	—

NART, National Adult Reading Test – Revised; BDI-II, Beck Depression Inventory; BAI, Beck Anxiety Inventory; PANSS, Positive and Negative Syndrome Scale.

[a] Calculated as time since first admission.

patients with schizophrenia in a task-shifting paradigm with a low working-memory load.

In summary, the aims of this study were to examine performance on the measures of interference control, task-shifting and valence-dependent inhibitory control on the AST, to assess whether participants with schizophrenia show an impairment in any of these domains.

METHOD

Participants

The patient group consisted of 43 patients with a DSM-IV diagnosis of schizophrenia selected from a psychiatric hospital in Perth, Western Australia. The control group comprised 24 healthy individuals recruited from the community through a blood donor agency. Exclusionary criteria for all participants included a history of head injury or neurological illness. Controls who reported a personal or first-degree family history of psychiatric illness were also excluded. Information concerning the patients' and controls' demographic and clinical data is presented in Table 1. The patient group consisted of 7 in-patients and 36 out-patients. Twenty-three of the patients were receiving atypical antipsychotic drugs; 9, typical neuroleptics; 10, a mixture of atypical and typical neuroleptics; 12, antidepressants; 14, anxiolytics and 13, mood stabilizers. The study was approved by the University of Western Australia and Graylands Hospital ethics committees and signed informed consent was obtained from all participants.

Tasks and questionnaires

Standardized tests

Premorbid intelligence was estimated using the National Adult Reading Test – revised (NART; Nelson, 1982). The Beck Depression Inventory (BDI-II; Beck, 1996) and Beck Anxiety Inventory (BAI; Beck, 1990) were used to assess negative affect: each has a maximum score of 63. Digits Backward (Digit Span subtest, WAIS-III; Wechsler, 1997), which has a maximum score of 14, was used as a measure of working memory.

AST (Murphy et al. 1999)

In this task, individual words were rapidly presented on the screen of a personal computer under the control of software written in MetaCard. Participants were required to respond (press the space-bar) to target words of one valence (positive or negative), while inhibiting responses to words of the alternate affective category. The 180 stimuli comprised 45 positive and 45 negative words, each used twice. Words were presented individually in the centre of the screen for 300 ms each with an inter-stimulus interval of 900 ms.

Words were selected from a list of 60 positive and 60 negative adjectives given to 25 university

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students (age range 18–33 years) who rated each adjective on a scale from 1 to 6 according to how positive or negative it was in connotation. The adjectives were ranked with respect to mean ratings, and the 45 positive and 45 negative words which attracted the highest and lowest ratings were selected (list available on request). Positive and negative words did not differ in word length [$t(88) = 1{\cdot}83$, $p > 0{\cdot}05$], or word frequency [$t(88) = 1{\cdot}84$, $p > 0{\cdot}05$] (Kucera & Francis, 1967).

There were two practice blocks and eight test blocks. Each block consisted of 18 words (nine positive and nine negative). The words were randomly allocated to, and ordered within, each block, and freshly randomized for each participant. For each block, positive (P) or negative (N) words were specified as targets. Every two blocks, participants were required to shift response set from one affective category to the other. This means that four of the eight test blocks were 'shift' blocks, in which participants had to inhibit responding to stimuli that were targets in the previous two blocks and start responding to words that had been distractors. For the other four test blocks ('non-shift' blocks), participants had to continue responding to targets of the same valence category and inhibiting responding to distractors of the alternate category. The two target category presentation orders were alternated between participants. An interval of 15 s separated blocks of trials. There was a 500 ms/450 Hz tone that sounded for false alarms (but not for omissions).

The AST was administered in the early stages of a testing session consisting of a large battery of cognitive tests lasting $1\frac{1}{2}$ hours.

Statistical methods

The data were analysed using SPSS 12.0 (SPSS Inc., Chicago, IL, USA). On the AST, mean latencies (RT), false alarms (FA) and omissions per block of trials were computed for each condition. Anticipatory responses (with a RT < 100 ms) were excluded from the analysis (Murphy *et al*. 1999). Inspection of plots and skewness and kurtosis statistics indicated that FA and omissions were skewed with outliers. Square-root transformations were performed on these count data prior to conducting statistical tests, although untransformed means are presented in the tables and figures. Shifting costs (difference scores between shift and non-shift blocks) and affective bias (difference scores between negative and positive targets) for FA and omissions were also skewed and contained negative values. In order to enable square-root transformation, a constant was added to these scores to make the lowest score equal to 1. All latency data were normally distributed with no outliers. Finally, BDI-II and BAI scores were skewed and were, therefore, subjected to square-root transformations.

Parametric tests were carried out on all data (*t* tests or ANOVA for group comparisons and Pearson correlation coefficients, as appropriate). On the AST, three ANOVAs were performed with (*a*) RT, (*b*) FA and (*c*) omissions as dependent variables, group as the between-subjects factor, and target valence (positive/negative) and shift condition (shift/non-shift block) as within-subjects factors.

RESULTS

Preliminary analyses showed that the patients and controls did not differ in age, educational level or premorbid IQ as measured with the NART (see Table 1). However, compared to controls, the patient group had significantly lower working-memory abilities as assessed with Digits Backward.

BDI-II and BAI

Healthy controls reported only minimal levels of depression (score 0–13; BDI-II manual, Beck, 1996) and anxiety (score 0–7; BAI manual, Beck, 1990). One patient with schizophrenia did not wish to complete the BDI-II and BAI so the results include the scores of 42 patients. Compared to controls, schizophrenia patients had significantly higher levels of depression and anxiety (Table 1). A total of 33% of patients had mild (scores = 14–19), moderate (= 20–28) or severe (= 29–63) levels of depression (Beck, 1996) and 43% had mild (scores = 8–15), moderate (= 16–25) or severe (= 26–63) levels of anxiety (Beck, 1990).

AST

Table 2 presents means and standard deviation (S.D.) for RT, FA and omissions as a function of the different shift and valence conditions. The

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Table 2. *Means (and standard deviations) for latencies (RT), false alarms (FA) and omissions per block of trials as a function of shift and valence conditions of healthy controls and patients with schizophrenia*

	Controls ($n=24$)	All patients ($n=43$)
RT		
Shift	516·77 (69·39)	594·98 (88·79)
Non-shift	514·47 (60·01)	595·21 (88·15)
Positive	512·17 (67·69)	598·28 (86·25)
Negative	519·10 (61·38)	591·68 (86·92)
FA		
Shift	0·96 (1·09)	1·66 (1·15)
Non-shift	0·71 (0·90)	1·52 (1·28)
Positive	0·98 (1·19)	1·65 (1·12)
Negative	0·69 (0·83)	1·54 (1·45)
Omissions		
Shift	0·47 (0·87)	1·30 (1·48)
Non-shift	0·38 (0·72)	1·01 (1·29)
Positive	0·50 (0·94)	1·22 (1·38)
Negative	0·36 (0·64)	1·09 (1·35)

controls' performance was within 1 S.D. of the performance of the control group in Murphy *et al.*'s (1999) study.

An ANOVA on RT showed that, overall, schizophrenia patients were significantly slower to respond compared to controls [$F(1,65)=16{\cdot}14$, $p<0{\cdot}001$]. The interaction between subject group and shift condition was not significant [$F(1,65)=0{\cdot}05$, $p=0{\cdot}81$], nor was the interaction between subject group and target valence [$F(1,65)=2{\cdot}34$, $p=0{\cdot}13$].

Patients made significantly more FA and omissions compared to controls [$F(1,65)=11{\cdot}12$, $p<0{\cdot}01$, and $F(1,65)=9{\cdot}91$, $p<0{\cdot}01$ respectively]. Overall, more FA were made on positive than negative words, and on shift blocks than non-shift blocks [$F(1,65)=4{\cdot}71$, $p<0{\cdot}05$, and $F(1,65)=6{\cdot}36$, $p<0{\cdot}01$ respectively]. For omissions, there were no significant differences between positive and negative words [$F(1,65)=0{\cdot}09$, $p=0{\cdot}76$], but there were more omissions on shift than non-shift blocks [$F(1,65)=4{\cdot}20$, $p<0{\cdot}05$]. For both FA and omissions, the interaction between subject group and target valence was not significant [$F(1,65)=0{\cdot}10$, $p=0{\cdot}75$, and $F(1,65)=0{\cdot}01$, $p=0{\cdot}89$ respectively]. Similarly, the interaction between subject group and shift condition did not approach significance for either FA or omissions [$F(1,65)=0{\cdot}37$, $p=0{\cdot}54$, and $F(1,65)=1{\cdot}39$, $p=0{\cdot}24$ respectively]. No other interactions were significant ($0{\cdot}30<p<0{\cdot}78$).

Overall, the results suggest that task-shifting abilities were not impaired in schizophrenia and that the patients did not show a bias towards negative words.

Affective status and task-shifting performance

In order to investigate whether the depression status of schizophrenia patients was critical to performance on the AST, the schizophrenia patient group was divided into those who reported low levels of depression (minimal or mild scores on the BDI-II = 0–19; $n=35$, mean = 8·17, S.D. = 5·68) and those who reported high levels of depression (moderate or severe scores on the BDI-II = 20 and above; $n=7$, mean = 36, S.D. = 13·44) (Beck, 1996). Although the sample size of high-depressed patients was small, it was necessary to have a patient group with depression levels that were comparable to the clinically depressed group reported in Murphy *et al.*'s (1999) study. χ^2 analyses showed no significant associations between patient subgroup and whether they were or were not taking antidepressants, mood stabilizers, anxiolytics, atypical, typical or a mixture of atypical and typical antipsychotics ($0{\cdot}08<p<0{\cdot}47$).

An analysis of RT showed no significant group difference between low-depressed and high-depressed patients [$F(1,40)=0{\cdot}18$, $p=0{\cdot}66$]. However, there was a near-significant interaction between participant group and target valence [$F(1,40)=3{\cdot}51$, $p=0{\cdot}06$]. Fig. 1 shows mean RT as a function of target valence for these two patients groups. A paired-samples *t* test revealed that high-depressed schizophrenia patients were slower to respond to positive targets compared to negative targets [$t(6)=2{\cdot}86$, $p<0{\cdot}05$], paralleling results with patients suffering major depression (Murphy *et al.* 1999). For low-depressed patients, there was no significant difference in RT between positive and negative targets [$t(34)=0{\cdot}10$, $p=0{\cdot}92$]. The interaction between participant group and shift condition was not significant [$F(1,40)=2{\cdot}15$, $p<0{\cdot}15$]. Group comparisons with FA and omissions revealed no significant interaction between depression level and target valence or shift condition ($0{\cdot}17<p<1{\cdot}00$).

The same analyses were conducted between a subgroup of patients and healthy controls

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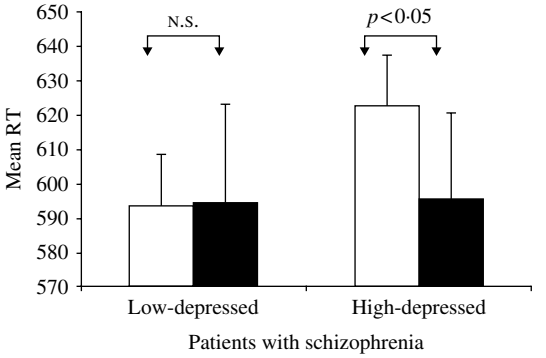


FIG. 1. Mean latency (RT) (and S.D.) as a function of target valence for low-depressed and high-depressed patients with schizophrenia. High-depressed, but not low-depressed patients are slower to respond to positive targets (□) compared to negative targets (■).

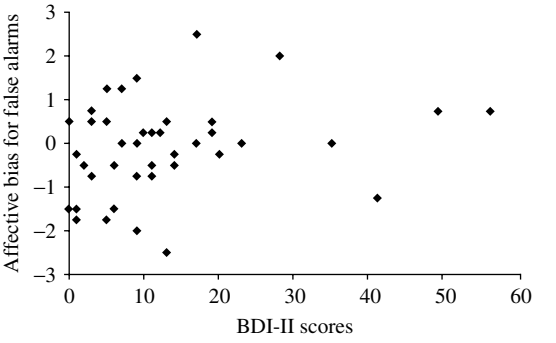


FIG. 2. Affective bias for negative material for false alarms (FA) (FA rate for negative words minus FA rate for positive words), as a function of BDI-II scores for patients with schizophrenia (positive values indicate a greater number of FA on negative words).

who both showed minimal levels of depression (scores = 0–13; $n = 28$ and $n = 24$ respectively). No significant interactions emerged between subject group and target valence, or shift condition, for RT, FA or omissions ($0{\cdot}24 < p < 0{\cdot}91$), suggesting that the latency difference between positive and negative targets was selective to those patients who suffer from a depressed mood.

Analyses were also carried out using BAI scores. The patient group was divided according to their anxiety status, low levels representing minimal and mild BAI scores (scores = 0–15, $n = 35$), and high levels representing moderate and severe scores (scores = 16–63, $n = 7$) (Beck, 1990). BAI and BDI-II scores were significantly correlated in the patient group ($r = 0{\cdot}61$, $p < 0{\cdot}001$), however, only five of the seven patients with high anxiety also had high levels of depression. No significant associations were found between anxiety levels and performance on the AST ($0{\cdot}09 < p < 0{\cdot}98$ for all effects involving BAI groups in ANOVAs).

Additional analyses were carried out to examine whether depression severity in the patient group was associated with a bias towards negative material, impaired task-shifting performance or overall performance. First, a bias for negative material was investigated by examining the additional time, or errors, incurred when responding to negative words compared to positive words, calculated as the difference in RT/FA/omissions between negative and positive words. For FA, the bias for negative material was found to be significantly correlated with BDI-II scores ($r = 0{\cdot}31$, $p < 0{\cdot}05$), suggesting that the number of FA on negative words when positive words were the target increased with higher depression scores (see Fig. 2). For RT and omissions, the bias for negative material was not found to be significantly correlated with BDI-II scores ($p = 0{\cdot}12$ and $p = 0{\cdot}83$ respectively). Second, task-shifting was examined by computing the cost of shifting, calculated as the difference in RT/FA/omissions between shift and non-shift blocks. BDI-II scores were not found to be significantly correlated with RT, FA or omission shifting costs ($0{\cdot}75 < p < 0{\cdot}96$). Third, overall RT, FA and omission rates were correlated with BDI-II scores to examine general performance. None of the correlations were found to be significant ($0{\cdot}20 < p < 0{\cdot}91$).

There were no significant correlations between BAI scores and a bias towards negative material, shifting cost or overall performance ($0{\cdot}11 < p < 0{\cdot}96$).

Additional analyses

Analyses were carried out to examine whether there was a specific demographic or clinical profile associated with depression or anxiety in the schizophrenia patient group. BDI-II and BAI scores were not found to be significantly correlated with age, years of education, intellectual functioning, number of periods of hospitalization, length of illness, chlorpromazine equivalents or positive, negative or general symptom scores on the Positive and Negative

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Syndrome Scale (PANSS; Kay *et al.* 1987) ($0{\cdot}18 < p < 0{\cdot}92$).

An investigation into the relationship between working-memory abilities and performance on the AST was also carried out with correlations between Digits Backward scores and (1) overall performance, (2) cost of shifting and (3) bias for negative material for RT, FA and omission rates in the patient group. The results showed that there was a significant correlation between Digits Backward scores and overall FA rates ($r = -0{\cdot}41$, $p < 0{\cdot}05$), suggesting that low working-memory abilities were associated with an increase in FA. There was also a significant association between Digits Backward scores and an affective bias for negative material of omissions ($r = 0{\cdot}23$, $p = 0{\cdot}05$), with increasing Digits Backward scores being associated with an increasing number of omissions on negative targets. There were no other significant correlations ($0{\cdot}21 < p < 0{\cdot}71$). Given that working-memory abilities were found to be related to performance on some AST measures, all the above analyses were repeated with Digits Backward scores as a covariate. There were no changes to the critical results of group comparisons or interactions effects.

The relationships between medication and AST performance were also considered. Independent-sample *t* tests were carried out for each of the six medication groups (antidepressants, anxiolytics, mood stabilizers, atypical, typical, and a mixture of atypical and typical antipsychotics) with patient medication status (on medication/not on medication) as the independent variable, and (1) overall performance, (2) shifting cost and (3) bias for negative material for RT, FA and omission rates, as the dependent variables. None of the comparisons were significant ($0{\cdot}13 < p < 0{\cdot}97$). In addition, there were no significant correlations between chlorpromazine equivalence dosage and AST performance ($0{\cdot}07 < p < 0{\cdot}83$).

DISCUSSION

The aim of the current study was to examine affective and cognitive processes (specifically selective attention and inhibition) in schizophrenia.

With regard to affective functioning, the results revealed that, overall, patients with schizophrenia reported significantly higher depression levels compared to controls. However, elevated depression scores were shown by only a third of patients, while the remainder scored in the minimal range of depression scores on the BDI-II. The results also showed that less than half of all patients reported mild, moderate or severe levels of anxiety. These results indicate that negative mood is frequently observed in patients with schizophrenia but it is not a necessary feature of the illness, consistent with findings by Siris *et al.* (2001).

The current study also found that the patients, as a group, did not show an attentional bias for negative material when compared to healthy controls. However, the results did indicate an association between depression and a bias towards negative targets in the patient group. The subgroup of patients with high levels of depression showed shorter latencies when negative words were the targets, and higher depression scores in the patient group were found to be associated with an increasing number of FA on negative words. The demonstration of faster RT for negative words, compared to positive words, in depressed schizophrenia patients resembles the results reported for clinically depressed individuals in Murphy *et al.*'s (1999) study. The current results should be interpreted with caution given the small sample size of the high-depressed schizophrenia group, but our findings are interesting given that the two patient groups, who were both depressed, demonstrated the same bias on negative words, indicating an overlap in affective cognitive mechanisms. Beck's (1976) model suggests that depression is characterized by distortions in information processing, or negative schemas, and is subject to biases that overvalue negative or threatening features in the environment (Hertel, 2002). The current results suggest that an attentional bias for negative information may also be part of the development and maintenance process of depression in schizophrenia patients.

The current study, however, also showed that this attentional bias for negative material, as measured by the AST, is not a generalized feature of schizophrenia but is selective to those with depressive symptoms. This suggests that some of the cognitive affective processes associated with clinical depression are present only

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in a subset of schizophrenia patients. This perhaps explains why only some patients with schizophrenia experience recurring depressive symptoms during the course of their illness, while others appear to be resistant to depression (Marengo *et al*. 2000).

The performance of patients with schizophrenia on the measures of interference control and task-shifting on the AST was also assessed. The results showed that, across the task, patients responded more slowly and made more FA and omissions relative to controls, suggesting difficulties focusing attention and inhibiting inappropriate responding to interfering stimuli. Difficulties in maintaining overall performance suggests impaired interference control in patients with schizophrenia, confirming previous findings of interference control failure in schizophrenia, as demonstrated by longer response latencies and greater numbers of errors in a Stroop paradigm (Brebion *et al*. 1996; Boucart *et al*. 1999).

With regard to the task-shifting measure, the results revealed that patients with schizophrenia were not impaired in shifting attention and responding, as the difference in performance in error and latency variables between shift and non-shift blocks was not significantly more pronounced relative to controls. The finding of intact task-shifting performance in patients with schizophrenia replicates the results obtained by Barton *et al*. (2002, 2005) and Manoach *et al*. (2002) on saccadic tasks, but contradicts other findings on tasks of verbal fluency (Lafonte *et al*. 1998), and on the IDED Attentional Set-Shifting Test of the CANTAB battery (Elliott *et al*. 1995) and the Visual Attentional Battery (Smith *et al*. 1998). As noted earlier, Manoach *et al*. (2002) proposed that significant differences between patient and control groups might be caused by the high working-memory requirements of some task-shifting paradigms. On the AST, the stimulus words form two distinct categories, the target remains unchanged across two blocks of trials and pressing the space-bar is the only response required. These conditions impose low working-memory requirements and consequently allow us to isolate task-shifting capability from working-memory capacity. Consistent with this task analysis, no significant association was observed between Digits Backward scores and cost of shifting on the AST. Furthermore, despite impaired working-memory abilities, schizophrenia patients had preserved task-shifting abilities. These findings are consistent with the suggestion that high working-memory load may be responsible for findings of impaired task-shifting abilities in schizophrenia.

We considered alternative explanations of performance. The AST was one of the first tasks to be administered in the testing session comprising a number of other cognitive tasks, suggesting that cognitive fatigue or motivation are unlikely contributors to the current performance. In addition, an investigation into the effects of medication revealed no significant association with AST performance.

Overall, the current results suggest that patients with schizophrenia have a selective impairment in inhibitory processes, with impaired interference control but intact task-shifting abilities. There is increasing evidence that inhibition is not a unitary construct but that it consists of several processes, each with its own distinct operating characteristic (Stuss *et al*. 1999; Friedman & Miyake, 2004). The current results support the suggestions that inhibitory processes are dissociable and that schizophrenia has a selective impairment only in some aspects of inhibitory control (Manoach *et al*. 2002).

Finally, a close inspection of the pattern of performance on the task-shifting and interference-control components of the AST by depressed patients with schizophrenia showed a disparity with the performance shown by clinically depressed patients in Murphy *et al*.'s (1999) study. Although depressed patients from both studies showed an attentional bias for negative material, their patterns of performance on the inhibitory processes of task-shifting and interference control were different. In the Murphy *et al*. study, depressed patients had impaired task-shifting abilities but intact interference control whereas the schizophrenia patients from our study showed the reverse pattern of performance. This indicates that the cognitive processes underlying depression may be somewhat different in the two clinical groups. In support, while studies have shown that perception of affect is impaired in schizophrenia (Edwards *et al*. 2002), it is not a consistently reported impairment in individuals with affective

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disorders. In addition, it is increasingly being argued that the symptom complaints of depression are different in the two disorders (Lancon *et al*. 2001) and also that evaluations of emotional dysfunction in schizophrenia need to take into consideration other negative symptoms typical of schizophrenia (Addington *et al*. 1993). Overall, the results from the current study highlight the current lack of understanding about the cognitive processes supporting negative emotions in schizophrenia and the exact nature of this affective dysfunction. Future studies investigating the role of cognitive biases in the development and maintenance of depression and the phenomenology of negative emotions in schizophrenia should particularly be encouraged.

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DECLARATION OF INTEREST

None.

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