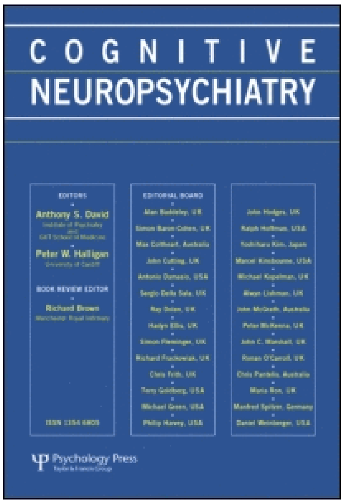

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Delusions and metacognition in patients with schizophrenia

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Delusions and metacognition in patients with schizophrenia

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Introduction. The aim of the present study was to explore the basis of the strong feeling of conviction and the high resistance to change characteristic of delusions and to test whether patients with schizophrenia suffering from delusions have specific metacognitive impairments when compared to both patients without delusions and healthy controls.
Methods. 14 actively delusional patients with schizophrenia, 14 nondelusional patients, and 14 healthy subjects were administered two measures assessing different

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aspects of metacognition: an emotional metacognitive version of the WCST adapted from Koren et al. (2004) and the Beck Cognitive Insight Scale.
Results. Relative to both healthy controls and nondelusional patients, delusional participants were specifically impaired on metacognitive measures of free choice improvement and global monitoring. This was correlated with high self-certainty on the BCIS relative to nondelusional patients.
Conclusions. Our results suggest that metacognitive impairments play an important role in the maintenance of delusional beliefs. It may therefore be important to adapt remediation strategies to the metacognitive profiles of patients.

Keywords: Cognitive insight; Delusional conviction; Delusions; Metacognition; Schizophrenia.

INTRODUCTION

Delusions may occur in a wide array of psychiatric and neurological conditions. In particular, they are regarded, together with hallucinations, as central manifestations of psychotic disorders. Delusions can have a wide variety of contents, ranging from the bizarre (the delusion that one has a nuclear power plant in one's ear) to the relatively mundane (e.g., the unjustified conviction that one's neighbours are conspiring against one, or the equally unjustified conviction that some famous person is secretly in love with one). Delusions can also vary in scope, from the circumscribed and monothematic—where one possesses only a single delusional belief or at most a few such beliefs all related to a single theme, while the rest of the belief system remains quite normal—to the widespread and polythematic.

Diverse in range, origin, and content, delusions share two main characteristics central to their definition as delusions. First, delusions are epistemically irrational. They are beliefs poorly or not at all justified by evidence available to the believer (lack of epistemic warrant) and they are highly resistant to revision even when the delusional person is exposed to compelling evidence or proof of their falsity (resistance to change). Their second main feature is their characteristic cognitive phenomenology: Delusions are typically accompanied by a strong sense of conviction. When asked, believers tend to describe their delusional beliefs as feeling intuitively right, self-evident, or obviously true. Indeed, Garety and Hemsley (1994) found the most characteristic feature of delusional experience to be high subjective conviction, followed by self-evidence (the belief is experienced as self-evident).

The ability to evaluate and revise beliefs seems clearly impaired in delusions, but the nature of the defective processes remains poorly understood. Yet, the association in delusions of belief evaluation and revision deficits with strong feelings of conviction and of self-evidence suggests one avenue of exploration. In research on metacognition, these feelings are known as metacognitive feelings, whereas belief evaluation is one of the functions attributed to metacognitive control. Thus, abnormally high feelings of conviction and belief revision deficits may both be linked to metacognitive impairments. The present study aims at testing this possibility and specifying the nature of this hypothesised metacognitive impairment.

Metacognition refers to what people know about their own cognitive processes. It involves evaluating the quality of one's cognitive processes (*monitoring*) and using these evaluations to regulate information processing and behaviour (*control*) (Nelson, & Narrens, 1990). Koriat and Levy-Sadot (1999) distinguish two forms of monitoring processes underlying metacognitive judgements. Theory-based metacognitive judgements rely on a deliberate use of beliefs concerning the extent of one's knowledge or competence in a task domain (e.g. "I am terrible at remembering names"). Experience-based metacognitive judgements rely on sheer subjective feelings (feelings of knowing, feelings of confidence, feelings of rightness, etc.) that are the products of subpersonal, nonanalytic inferential processes from cues (e.g., fluency) that relate to the quality of the underlying process. For instance, in the tip of the tongue phenomenon, one feels confident that one knows an answer, yet is unable to produce the word, or in problem solving, one may have a strong intuition that an answer is correct, but be unable to provide an explicit justification for its correctness. Theory-based metacognitive judgements are intellectual judgements, where subjects can articulate the reasons for their judgements, whereas experience-based metacognitive judgements have an intuitive quality and a form of immediacy. Subjects have no clear awareness of the basis of their subjective feelings, since the processes that give rise to them are implicit and largely unconscious. Research suggests that people often rely on experience-based rather than theory-based metacognitive judgements (Koriat, 2007; Koriat & Bjork, 2006; Koriat & Levy-Sadot, 1999; Rhodes & Jacoby, 2007; Schwarz & Clore, 1996; Slovic, Finucane, Peters, & MacGregor, 2002).

Much of the work in metacognition is premised on the idea that monitoring affects control, so that the output of monitoring serves to guide the regulation of control processes. Research also suggests that when these metacognitive feelings are strong and positive, their verdict is often accepted with little or no further analysis. Furthermore, metacognitive feelings tend to resist correction: When metacognitive judgements based on biased subjective experience are corrected, the biased subjective experience survives the correction operation (Kahneman, 2003; Nussinson & Koriat, 2008; Sloman, 2002; Thompson, 2009).

Metacognitive impairments may involve defective monitoring, defective control, or both. On the one hand, strong (and misplaced) feelings of conviction are the phenomenological hallmark of delusions, suggesting that experience-based monitoring may be impaired in patients with delusional beliefs. On the other hand, the inability to revise beliefs even when presented with compelling counterevidence also suggests a possible impairment of metacognitive control.

In contrast to clinical measurements of insight that have focused primarily on patients' unawareness of their having a mental disorder and of their need for treatment, the Beck Cognitive Insight Scale (BCIS) was devised to measure patients' capacity for distancing themselves from and reevaluating anomalous beliefs and misinterpretations (Beck, Baruch, Balter, Steer, & Warman, 2004). The BCIS is a 15-item self-report measure composed of two subscales evaluating separate components of cognitive insight: nine Self-Reflectiveness items that assess the patients' capacity and willingness to observe their mental productions and to consider alternative explanations, and six Self-Certainty items that tap certainty about being right and resistance to correction. Several independent groups have demonstrated that the BCIS is reliable, demonstrates convergent and construct validity, and distinguishes patients with psychosis from healthy controls and patients without psychosis (Riggs, Grant, Perivoliotis, & Beck, 2010). The BCIS is thus a useful tool for measuring metacognitive processes in psychotic patients. Yet, because it focuses on patients' attitudes towards their anomalous experiences and their interpretations thereof, it cannot provide direct evidence for or against the presence of metacognitive impairments extending outside the scope of their delusional thinking.

A number of studies suggest the presence of such metacognitive impairments in schizophrenia. Using a probabilistic reasoning task, Huq, Garety, and Hemsley (1988) found that participants with delusions requested less information before making their decision and gave higher subjective judgements of certainty about their decision, relative to control participants (both normal and psychiatric). This "jumping to conclusions" (JTC) bias, as it has come to be known, has been replicated in a series of subsequent studies and appears to be quite robust (Garety & Freeman, 1999, for a review). One of these studies (Dudley, John, Young, & Over, 1997) found the JTC bias to be more pronounced in tasks using emotionally salient material. Danion, Gokalsing, Robert, Massin-Krauss, and Bacon (2001) also found that patients with schizophrenia were impaired in subjectively assessing the correctness of their knowledge in a general knowledge task and in using this assessment to control their response behaviour. Koren and colleagues (Koren, Seidman, Goldsmith, & Harvey, 2006; Koren et al., 2004) also found that poor insight in first-episode schizophrenia patients was more strongly related with deficits at the metacognitive level than with cognitive deficits per se.

However, it is not clear from these studies whether metacognitive deficits are associated with schizophrenia per se or more specifically with delusional thinking. The main aim of the present study was therefore to assess the presence of specific metacognitive impairments in patients with schizophrenia suffering from delusions relative to both patients without delusions and healthy controls. It is also unclear what factors trigger or exacerbate metacognitive dysfunction. One possibility is that emotionally salient material or content may be one such factor. A secondary aim of our study was to test this hypothesis.

SUBJECTS AND METHODS

Participants

Forty-two subjects participated, 28 patients with schizophrenia and 14 healthy controls.

Patients were recruited from the outpatient services of the university hospital Le Vinatier in Lyon-Bron (France). They fulfilled DSM-IV-TR (American Psychiatric Association, 2000) criteria of schizophrenia, with no other psychiatric diagnosis on DSM-IV-TR Axis 1. All patients were receiving antipsychotic medication and were clinically stable at the time of testing.

Control subjects were recruited from the staff of the same hospital and matched with patients for gender, age, and years of education.

IQ was estimated with the fNART, a French adaptation of the NART validated by Mackinnon and Mulligan (2005). The Mini-International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) was also administered to all subjects by a trained interviewer.

For all subjects, exclusion criteria included a history of neurological illness or trauma, alcohol or drug dependence according to DSM-IV criteria, age older than 60 years, illiteracy, and French as a nonnative language; for controls, a further exclusion criterion was any history of mental problems, as evaluated with a clinical examination by a psychiatrist and the MINI; patients with therapeutic modification (medication and/or psychotherapy) in the previous month were also excluded.

Sociodemographic measures showed no difference between groups regarding age, gender, education, and IQ scores (Table 1).

Clinical assessment

In patients with schizophrenia, negative and positive symptoms were evaluated with the SANS (Andreasen & Olsen, 1982) and the SAPS (Andreasen & Olsen, 1982). Patients with a score superior or equal to 3 (referring to moderate severity) on any item in the delusion section of the

TABLE 1
Participant characteristics

	Healthy controls (n = 14)	Delusional patients (n = 14)	Nondelusional patients (n = 14)	p (t-test except gender)		
				C/ND	C/D	ND/D
Age, mean (*SD*)	38.357 (11.920)	35.071 (6.855)	33.500 (9.898)	0.380	0.251	0.629
Gender (M/F)	11/3	10/4	9/5	$p\chi^2 = .705$		
Education, mean (*SD*)	11.357 (2.098)	11.500 (2.739)	10.714 (1.590)	0.878	0.369	0.362
Full-scale IQ (fNART)	104.976 (9.335)	104.446 (8.831)	102.007 (8.362)	0.879	0.384	0.460
Verbal IQ (fNART)	106.017 (11.754)	105.320 (11.105)	102.275 (10.532)	0.873	0.383	0.463
Performance IQ (fNART)	103.604 (5.150)	103.300 (4.866)	101.964 (4.616)	0.874	0.383	0.463

C = healthy controls, ND = nondelusional patients, D = delusional patients.

SAPS were assigned to the delusional group, resulting in 14 patients per group.

In both groups of patients, cognitive insight was assessed with the 15-item self-report Beck Cognitive Insight Scale (BCIS; Beck et al., 2004) The BCIS has two factors, the first labelled Self-Reflectiveness (SR), which assesses how much the individual believes he/she may be wrong at times and a willingness to admit such, and the second labelled Self-Certainty (SC), which assesses how much the individual believes he/she is definitely correct about his/her decisions and experiences. A Composite Index (CI), the measure of the person's overall cognitive insight, is determined by subtracting the individual's Self-Certainty score from his/her Self-Reflectiveness score. Nonpathological scores are high SR and low SC. Previous work suggests that poor cognitive insight, in particular high self-certainty in beliefs and judgements, is associated with delusions in schizophrenia (Engh et al., 2009; Warman, Lysaker, & Martin, 2007).

Scores on SANS, SAPS, and BCIS for both groups of patients are shown in Table 2. As also shown in Table 2, there were no differences between the two groups on antipsychotic medication according to chlorpromazine-equivalent doses.

The study was approved by the local Ethical Committee—CPP Lyon Sud-Est-IV, No. ID RCB (AFSSAPS): 2008-A01599-46. All participants provided written informed consent after receiving detailed explanation of the study, and, for patients, after being assessed for competency to consent to participate in the study by their treating psychiatrists.

TABLE 2
Clinical data for D and ND groups

	ND	*D*	*p (t-test)*
SAPS	16.143 ± 9.639	38.429 ± 15.098	< .001
SANS	42.643 ± 14.189	42.714 ± 12.815	.989
BCIS			
CI	7.286 ± 6.707	4.357 ± 5.719	.225
SR	13.571 ± 4.863	15.214 ± 3.577	.318
SC	6.286 ± 2.894	1.857 ± 3.592	.001
Length of illness (months)	109.74 ± 56.097	146.357 ± 93.405	.218
Medication (mg/day) Chlorpromazine equivalents	433.143 ± 407.687	423.500 ± 315.139	.945

Task

We used a variant of the metacognitive version of the Wisconsin Card Sorting Task (Meta-WCST) developed by Koren et al. (2004). In their metacognitive version, administration of the WCST follows standard administration instructions, but, prior to getting feedback, subjects are also asked (1) to rate their level of confidence in the correctness of that sort on a "0" ("just guessing") to "100" ("completely confident") scale, and (2) to decide whether they want that sort to be "counted" towards their overall performance score on the test ("volunteered" sort) or not. As pointed out by Koren and colleagues, in addition to the conventional WCST measures that reflect the patients' cognitive performance on the task, this procedure also yields measures of "free response performance" that depend on metacognitive skills of monitoring and control.

In order to test whether emotion influences metacognitive performance, we replaced the emotionally neutral material of the standard WCST task with emotionally more salient material. Instead of coloured forms, we used words drawn from a corpus of 604 French words evaluated for emotional valence and salience (Syssau & Font, 2005). From this corpus, we selected 64 words (32 emotionally neutral, 16 positive, 16 negative) according to the following criteria: a maximal length of eight letters, the absence of semantic or cultural ambiguity, a high emotional intensity value for positive and negative words, and a zero or close to zero value for neutral words, no obvious relation to the most common delusional themes according to three judges.

Words drawn from this selection were only present on the cards to be sorted; the target card piles presented the neutral word "word" (Figure 1). The dimensions relevant to the sorting task were kept as close as possible to the dimensions (number, colour, and shape of the forms) used in the standard WCST. They were the number of repetitions of the word on the card, the ink colour, and the types of brackets around the word. The rule changed after six

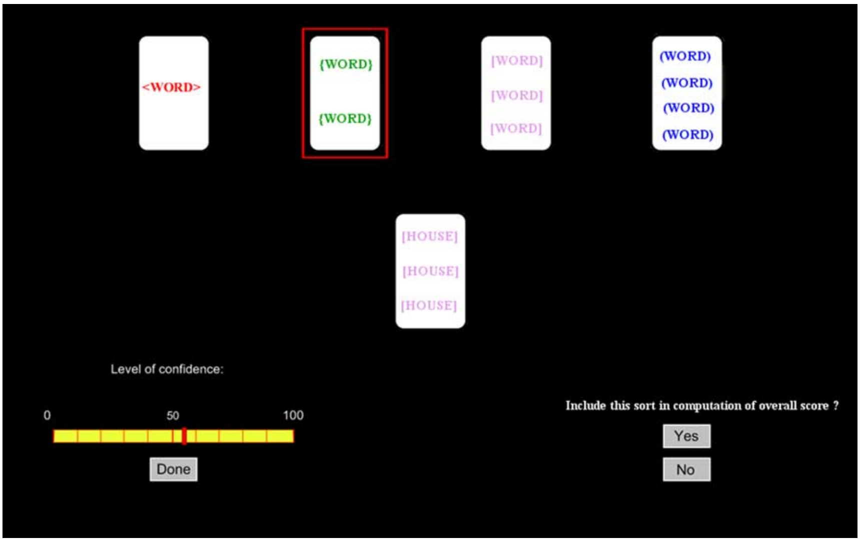

Figure 1. A representative screen from the computerised emotional metacognitive version of the Wisconsin Card Sorting Test. [To view this figure in colour, please visit the online version of this Journal.]

successive correct sorts. As in Koren et al.'s metacognitive version, subjects were asked to rate their level of confidence and to decide whether they wanted their sort to be counted towards their overall score on the test, before receiving feedback.

Each "volunteered" sort increased their point score by 1 point if correct, and decreased it by 1 point if wrong. The point score remained unchanged when the sort was not volunteered. The key metacognitive variables that were derived are those used by Koren et al. (2004):

1. *Accuracy score*, defined as the proportion of correct responses out of those volunteered.
2. *Free choice improvement*, defined as the difference between the accuracy score and the quantity score (the standard performance score, defined as the proportion of correct responses out of all responses).
3. *Global monitoring*, i.e., the veridicality of one's overall sense of one's level of knowledge, defined as the difference between the total number of correct sorts and the total number of sorts asked to be counted.
4. *Monitoring resolution*, i.e., the extent to which the confidence judgements distinguished between correct and incorrect sorts.
5. *Control sensitivity*, i.e., the degree to which the control process was dependent on the monitoring process, indexed by the gamma correlation calculated across all sorts between the level of confidence in a sort

TABLE 3
Formulas for metacognitive measures based on Koren et al. (2004)

Measure	*Formula*
Quantity score	Ncorrect/Ntotal
Accuracy score	Vcorrect/Vtotal
Free choice improvement	Accuracy score – Quantity score
Global monitoring	Ncorrect – Vtotal
Monitoring resolution	γRconfidence Rcorrect
Control sensitivity	γRconfidence Rventure
Point score	Vcorrect – Vincorrect

Ntotal = total number of items that were presented; Ncorrect = total number of correct responses; Vtotal = total number of volunteered responses; Vcorrect = total number of correct responses out of those volunteered; Vincorrect = total number of incorrect responses out of those volunteered; Rconfidence = confidence in the correctness of a given response; Rcorrect = actual correctness of a given response; Rventure = actual decision to venture a given response; γ = within-participant Kruskal-Goodman gamma correlation.

(corresponding to the monitoring process) and the decision to venture the sort (corresponding to the control process).

6. *Point score*, the number of points earned, computed as the difference the number of correct and incorrect volunteered sorts.

Free choice improvement and point score measure both monitoring and control skills; higher scores indicate greater skills. Global monitoring and monitoring resolution are measures of monitoring skills, measuring monitoring accuracy and monitoring resolution, respectively. In both cases, higher scores indicate better monitoring skills. The mathematical formulas used to compute these scores are described in Table 3. Given the additional tasks, only 64 cards were administered.

Statistical analyses

Correlations were computed using *Spearman's* Rank Correlation *Test*. For the variables with a normal distribution such as age, FNART, and global monitoring, two-group comparison was done using a Student's *t*-test, and ANOVA was used for three-group comparison.

For the nonparametric variables such as most WCST scores, the three-group comparison was done using the Kruskal-Wallis test followed by a 2×2 Mann-Whitney nonparametric test.

To test the effects of the emotional valence of words on the cognitive and metacognitive measures, average reaction time for subjects in each group were computed for the three types of words presented (neutral, positive, and negative). Group comparisons were done using paired *t*-tests.

RESULTS

BCIS scores are presented in Table 2. There was a significant difference ($p < .001$) between delusional (D) and nondelusional (ND) subjects for the Self-Certainty component, higher in the delusional group, but not for the Self-Reflectiveness component.

No significant differences were found on the key conventional scores of the WCST in the three groups (Table 4).

We found significant differences between groups on three metacognitive measures. Global monitoring score (i.e., the veridicality of one's overall sense of one's level of knowledge) was significantly worse for the D group compared to the healthy controls (C), $t = 2.174$, $df = 26$, $p = .039$, and a trend was observed between the D and the ND groups, $t = 144$, $df = 26$, $p = .093$ (Figure 2). Free choice improvement (measuring improvement of performance when one can choose whether or not to volunteer an answer) was lower for the D group compared to the ND group, $t = 2.176$, $df = 26$, $p = .0388$, and a trend was observed between the D and the C group, $t = 1.861$, $df = 26$, $p = .074$ (Figure 3).

A regression analysis also showed a very high correlation, $r = .900$, $p < .0001$, between the point score, one of the metacognitive measures, and the number of rules achieved, one of the cognitive measures (Figure 4). We

TABLE 4
Measures of the WSCT and IQ Scores

	D	*ND*	*C*
Number of correct sorts	43.000	42.214	46.071
Number of rules achieved	4.857	4.500	5.786
Perseverations (%)	47.935	44.178	35.584
Set loss (%)	5.184	6.878	4.737
Point score	22.714	21.929	28.000
Accuracy score	68.948	71.886	75.818
Free choice improvement	0.018	0.060	0.039
Global monitoring	−16.714	−8.714	−8.214
Monitoring resolution	0.324	0.313	0.437
Control sensitivity	0.669	0.615	0.670
FNART_IQ	102.007	104.446	104.976
FNART_V	102.275	105.320	106.017
FNART_P	101.964	103.300	103.604

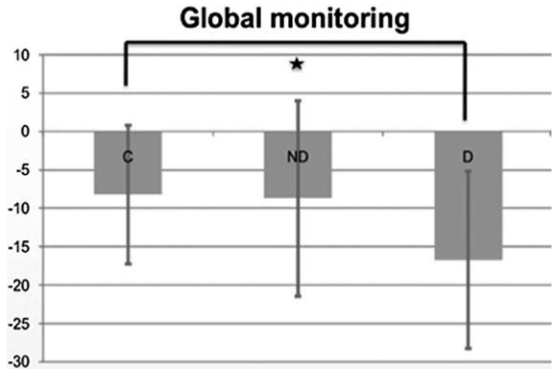

Figure 2. Global monitoring measures for the control (C), delusional (D), and nondelusional (ND) groups.

performed an ANCOVA analysis with the "number of rules achieved" measure as a covariate and found a significant difference between groups on the metacognitive measure "point score", C and D, ($p = .0202$) and C and ND ($p = .0414$).

Patients in the delusional group also exhibited a specific pattern of behaviour in the second metacognitive step of the meta-WCST. Eleven out of the 14 subjects in this group systematically volunteered their sort, independently of their confidence ratings, a behaviour we called saturation. In contrast, only four of the nondelusional patients and a single control exhibited that behaviour. The difference we observed between the delusional group and the nondelusional group was significant (Chi-square test, $p = .023$).

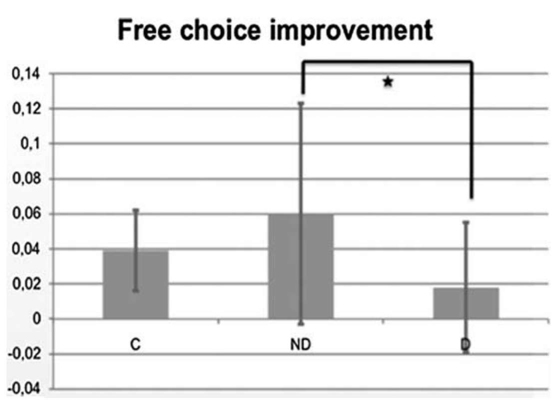

Figure 3. Free choice improvement measures for the control (C), delusional (D), and nondelusional (ND) groups.

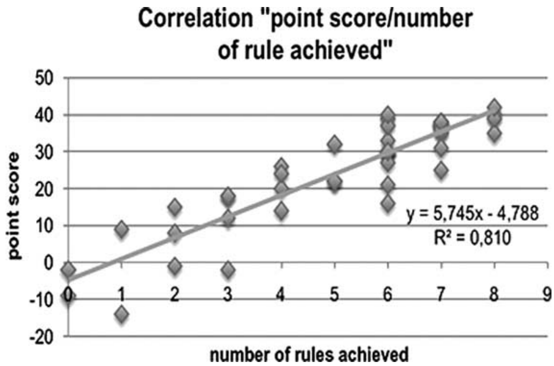

Figure 4. Correlation between point score and number of categories achieved for the participants in the delusional and the nondelusional groups.

Finally, Table 5 presents data on the relationship between cognitive, metacognitive, and IQ measures on the one hand, and BCIS components on the other hand. The conventional WCST scores had zero correlations with the BCIS items. Among the metacognitive variables, Free Choice Improvement was negatively correlated with Self-Certainty and positively correlated with the Composite Index, whereas Global Monitoring was negatively correlated with Self-Certainty and had a positive correlation approaching significance with the Composite Index.

TABLE 5
Spearman correlations between cognitive/metacognitive/IQ measures and BCIS components

Group = *D* + *ND*		*SR*	*SC*	*CI*
Cognitive measures	Number of correct sorts	−.014	−.117	.127
	Number of rules achieved	.027	−.078	.129
	Perseverations	−.112	.200	−.235
	Set loss	.009	.102	−.083
Metacognitive measures	Quantity score	-.036	−.136	.122
	Accuracy score	.028	−.289	.256
	Free choice improvement	.225	−.336**	.432**
	Global monitoring	.029	−.409**	.324*
	Monitoring resolution	−.075	−.191	.108
	Control sensitivity	.058	−.144	.109
IQ scores	FNART_IQ	−.184	−.342*	.131
	FNART_V	−.165	−.340*	.137
	FNART_P	−.173	−.348*	.140

*p <.1, **p <.05.

We found no difference between point scores in the first half-period of the WCST assessment and the second period, suggesting the absence of learning or reinforcement effects that could have biased our results.

We found no effects of the emotional valence or intensity of words on either the cognitive or metacognitive measures. For all groups, paired *t*-test showed no difference in performance (reaction time) due to the emotional valence of the presented word.

DISCUSSION

Our results regarding high Self-Certainty on the BCIS in delusional patients are consistent with the findings of prior studies that have reported an association between active delusions and increased Self-Certainty for chronic patients with psychosis (Engh et al., 2009) and for healthy people who report delusion proneness (Warman & Martin, 2006). We found no difference between delusional and nondelusional patients on Self-Reflectiveness. Previous evidence regarding Self-Reflectiveness has been equivocal, with some groups reporting decreased Self-Reflectiveness in delusional compared to nondelusional patients for first-episode psychosis (Buchy, Malla, Joober, & Lepage, 2009) and for chronic psychosis (Engh et al., 2009). However, in the study conducted by Warman et al. (2007), patients with delusions reported as much Self-Reflectiveness as normal controls, whereas patients without delusions reported low Self-Reflectiveness relative to healthy controls and individuals with delusions. As suggested by Buchy et al. (2009), it may be that the conjunction of high Self-Certainty and low Self-Reflectiveness favours the emergence of delusions at early stages of the psychotic illness, while high Self-Certainty is sufficient for their maintenance. Improvement of Self-Reflectiveness at later stages of the illness might be explained by the fact that these patients systematically receive negative feedback regarding the falsity of their beliefs. It may appear paradoxical that Self-Certainty (overconfidence) remains high while Self-Reflectiveness improves. However, as pointed out by Warman et al. (2007), this apparent contradiction may be accounted for by the nature of the items on the BCIS itself). While all of the items of the Self-Certainty subscale can be understood as relating to assessment of current judgement, four of the nine9 items on the Self-Reflectiveness subscale can be understood as reflecting back on previous experiences. Perhaps receiving systematic feedback helps individuals with active delusions admit they have been wrong in the past, thus accounting for improvements on Self-Reflectiveness. Yet, in the same individuals overconfidence in their current judgements can be kept up by active delusional processes due to metacognitive impairments.

Self-Reflectiveness was not statistically different between people with and without delusions, but Self-Reflectiveness was a bit higher in the delusional group. Two previous studies (Colis, Steer, & Beck, 2008; Warman et al., 2007) found that higher SR was associated with greater depression, We cannot completely rule out the possibility that patients in our delusional sample might have had elevated depression, even though mood disorders were explored using the MINI and none of the patients presented with current major depressive disorder.

In contrast to many prior studies, we found no difference between patients with schizophrenia and healthy controls on conventional measures of the WCST. However, the effect found by these studies is often modest and the literature consistently shows that there is a small subgroup of patients whose cognitive performance appears to be unimpaired on this task (Goldstein, Allen, & Seaton, 1998; Kremen, Seidman, Faraone, Toomey, & Tsuang, 2000, 2004; Palmer et al., 1997; Silverstein, McDonald, & Meltzer, 1988; Silverstein & Zerwic, 1985). There is also strong evidence that cognitive remediation improves executive functioning (Demily & Franck, 2008). The unimpaired performance found in our two groups of patients may be explained by the fact that most of them had previously taken part in cognitive remediation programs. It may also be that the average IQ and education level of our patients was somewhat higher than normally found in this population.

Finally, in order to increase possibilities of variation in confidence levels in the metacognitive part of the task, we chose to change the rule after six consecutive correct sorts instead of 10 as is more standard. As a result, sorting rules perhaps did not become as entrenched, which might contribute to explaining why we didn't find more perseverative errors in the two groups of patients.

The absence of differences between our three groups on cognitive measures makes the differences on the metacognitive measures all the more salient. We found the metacognitive performance of both groups of patients with schizophrenia, as measured by the metacognitive variable point score to be significantly lower than that of controls. we also found that free choice improvement was lower for the delusional group compared to the nondelusional group. Point score performance and free choice improvement both depend on metacognitive skills of monitoring and control. Thus, although these results indicate that metacognitive processes are impaired in patients relative to healthy controls and more so in delusional than in nondelusional patients, they do not tell us whether it is metacognitive monitoring that is defective, metacognitive control, or both. Results on other metacognitive variables allow us to be more specific. The global monitoring score, reflecting the veridicality of one's overall sense of one's level of knowledge, was significantly worse for the D group compared to the healthy controls and a trend was observed between the D and the ND groups. These results point to a more severe disruption of cognitive monitoring in delusional than in nondelusional patients. Finally, the phenomenon we called saturation, the systematic volunteering of sorts, was characteristic of the delusional group. Saturation suggests a specific impairment related to the control aspect of metacognition in delusional compared to nondelusional patients.

Altogether, our results support the idea that although most patients with schizophrenia present with metacognitive impairments, patients with delusions are more seriously impaired, in particular on the control dimension of metacognition.

The correlational analysis we conducted found correlations between IQ and BCIS measures but no correlations between WCST measures of executive functioning and BCIS measures. The lack of a correlation between WCST performance and the BCIS is inconsistent with the results of other studies in which cognitive insight was associated with neurocognitive performance (Buchy et al., 2010; Lepage et al., 2008). However, these studies only included first-episode patients; the patients in our study had been ill for a number of years (on average about 9 years for patients in the nondelusional group and 12 years for patients in the delusional group). Also, as already noted, the patients in our study had relatively higher intellectual functioning than normally found in this population, which may contribute to explaining why we found no correlation. Taken together, the results of these studies suggest that although poor cognitive functioning may contribute to poor cognitive insight, it cannot fully account for it.

We found negative correlations between two metacognitive measures, free choice improvement and global monitoring, and the Self-Certainty component of the BCIS. Better metacognition was associated with better cognitive insight (at least in terms of lower Self-Certainty). This should come as no surprise given that metacognition and cognitive insight are partly overlapping constructs. Our results further show, however, that metacognitive impairments in patients are not confined to their evaluations of their anomalous experiences and delusional beliefs, but are present as well in cognitive tasks that bear no direct relation to their delusional thinking. Since high Self-Certainly also differentiated delusional from nondelusional patients, these results appear to further support the idea of a specific relation between metacognitive impairments and delusions. In particular, they suggest that metacognitive impairments may be responsible for the high subjective conviction and self-evidence characteristic of delusional experience and play an important role in the maintenance of delusional beliefs.

We found no effects of the emotional valence or intensity of words on either the cognitive or metacognitive measures. One reason for this might be that the lexical induction method we used was not best suited to induce emotions in a task that was already demanding in terms of cognitive, and in particular, attentional resources. It might therefore be worthwhile to try other and perhaps more effective emotional induction techniques, such as the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008).

The study's main limitations are its small sample size and restriction to a single pathology, schizophrenia. Thus, to corroborate the idea that metacognitive impairments are central factors in delusions, contributing to an explanation of their defining epistemic and phenomenological properties, replication and further validation in larger samples and in other psychiatric and neurological pathologies where delusions are present are necessary. It should also be noted that patients in our study appear to have relatively high intellectual functioning. In these patients metacognitive abilities appear to be relatively independent of cognitive skills, the latter being intact while the former are impaired. Yet, it is quite possible that, in patients with lower cognitive skills, poor cognitive functioning may contribute to poor metacognitive functioning.

Confirmation of the idea that metacognitive impairments are central to delusions would open new therapeutic perspectives. Therapeutic strategies focusing on the remediation of metacognitive deficits might help reduce delusional conviction and thus facilitate the revision of delusional beliefs. Insofar as metacognitive abilities can be relatively independent of cognitive skills, metacognitive remediation strategies might thus usefully complement existing cognitive remediation treatments. Finally, different subgroups of patients with schizophrenia and patients at different stages of their illness present different patterns of cognitive and metacognitive impairments and may not benefit in the same way from the same therapeutic interventions. It is therefore important to adapt remediation strategies to the cognitive and metacognitive profiles of patients.

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