

# Patients with schizophrenia do not produce more false memories than controls but are more confident in them

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## ABSTRACT

**Background.** Patients diagnosed with schizophrenia consistently demonstrate impairment in memory acquisition. However, no empirical consensus has been achieved on whether or not patients are more prone to produce false memories.

**Method.** A visual variant of the Deese–Roediger–McDermott (DRM) paradigm was administered to 35 schizophrenia patients and 34 healthy controls. Recognition and recognition confidence were later tested for studied and lure items. Strong contextual cues at recognition encouraged adoption of a gist-based retrieval strategy, which was predicted to elicit over-confidence in errors and increase the false memory rate in patients.

**Results.** Patients were significantly impaired on true item recognition but did not display more false memories than healthy subjects. As predicted from prior findings by our group, patients were more confident than controls for lure items, while being at the same time under-confident for studied items (reduced confidence gap).

**Conclusions.** Although patients did not produce more false memories than controls, such errors were made with higher confidence relative to controls. The decreased confidence gap in patients is thought to stem from a gist-based recollection strategy, whereby little evidence suffices to make a strong judgment.

## INTRODUCTION

Episodic memory recall and recognition are severely compromised in patients diagnosed with schizophrenia (Heinrichs & Zakzanis, 1998; Aleman *et al.* 1999). There is evidence that episodic memory impairment arises primarily at the stage of information acquisition, and is neither due to accelerated fading of memory traces nor enhanced interference (Moritz *et al.* 2001*b*; Egeland *et al.* 2003). Thus, unlike patients with amnesic syndrome, item recollection is impaired not only for delayed, but also for

immediate recall (short-term memory). Recent studies have increasingly extended the search for memory deficits in schizophrenia to other components such as source memory (Vinogradov *et al.* 1997; Keefe *et al.* 1999, 2002; Brébion *et al.* 2000; Moritz & Woodward, 2002; Moritz *et al.* 2003; Woodward *et al.* in press) and false memory (Huron & Danion, 2002; Weiss *et al.* 2002, 2004; Elvevåg *et al.* 2004; Moritz *et al.* 2004). These studies have often yielded mixed results. Whether or not enhanced source errors or false memories have been detected in schizophrenia depended largely on the paradigms administered, suggesting that impairment on these memory functions is not as ubiquitous as impairment in episodic memory.

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The present study is concerned with false memory in schizophrenia. Recent studies on this issue utilized the Deese–Roediger–McDermott (DRM) or false memory paradigm (Deese, 1959; Roediger & McDermott, 1995), which is also central to the present study. In a typical set-up, a series of word lists is presented to the participant, each converging on one word that is not part of the learning list, the so-called critical lure item (e.g. learning list: *hill, climb, valley, summit, top, molehill, peak, plain, glacier, goat, bike, climber, range, steep*; critical lure: *mountain*). It has been demonstrated by Deese (1959), Roediger & McDermott (1995) as well as others that healthy participants often falsely recall or recognize the critical lure in a later trial. Unlike other memory paradigms that may also elicit false memories, such errors are typically accompanied by high subjective confidence. In addition, participants often claim that they (vividly) remember the critical lure, as measured by the *remember-know* procedure (Tulving, 2001). In recent years, the DRM effect has been replicated under a variety of conditions and modalities, confirming its robustness (Miller & Gazzaniga, 1998; Röder & Rösler, 2003).

To the best of our knowledge, studies that have employed the DRM paradigm in schizophrenia (Huron & Danion, 2002; Elvevåg et al. 2004; Moritz et al. 2004) have administered only verbal material. Consistently across studies, schizophrenia patients recognized fewer studied items but at the same time did not display more intrusions. In fact, in two studies (Huron & Danion, 2002; Elvevåg et al. 2004), patients were even less susceptible to the false memory effect than controls. In line with previous research from their group (Huron et al. 1995; Danion et al. 1999), Huron & Danion (2002) found that schizophrenia patients recognized items less vividly.

We recently investigated recognition for DRM items along with confidence ratings and found no increase in false memory rates for schizophrenia patients (Moritz et al. 2004). However, the findings suggested that false memories in patients and controls are subserved by different cognitive mechanisms. False memories in *healthy controls* were attributable to sustained spreading of semantic activation *at the stage of encoding*: during presentation of the study items, lure items are co-activated by

means of summation of spreading activation, consolidated, and then reactivated on recall or recognition (Roediger et al. 2001). In schizophrenia patients, this process is reduced or absent, due to decreased sustained spreading of semantic activation for longer intervals (Barch et al. 1996) and attention problems (Heinrichs & Zakzanis, 1998) at the time of encoding. False memories in *schizophrenia patients*, on the other hand, may arise from the adoption of a gist-based strategy *at retrieval* (e.g. 'I can remember similar words, such as *valley* and *hill*, so I guess *mountain* has been presented, too'). A gist-based recognition strategy was suggested by a positive correlation between veridical and false recognition (Roediger et al. 2001), which emerged in patients ( $r=0.76$ ) but not in controls ( $r=0.05$ ) in our study (Moritz et al. 2004). To summarize, although the false recognition rate was comparable between schizophrenia patients and healthy controls, false memories appear to reflect distinct mechanisms in the two populations: gist-based retrieval strategies for patients (Weiss et al. 2002; Moritz et al. 2004), and sustained semantic activation at encoding for controls (Roediger et al. 2001).

In the current study, one of our goals was to test this account of distinct underlying causes of false memories in patients and controls by attempting to cue recognition in a fashion that would encourage usage of a gist-based recognition strategy. This manipulation was designed to increase the false memory rate for patients but not controls. To achieve this goal, we constructed a visual version of the DRM paradigm. Visual material was selected as it is contextually more salient than word lists (i.e. subjects often do not realize that words from a particular list are inter-related, whereas even a subject with memory and intellectual impairment can grasp the essence from a prototypical picture such as a beach scene). Importantly, the central theme for each picture (e.g. beach scene) was made explicit at recognition (e.g. the participant was asked if he/she saw towels at the beach scene). We expected that these salient contextual cues would induce more false memories in patients with schizophrenia by activating contextually congruent items along with studied items at recognition.

A series of past studies have demonstrated that patients with schizophrenia make firm

judgments (i.e. decision, high-confident ratings) on the basis of little evidence (Garety *et al.* 1991; Dudley *et al.* 1997; Moritz & Woodward, 2004, 2005). The use of contextual cues provides an opportunity to further validate this assumption. A contextual cue may provide sufficient evidence for a high-confident judgment in patients [e.g. towel (lure): 'People on the beach usually lie on towels, so I am sure I saw some']. Thus, it was expected that the introduction of strong contextual cues would both increase the number of false memories in patients as well as confidence for false memories relative to controls.

Finally, we manipulated the emotional content of the pictures presented, with the expectation that patients with current paranoid symptoms would display better recognition for mood-congruent (i.e. delusion) material and may also display greater false recognition of such material (for corresponding findings see Kaney *et al.* 1992).

## METHODS

### Participants

Thirty-five patients diagnosed with schizophreniform disorder or schizophrenia according to DSM-IV criteria participated in the present investigation. All patients were recruited from the Department of Psychiatry and Psychotherapy in Hamburg (Germany). Patients were screened by trained clinicians prior to further investigation. Pre-selected patients then underwent a thorough psychopathological assessment using the MINI neuropsychiatric interview (Sheehan *et al.* 1998). The schizophrenic psychopathology was evaluated with the German version of the SCID. None of the patients had a known current or past history of brain damage, severe substance abuse, or an Axis I diagnosis other than schizophreniform disorder or schizophrenia. However, the presence of a co-morbid depressive illness was tolerated.

Through advertisement, an established subject pool and word-of-mouth, 34 healthy controls were recruited and carefully screened with the MINI interview for absence of any psychiatric disorders including substance dependence.

Schizophrenic psychopathology was assessed with the Positive and Negative Syndrome Scale (PANSS; Kay *et al.* 1989), which was complemented by six additional ratings from the

Positive and Negative and Disorganized Symptoms Scale (PANADSS; Moritz *et al.* 2001*a*) covering inadequate affect, flat affect (both symptoms are not fully separated in the PANSS), associative loosening, thought blocking (both symptoms are not fully separated in the PANSS), auditory hallucinations and other hallucinations (the PANSS does not differentiate between different types of hallucinations).

Three syndromes were composed from the PANSS/PANADSS which closely followed recent factor-analytic solutions obtained with these scales (Mass *et al.* 2000; Moritz *et al.* 2001*a*): positive syndrome (delusions, hallucinations, suspiciousness/ideas of persecution, unusual thought content), negative syndrome (flat affect, emotional withdrawal, lack of relationship, passive social withdrawal, lack of spontaneity) and disorganization (associative loosening, inadequate affect, problems with abstract thinking, attention, disorientation). After complete description of the study to the subjects, written informed consent was obtained.

### Material

Four black-and-white scenes were drawn by hand for the purpose of the study (see Appendix). Themes were selected on the basis of the following criteria: (1) universally familiar from personal experience or media sources (e.g. movies, books), (2) easy to identify, (3) highly detailed in order to increase salience, and (4) representative of the affective content designed to capture (neutral, positive, negative, delusional). We eventually decided on the following four themes: classroom (neutral), beach (positive), funeral (negative) and room surveillance (paranoid delusional). The scenarios were equated in terms of perceptual complexity: the artist of the four pictures was advised to draw equivalent amounts of typical items for each of the pictures, which later had to be recognized as studied items. Moreover, for each of the pictures the same number of prototypical items was left out, which later served as lures.

In order to avoid evoking feelings of school-related anxiety for the classroom picture, the students and the teacher in the classroom scene looked rather relaxed. Subjects were asked to rate each scene on a visual analogue scale capturing judgments of valence (1 = very positive

Table 1. Sociodemographic and psychopathological characteristics of the samples

Variables	Healthy (H; n=34)	Schizophrenia (S; n=35)	Statistics
Sociodemographic variables			
Age (yr)	34.29 (11.38)	36.29 (11.34)	$t=0.76, p>0.4$
Gender (male/female)	13/21	18/17	$\chi^2(1)=1.21, p>0.2$
School and vocational education	15.71 (3.68)	15.28 (4.43)	$t=0.43, p>0.6$
Parental education	13.20 (4.00)	13.70 (3.23)	$t=0.50, p>0.6$
Psychopathological variables			
Number hospitalizations (including present)	—	4.00 (3.35)	—
PANSS Total Score	—	66.31 (16.62)	—

Except for three schizophrenia patients, all schizophrenia patients received neuroleptic treatment.

to 9=very negative) and arousal (1=very aroused to 9=no arousal at all) (Self-Assessment Manikin; Lang, 1985).

For the recognition trial, 12 previously presented items ('old' items) from each scene were presented verbally on the screen. We chose items which were regarded as clearly prototypical for each individual scene. In addition, 12 new (distractor) items were selected per scene. These were comprised of four items that were unrepresented and unrelated to the scene, and eight items that were central but unrepresented aspects of the scene (such as towels for the beach scene, critical lures). Thus, 48 old and 48 new items were presented.

### Experiment

In the encoding phase of the experiment, the four pictures were presented in a randomized order for each 40 seconds. The picture filled the entire screen of a 15-inch monitor. Participants were seated approximately 50 cm away from the screen. Each picture was initiated via mouse-click. Beforehand, subjects were instructed to attend to each of the pictures, and were told that they will later have to recognize details from each of the four pictures. Between encoding and retrieval, participants were requested to complete a filler test (vocabulary task), which took approximately 10 minutes (Lehrl, 1995). None of the items of this test overlapped with items for the recognition task. In the recognition trial, subjects were asked if a particular item (e.g. curtain, blankets, etc.) was presented on a specific picture by presenting items along with the corresponding contextual cues ('classroom', 'beach', 'funeral', 'room surveillance'). In this way it was made clear that each recognition item

referred to a specific picture. A four-point scale was used for responses: old and confident (=1); old and not confident (=2); new and confident (=3); new and not confident (=4). The recognition items were also fully randomized.

## RESULTS

### Participants

As can be seen in Table 1, the participants did not differ on major sociodemographic background variables including length of parental education.

### Accuracy

A three-way mixed ANOVA was conducted with Scenario Type (classroom, beach, funeral, room surveillance) and Item Type (old, new-related, new-unrelated) as within-subject and Group (patients and controls) as a between-subject variable. Percentage of 'old' responses served as the dependent variable. The interaction of Group  $\times$  Item Type achieved significance, [ $F(2, 134)=4.42, p=0.02$ ], which was not further moderated by Scenario Type ( $p>0.7$ ). Subsequent  $t$  test comparisons showed that patients recognized fewer studied items than controls [ $t(67)=4.38, p<0.001$ ], but the groups did not differ with regard to distractor items (at least  $p>0.3$ , see Fig. 1).

### Confidence

A three-way mixed ANOVA was conducted with Accuracy (correct, incorrect) and Response Type (old, new) as within-subject variables, and Group as a between-subject variable. The percentage of high-confident responses served

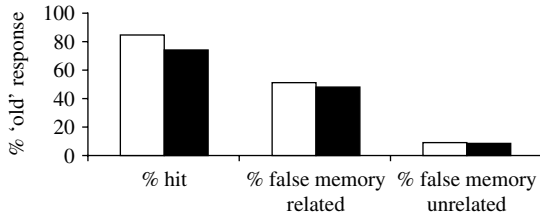


FIG. 1. While patients produced fewer hits than controls ( $p < 0.001$ ), no group differences emerged for lure items when the data was analyzed irrespective of subjective confidence. □, Healthy; ■, schizophrenia.

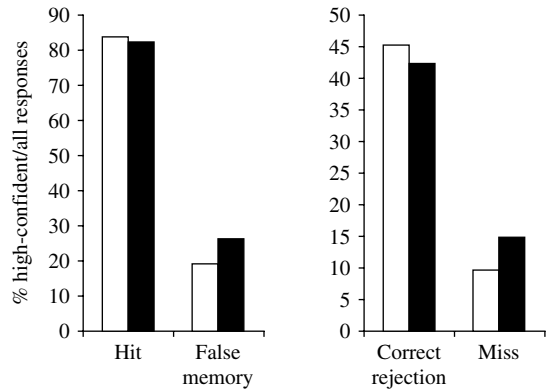


FIG. 2. For both error types (false memory, miss) patients showed increased confidence ratings while patients had decreased confidence in correct responses (hit, correct rejection). The interaction of Response Type (correct, incorrect) and Group achieved significance ( $p = 0.007$ ), and this was not further moderated by Item Type (old, new) ( $p > 0.8$ ). Separate analysis showed that the interaction achieved significance for both item types: hit/false memory ( $p = 0.03$ ) and correct rejection/miss ( $p = 0.04$ ). □, Healthy; ■, schizophrenia.

as dependent variable. The main effects of Accuracy [ $F(1, 67) = 962.63$ ,  $p < 0.001$ ], and Response Type [ $F(1, 67) = 168.25$ ,  $p < 0.001$ ], achieved significance, indicating that correct responses were made with higher confidence than incorrect ones. Overall more 'old' than 'new' responses were made. The interaction of Accuracy  $\times$  Response Type also turned out to be significant [ $F(1, 67) = 92.02$ ,  $p < 0.001$ ] as well as the interaction of Accuracy  $\times$  Group [ $F(1, 67) = 7.84$ ,  $p = 0.007$ ], but not the three-way interaction. Further analyses showed that for both response types (see Fig. 2) patients displayed higher confidence in incorrect responses and lower confidence in correct ones (i.e. decreased confidence gap). When the analysis for the false-positive errors was confined to related lures, the group difference depicted in Fig. 2 remained essentially unchanged ( $p = 0.028$ ).

Schizophrenia patients showed significantly higher knowledge corruption (percentage of high-confident responses that are errors) than healthy participants [mean = 24.15%; mean = 18.30%;  $t(67) = 2.91$ ,  $p = 0.005$ ].

### Valence and arousal

When Scenario Type and Group were submitted to a mixed two-way ANOVA with valence ratings as dependent variable, Scenario Type ( $p < 0.001$ ), but not the interaction yielded significance ( $p > 0.5$ ), indicating that the two samples rated the scenarios similarly with regard to valence. As expected, the beach scene was rated as positive (mean = 2.60), whereas the classroom scene was judged as rather neutral (mean = 4.42). The funeral (mean = 5.68) and room surveillance scenarios (mean = 6.13) were rated as rather negative. Except for the difference between the funeral and the room surveillance

scene, all valence ratings were significantly different (at least  $p < 0.005$ ).

For arousal ratings, the effect of Scenario Type ( $p = 0.007$ ) was again significant but not the interaction ( $p > 0.1$ ). The beach scene (mean = 6.95) was rated the least arousing followed by the classroom scene (mean = 6.50), the funeral scene (mean = 5.83) and the room surveillance scene (mean = 5.60). Only the difference between the funeral scene and the beach scene achieved significance ( $p = 0.02$ ).

### Relationships with psychopathology

Even before a Bonferroni correction, none of the experimental parameters reported above correlated significantly with item scores for delusions, suspiciousness or hallucinations.

## DISCUSSION

The present findings corroborate and extend previous research on memory dysfunction in schizophrenia. In accordance with the episodic memory literature (Heinrichs & Zakzanis, 1998; Aleman *et al.* 1999; Moritz *et al.* 2001 *b*) patients recognized fewer studied items relative to controls. Congruent with our previous false memory study (Moritz *et al.* 2004), the rate of false memories did not differ between schizophrenia patients and healthy participants. However, as described in greater detail in the Introduction, it

is assumed that false memories have occurred for different reasons in healthy and schizophrenic participants: whereas spreading of activation may represent the primary source for false memories in healthy subjects (Roediger *et al.* 2001), gist-based recollection is the presumed primary source for false memories in patients. In line with this reasoning, studies that were less sensitive to gist-based recollection found fewer false memories in patients (Huron & Danion, 2002; Elvevåg *et al.* 2004).

As hypothesized, samples differed on the extent to which confidence was expressed for correct and incorrect responses. For both old and new items, schizophrenia subjects were under-confident for correct responses while at the same time being over-confident for incorrect responses. For this pattern of results, which replicates findings gathered with source memory tasks (Moritz & Woodward, 2002; Moritz *et al.* 2004, 2005*b*), we have previously coined the expression decreased 'confidence gap'. This denotes that patients are less able than controls to disentangle correct from incorrect memories in terms of confidence. A decreased confidence gap along with enhanced error rates contributed to higher rates of knowledge corruption in patients [i.e. increased high-confident judgments (subjective knowledge) that are errors].

A decreased confidence gap for false memories in schizophrenia emerged in the present but not a previous false memory study (Moritz *et al.* 2004). This discrepancy is attributed to procedural differences between the two experiments. Unlike verbal lists where contextual salience is low (in fact, the critical lure carries the strongest contextual cue, which by definition is not presented; therefore, many subjects do not realize that lists are comprised of interrelated words), the present visual study implemented additional strong contextual cues: At recognition, participants were asked if a specific item was seen in the classroom, beach, funeral, or room surveillance scene. Drawing on a literature that patients with schizophrenia use mere gist/familiarity (Weiss *et al.* 2002; Moritz *et al.* 2004) and poor evidence (Dudley & Over, 2003) when making strong inferences it was predicted that such contextual cues would prompt patients to make more high-confident judgments. In contrast, healthy subjects appear to gather more information before arriving at

strong inferences. This did not prevent them from falling into the 'DRM trap' – but they did so with less certainty compared to patients. By the same token, healthy participants in the present study displayed higher confidence in their correct responses as a more lengthy and scrupulous search process maximizes the probability of finding valid information. Hasty decision-making as evidenced by schizophrenia patients (Garety *et al.* 1991; Dudley & Over, 2003; Moritz & Woodward, 2005) in turn may result in a neglect of affirmative information which would have otherwise raised subjective confidence.

Unexpectedly, type of event did not moderate results. It was initially expected that patients with schizophrenia would produce more hits for the room surveillance scene. Since delusional themes vary across paranoid patients, the picture might not have been idiosyncratic or specific enough to elicit the effect. In line with this, affective and arousal ratings did not differ between groups. Administration of a broader range of delusional scenarios would provide a fair test of the hypothesis. Moreover, apart from an arousal rating, a rating of personal significance should be introduced to test this assumption.

Although patients did not differ from controls on the extent of false memories, the behavioral consequences of false judgments are presumably more severe in patients than in controls, as patients were more confident in their errors. Doubt, as displayed by healthy subjects in face of false judgments, is an important modulator of behavior and encourages a person to seek more information and to withhold strong actions. False judgments *per se* may not necessarily interfere with the social environment as long as doubt is attached.

To attenuate over-confidence in errors and jumping to conclusions in schizophrenia as well as risk factors for the exacerbation of symptoms we have recently developed a meta-cognitive skill program (Moritz *et al.* 2005*a*). Patients are confronted with pictures such as those utilized in the present investigation, which often elicit false memories. Patients are taught helpful strategies such as the vividness heuristic (e.g. true memories are usually more vivid than false memories) to avoid such errors. Thus, memory contents one just 'knows' without detailed recollection should be rather mistrusted

and either witnesses or additional information should be sought for verification.

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## DECLARATION OF INTEREST

None.

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