

# Metacognitive Control Over False Memories: A Key Determinant of Delusional Thinking

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This article reviews the current literature on false memories in schizophrenia. Increasing evidence suggests that neither memory impairment in general nor false memories in particular can reliably differentiate patients with schizophrenia or delusions from psychiatric controls. In contrast, it is proposed that a reduced metacognitive awareness of one's own fallibility, and overconfidence in errors, may predispose a person to fixed, false beliefs (ie, delusions). Congruent with this position, a number of recent investigations suggest that the memory of patients with schizophrenia, as well as healthy subjects scoring high on delusional ideation, is corrupted by an increased number of incorrect memories held with high confidence, possibly relating to a jumping-to-conclusions or liberal acceptance bias in schizophrenia spectrum disorders. A new training approach is described that is intended to sharpen patients' awareness of such errors and reduce confidence in fallible memories. Some empirical gaps and directions for further research are outlined.

## Introduction

Thomas: "He used to use her like a punching bag, that's what. He'd sock her in the jaw. Kick her. Slam her against the wall. He used to make us watch.... One time we were sitting there eating dinner, the four of us, and Ray just reached over and elbowed her, right in the face. For no reason. Just because he felt like it, that's all. He broke her nose."

Dominique: "Never happened."

—Wally Lamb, *I Know This Much Is True*

The foregoing excerpt is taken from the novel *I Know This Much Is True* [1], which tells the story of a man with paranoid schizophrenia, Thomas, and his nonaffected twin brother, Dominique. Although fictional, the dialogue illustrates an important yet understudied feature of schizophrenia cognition: the intrusion of false or fabricated information into the memory of patients. Thomas is convinced that his stepfather had physically abused his mother in front of him and his brother. At other times, he adds incidents of sexual abuse and recalls that the father used to urinate in his shoes. But according to the healthy brother, their father never intentionally harmed their mother, although he was a bully who mistreated Thomas. This episode is particularly instructive because, in accordance with studies reported below, false recollection in schizophrenia may occur beyond core delusional ideas and thus likely represents a risk factor for, rather than merely a secondary expression of, delusional ideation.

## Memory and Schizophrenia

Memory studies of schizophrenia to date have been predominantly concerned with memory accuracy, particularly recall and recognition rates (hits in terms of signal detection theory). According to meta-analyses, memory deficits are perhaps the most severe neurocognitive impairment in schizophrenia [2-4]. In contrast to early claims by Bleuler [5] that memory impairment is a mere epiphenomenon of distractibility [6], there is strong evidence that memory deficits stem from alterations in mediotemporal brain areas [7,8], which play a pivotal role in memory acquisition and recognition [9]. Fine-grained analyses suggest that patients with schizophrenia display problems with information acquisition rather than rapid decay of memory traces [6,10], but the specificity of this memory impairment is subject to ongoing debate. The available evidence strongly indicates that the memory profile of patients with schizophrenia is not unique and that several disorders (eg, dementia, amnesic syndrome) that are not necessarily accompanied by psychotic symptoms may show even greater impairment [11-13].

**Table 1. Knowledge corruption in patients with schizophrenia and delusion-prone individuals**

Studies	Task	Knowledge corruption, %	
		Experimental subjects	Healthy controls
Moritz and Woodward [24]	Source memory	12*	5
Moritz et al. [18]	False memory paradigm (verbal)	34*	21
Moritz et al. [35]	False memory paradigm (visual)	21*	9
Moritz and Woodward [36•]	Source memory	22*	13
Moritz et al. [22]	Source memory	21*	9
Laws and Bhatt [38•]	False memory paradigm (verbal)	46†	27

\* Patients with schizophrenia.  
† Healthy subjects with delusional symptoms.

Compared with the extensive literature on hits and misses, until recently the study of false memories (ie, false positives) has attracted little attention. The neglect of false memories may be partly due to methodologic problems (eg, floor effects) or the fact that many traditional neurocognitive tasks (eg, Wechsler Logical Memory, Rey figure) are scored solely according to correct recall or recognition. Studies on false memories in schizophrenia have often reported an increased rate of false memories, especially in patients displaying acute positive symptoms [14–17], although unequivocal support is lacking. For example, studies using the Deese-Roediger-McDermott paradigm have not found evidence for increased false memories [18–20], which may be partly attributable to low recognition rates [18,19].

### Metamemory in Schizophrenia

The measurement of memory accuracy in schizophrenia has recently been complemented by the investigation of more qualitative aspects of memory parameters, such as memory confidence [18,21•,22–24], awareness of cognitive deficits [25,26], memory vividness [27,28•,29,30], and feeling-of-knowing ratings [31]. These cognitive concepts are subsumed under the term *metamemory* (*meta-* from Greek for “above”). We will make the case that the parallel assessment of metamemory and accuracy advances our understanding of both delusions and schizophrenia, and that this combination is essential for the development of a schizophrenia-specific cognitive profile.

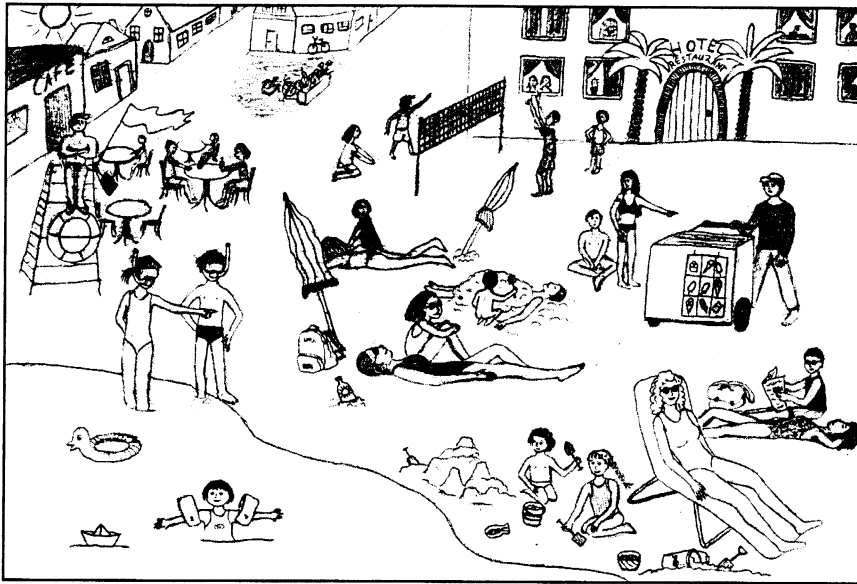
The assessment of metamemory is important for several reasons. First, conviction in false beliefs is a core defining feature of delusions. Furthermore, the degree of subjective conviction moderates overt behavior. Memory episodes that are internally tagged as not trustworthy [23] are unlikely to give rise to delusional ideas but may receive status as working hypotheses that require further validation. Put differently, even a large store of false memories may not affect behavior if they are correctly tagged as fallible. In fact, this is a core characteristic differentiating patients with schizophrenia from most patients with

a diagnosis of obsessive-compulsive disorder (OCD). An unshakable belief in just a single but vital false memory, however, such as a strong belief about alien abduction, may produce dramatic consequences.

In a recent set of studies, it was shown that metacognitive judgments regarding one's own knowledge (certainty monitoring) is a stronger predictor of insight into illness and decision-making competence than cognitive deficits per se [32]. These preliminary findings further substantiate the claim that metacognition is a bridge between task performance and everyday functioning [21••].

The experimental psychology literature on metacognition has provided several indices to relate confidence and performance accuracy, such as output-bound accuracy and monitoring resolution [33], gamma correlations for confidence and accuracy ratings [34], and the confidence gap [23]. The latter index expresses the degree to which true and incorrect memories can be differentiated in terms of confidence; it is computed by subtracting confidence in errors from confidence in correct responses. In a prior study, we found (not surprisingly) that correct memories were accompanied by a high degree of confidence, whereas incorrect memories were accompanied by a relatively low degree of confidence [23]. For example, in a recent investigation employing a four-point scale ranging from 1 (guessing) to 4 (absolutely certain), healthy subjects reported 3.75 confidence for correct responses and 2.62 for incorrect ones. In contrast, the confidence gap was decreased for patients with schizophrenia: they were overconfident in incorrect memories (3.16) and less confident in memories that turned out to be true (3.71).

We routinely compute another metacognition parameter, termed the knowledge corruption (KC) index, which incorporates both the extent of memory errors and confidence. This index is computed as the number of erroneous memories held with high confidence divided by the number of all memories held with high confidence. Although the overall degree of KC depended on the task administered, in all studies patients showed significantly more KC than controls (Table 1) [18,22–24,35,36•]. This effect has been found for both misses and false positives (ie, false memories) [22,36•].



**Figure 1:** Example of a visual false memory item used in Moritz et al. [37]. Participants falsely recognized approximately half of "lure" items (towels, ball, waves, straw hat, rubber boat, flippers for diving, mussels, open beach umbrella), which are consistent with the context but do not actually appear in the picture. Schizophrenia patients showed enhanced confidence for false memories, while at the same time being less confident than controls for studied items (eg, palms, sunglasses).

In a recent study [37] using complex scenes such as the one depicted in Figure 1, we found that patients and controls did not differ on the number of false memories, but they did differ with respect to the conviction with which these were held! Patients and controls were comparably prone to recognize strong lure items in a complex scene (eg, remembering towels on the beach even though they were not displayed). The controls seemed to attach "not trustworthy" tags to those episodes, whereas the patients were overly confident in the recollection. In line with our observations, an analogue study [38•] of healthy students dichotomized for high and low delusional symptoms on the Peters et al. Delusions Inventory [39] found that those scoring high produced an increased number of false memories on a verbal variant of the Deese-Roediger-McDermott paradigm [40] and also displayed greater conviction in their false memories. The KC index in the high-delusional group was 46%, whereas the KC index of those with low scores on delusional symptoms was 27%.

There is also some evidence that KC is stronger in patients with schizophrenia than in other psychiatric patients, such as those with OCD or post-traumatic stress disorder, two disorders that frequently involve mental intrusions [36•]. The joint assessment of accuracy and confidence thus provides nonredundant information that may help to pinpoint a specific performance profile for patients with schizophrenia, since neither accuracy nor confidence ratings alone seems to reliably differentiate these patients from psychiatric controls.

### A Possible Explanation for Overconfidence in Memories

Why are patients with schizophrenia more confident in their erroneous memories? We propose that overconfidence in memory errors stems from a liberal acceptance bias [41,42], whereby partial information is taken as

sufficient evidence for high confidence. In contrast, the same partial information will be insufficient for a healthy person to make the same strong inference. This account is based on a wealth of studies showing that patients with schizophrenia jump to conclusions [43–47]. This line of research has often used the so-called beads or probabilistic reasoning paradigm. In a standard task, the subject is confronted with two jars with colored beads in opposing ratios (eg, 85 red beads and 15 green beads in one jar, and the reverse in the other jar). The experimenter then draws one bead at a time, and the subject is required to indicate when he or she is certain which jar is the source of the beads. Approximately 40% to 70% of the patients with a diagnosis of schizophrenia decide after only one bead.

We have recently proposed a variant of the jumping-to-conclusions theory, termed "liberal acceptance." In our view, patients are hasty to accept or consider alternatives but decide only when no strong alternatives exist. In most paradigms, such as the beads task, both the jumping-to-conclusions theory and liberal acceptance come to the same predictions, but we believe that liberal acceptance is superior because it explains why patients are indecisive when confronted with highly ambiguous material: If several alternatives surpass the assumed lowered threshold of acceptance, decisions are actually postponed.

In a recent study that expands on the beads paradigm [41], we presented patients with items comparable to questions from the "Who Wants to Be a Millionaire" television game show. Patients were asked to provide probability estimates (0% to 100%) for each of four response alternatives. Participants were free to decide on or reject an alternative (optional rating). Patients and controls did not differ on probability judgments, but patients had a significantly decreased threshold for translating probability estimates into decisions: The minimal threshold for a decision to accept was 54% in patients, compared with 70% in controls. Similarly, patients rejected alterna-

tives with probability estimates of 6%, whereas controls rejected alternatives with probability estimates of 0.7%. This agrees with the assumption that patients are more hasty to both accept and reject alternatives [48••].

In accordance with these findings, several studies have suggested that patients with schizophrenia rely more on mere familiarity to make confident memory decisions, whereas healthy subjects require rich episodic information to warrant high confidence [18,49••]. Both jumping to conclusions and liberal acceptance can parsimoniously explain overconfidence in errors for patients, and can also explain why patients show somewhat less confidence in correct responses: Premature termination of information collection may result in neglect of affirmative information that otherwise would have raised subjective confidence. In controls, a longer and more searching decision process maximizes the probability of finding valid cues and leads to higher confidence. As described in more detail elsewhere, liberal acceptance may also trigger hallucinatory experiences in patients [36•,41]. Often our external auditory input is incomplete, prompting guessing as to the source of the noise (eg, mistaking a sound as a voice, mistaking a TV voice for the voice of the partner, being unsure if one has heard or just imagined a sound). Likewise, internal processes may carry characteristics of external input (eg, "foreign" thoughts incompatible with regular attitudes or opinions, strong thoughts with almost auditory quality). Liberal acceptance of improbable guesses (eg, that God is directly talking to you) may promote hallucinatory experiences, since reality checks may be absent or suboptimal decision heuristics applied [50].

### Consequences of High-Confident Memory Errors

False memories are a hallmark of schizophrenic delusions and fuel many delusional beliefs [51]. To illustrate, in *I Know This Much Is True*, Thomas recalls that Jimmy Carter has tried to send him three letters to persuade him to go on a peace mission in the Middle East [1]. False memories that have attracted much attention in the public relate to alien abduction and sexual or physical abuse, although idiosyncratic memories such as the ones reported by Thomas seem to be more common in schizophrenia. Unlike other aspects of reality distortion, however, the prevalence of false memories is not known, so it is difficult to estimate the relative contribution of false memories to delusion formation over and above the impact of hallucinations and overinterpreting available evidence (eg, illusionary correlation). This question may be quite important for the treatment outcome of patients because false memories may act as negative predictors of therapy-resistant schizophrenia. Hallucinations and hallucination-based delusions are quite responsive to neuroleptics [52], but false memories and associated delusional phenomena may be more resistant.

In conjunction with false memories (ie, false positives), high confidence for false-negative memories (true memories that are forgotten and may even be actively denied on confrontation) may also represent an important maintenance factor for delusions. For example, a delusion that a patient's sister is plotting to keep the patient in the hospital could be countered by a clear recollection that the sister has shown love and trust to the patient in the past. Likewise, a patient who can vividly recall prior positive encounters with a physician may not think that the same physician is trying to poison him or her. An over-reliance on current or recent perceptual input, and relative neglect of prior events, has been noted by a number of researchers and originates from the work of Hemsley and others [53,54]. Likewise, source confusions and problems remembering temporal order may lead to interpersonal conflict (eg, misremembering the instigator of an argument, assuming that a person has spoken badly about you when in fact it was another person). The impact of false memories on behavior may be reduced somewhat if a patient is aware of his or her tendency to confuse fact with fiction.

### The Neuronal Correlates of High-Confident Errors

Despite advances in our comprehension of human memory processes in both healthy individuals and patients with schizophrenia, the neuronal underpinnings of memory confidence are currently poorly understood. A recent study conducted with healthy participants (Moritz et al., unpublished data) found widespread bilateral activation in the anterior and posterior cingulate cortex whenever a subject was confident that a memory was true, irrespective of validity. Similar findings have been obtained by Chua et al. [55]. Correct memories (hits, correct rejections) could be differentiated from incorrect ones (misses, false memories) by activation in both frontal and occipital regions. False memories showed few differences from correct memories, which were confined to the left inferior temporal cortex. Another study found that true memories led to enhanced activation in primary visual cortex [56,57], which fits well with the observation that true memories are perceptually more rich than false memories [58]. Until more direct research is undertaken in patients with schizophrenia, we speculate that dysfunction in the anterior cingulate cortex, which is commonly reported in schizophrenia [59], may mediate overconfidence in errors. A recent study by Blackwood et al. [60] has suggested that the cerebellum, along with occipital and parietal regions, is involved in probability reasoning paradigms such as the beads task.

### How to Treat False Memories

Our group has recently developed a training program that aims to correct cognitive and metacognitive biases.

Alone or in concert, these may contribute to false beliefs and in turn may promote the development of delusional thought [61]. Apart from attributional biases, jumping to conclusions, and theory of mind, one entire module is devoted to memory and metamemory. In the introduction of the module, patients are told which factors may impede memory acquisition (eg, alcohol, stress) and which factors may promote it (eg, sleeping after learning, quiet environment, mnemonic aids). Subsequently, we present patients with tasks like the one shown in Figure 1, which are known to elicit a high number of false memories in participants. The patients are provided feedback about their errors and strategies for preventing false memories (especially application of a "vividness heuristic": True memories are "livelier" than false memories). Thus, patients are directly confronted with the experience that our memory can play tricks on us and that memory is constructive rather than passive (like a video recorder). The final slide of the program instructs patients not to rely too much on their memories when these are pale and blurred, particularly for events with important consequences, such as a quarrel that may cost a friendship. In these situations, more evidence should be taken into account before drawing conclusions.

## Conclusions

Liberal acceptance or jumping to conclusions in patients with schizophrenia may promote the establishment of incorrect memories held with high confidence. Such false recollections are thought to nurture or even initiate fixed, false beliefs. Many empirical gaps remain, and the outlined hypotheses are far from being consolidated, but independent replications are beginning to emerge [37•]. A number of other factors that may promote false memories also should be investigated. The contribution of anxiety [62], real or perceived time pressure [63], gain from illness (eg, an encounter with God may give a patient a purpose in life and comforting experience, or a false memory may supply a patient with a missing link to explain and prove certain phenomena), and incorrigibility [64] are important areas for future research. In addition, exploration is needed to determine whether overconfidence in errors may also be found in patients who have delusions but do not have a diagnosis of schizophrenia.

Unlike false recollections about childhood sexual abuse or other testimonies that often reflect misinformation fed to the subject [58], false memories in schizophrenia seem to be entirely the product of a mind affected by illness, in accordance with early claims by Jaspers [65] that delusional phenomena are irreducible and "ununderstandable" [66]. However, on closer inspection, even the most bizarre delusions may not appear "out of the blue" but instead may have an element of truth, which is then embellished (as in the fictional episode recounted at the beginning of this article). Similarly, the

delusional belief may be rooted in aberrant subcultural beliefs. Recalling Golda Meir's famous saying, "Even a paranoid can have enemies," the biographical context of false memories may deserve more thorough elaboration; delusional systems may be based on biographical incidents and observations in a distorted form. It has been shown that even very bizarre false memories such as being a victim of alien abduction or satanic rituals may be traced partly to suggestion [67].

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