



## The neuropsychological basis of insight in first-episode schizophrenia: a pilot metacognitive study

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### Abstract

The aim of the present study was to explore the neuropsychological basis of insight in first-episode schizophrenia, by evaluating its differential and joint links with cognitive vs. metacognitive performance. Thirty first-episode patients were assessed with the Scale of Unawareness of Mental Disorder (SUMD) and a metacognitive version of the Wisconsin Card Sorting Test (WCST). In addition to the standard administration of the WCST, subjects were also asked to rate their level of confidence in the correctness of each sort (prior to getting the feedback), and to choose whether they wanted each sort to be “counted” toward their overall performance score on the test. Each “volunteered” sort received a bonus of 10 cents if correct, but an equal penalty if wrong. Insight into illness had higher correlations with free-choice metacognitive indices derived from confidence ratings and volunteered sorts than with the conventional scores from the WCST. Moreover, prediction of poor insight was significantly improved when adding the new, free-choice metacognitive measures to the conventional WCST measures, but not the other way around. These preliminary results suggest that metacognition is an important mediator between basic cognitive deficits and poor insight, and might be even more relevant to poor insight than cognitive deficits per se.

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### 1. Introduction

Current research suggests that impaired insight (i.e., poor awareness of illness) may have high descriptive and prognostic validity (Amador et al., 1994). While

poor insight is clearly associated with impaired cognitive functioning, relatively little is known about the underlying neuropsychological functions on which it is dependent. Recent studies have suggested that impaired awareness in schizophrenia may be associated with executive dysfunction related to abnormal brain networks involving prefrontal or parietal lobes (David, 1999). However, other studies failed to replicate even the most consistent finding regarding an association between poor insight and executive tasks such as the

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Wisconsin Card Sorting Test (WCST) performance (Drake and Lewis, 2003). Overall, correlations in the numerous studies that examined the relationship between poor insight and neuropsychological impairments were wide ranging and fit no particular explanatory pattern (David and Kemp, 1997; McGlynn and Schacter, 1997). Moreover, because most of these studies were not designed to test clear hypotheses about the nature of this relationship, almost nothing is known about the mechanisms that may mediate between basic neurocognitive deficits and poor insight (Drake and Lewis, 2003).

Our perspective is that the hypothesis suggesting a relationship between performance on executive tests of neuropsychological function and impaired insight is overly simplistic. The current study was motivated by the view that the major limitation of previous studies stems from their failure to address deficits at a *metacognitive* level of functioning, which, reflecting one's monitoring and the ensuing regulation of one's performance, may mediate between basic-level cognitive deficits and the observed clinical phenomena of poor insight. According to our analysis, metacognitive deficits have been overlooked in these studies, in part, because of their overreliance on standardized forced responding tasks (Nelson and Narens, 1996), that do not allow patients the freedom to decide whether to volunteer or withhold their answers. Consequently, they fail to take into account the role of subject *control* over their performance that is common in real-life phenomena like insight into illness. Moreover, in so doing, they focused exclusively on the *quantity* aspect of performance; in other words, the amount of information remembered or solved, as measured by the percentage of correct answers out of the total items *presented* at the expense of the *accuracy* aspect of it (i.e., the extent to which this information can be trusted, as assessed by the percentage of correct answers out of those *freely volunteered*) (Koriat and Goldsmith, 1994). Yet, this latter dimension of performance (i.e., accuracy) appears more relevant to awareness than the actual ability to solve certain tasks.

To address these problems, we adapted methodologies used in experimental psychology to study *metacognition*, in particular the two-phase paradigm developed by Koriat and Goldsmith (1996). Metacognition is a term used to distinguish between a person's

cognitive abilities and the person's awareness or knowledge regarding those abilities. Metacognitive abilities can vary independently of cognitive skills per se, and have important consequences over and above those skills. Two important aspects of metacognitive functioning are *monitoring* (the mechanism that is used to subjectively assess the correctness of potential responses) and *control* (the mechanism that determines whether or not to volunteer the best available candidate answer) (Klatzky and Erdelyi, 1985).

The aim of the present study was to further explore the neuropsychological basis of insight in first-episode schizophrenia, by evaluating its differential and joint links with cognitive vs. metacognitive performance. The focus on first-episode schizophrenia was guided by the relatively sparse data that exists in the literature on the nature of insight-related neuropsychological deficits early in the course of the illness. We hypothesized that impaired insight would be less strongly related to conventional measures of how much the person knows ("performance quantity") than to measures of how much this knowledge can be trusted ("performance accuracy"), which depend on metacognitive processes of self-monitoring and self-directed action. To assess this hypothesis, a paradigm developed to study monitoring and control processes in memory performance (Koriat and Goldsmith, 1996) was adapted for use with the WCST. The WCST was selected because the literature, including works from our own group (Koren et al., 1998; Seidman et al., 2002), suggests that abstraction is among the more salient and persistent cognitive deficits in schizophrenia, and because, as already mentioned, performance on the test, particularly the perseverative error score, showed the most replicated association with poor insight in schizophrenia (Drake and Lewis, 2003).

## 2. Subjects and methods

### 2.1. Participants

Participants in the study were 30 patients (19 males, 11 females; age  $24.5 \pm 4.5$  years; formal education  $12.4 \pm 1.8$  years) hospitalized for first

episode of schizophrenia or schizophreniform disorder at Tirat Ha'carmel Mental Health Center (Israel). Patients were diagnosed according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV; American Psychiatric Association, 1994). Exclusion criteria were (a) neurologic disorders, (b) substance abuse in the past 6 months or lifetime history of substance dependence, (c) history of head injury with loss of consciousness greater than 5 min, (d) mental retardation, and (e) medical illnesses associated with neurocognitive impairment. Twelve patients were receiving Haldol (Mean = 12.8 mg/day), 14 Olanzapine (Mean = 12.9 mg/day), three Risperidol (Mean = 4.0 mg/day), and one Clozapine (Mean = 125 mg/day).

The study was approved by the Institutional Review Board. All patients provided written informed consent after receiving detailed explanation of the study, and after being assessed for competency to consent to participate in the study by their treating clinicians.

## 2.2. Measures and procedures

All patients were assessed within the first 2 weeks of admission as soon as they were deemed by their treating clinicians stable enough to participate and cooperate with neuropsychological testing. Initial level of minimal stabilization was chosen as a criterion for approaching our patients in order to minimize state-dependent effects and maximize testing validity.

### 2.2.1. Clinical assessment

Patients diagnoses were derived from structured interviewing using the Structured Clinical Interview for DSM-IV (SCID-IV, First et al., 1996), a systematic review of the medical record and clinician information. A senior psychiatrist, expert in diagnosis (MP), carried out the SCID interview and reviewed all available information to determine the diagnoses. The diagnostician was blind to the insight and neuropsychological test results.

Exclusion criteria were assessed based on systematic review of medical records and a special neuropsychological status interview that was specifically developed by Seidman (Faraone et al., 1995) for

screening purposes of factors (e.g., history of neurological problems, brain injuries, substance dependence, ECT treatment, sensory motor problems, etc.) that might affect cognitive performance in potential candidates for neuropsychological studies.

Finally, to assess degree of overt psychosis agitation and level of cooperation while performing the cognitive tasks (i.e., during the testing session), the examiner rated each subject at the end of each session. Possible scores ranged from 0 (essentially normal effort) to 6 (very poor effort or high degree of psychosis). All patients were rated in the 0–2 range (that was designed a priori to quantify normal to mildly abnormal behaviors) on either of these scales.

### 2.2.2. Insight assessment

Insight into illness was assessed with the Scale to Assess Unawareness of Mental Disorder (SUMD, Amador and Strauss, 1990). This is a semistructured interview that assesses several dimensions of insight into illness. It is comprised of three general items that assess (current and retrospective) (a) global awareness of mental disorder, (b) awareness of the effect of medications, and (c) awareness of the social consequences of having a mental illness; and two subscales that evaluate (current and retrospective) awareness and attribution of 17 specific signs and symptoms of severe mental disorder (e.g., awareness of thought disorder, delusions, anhedonia, etc.). The scores on all scales range from “1” (full awareness) to “5” (unawareness). For purposes of the current study, we used only the first three general items and the subscale assessing awareness of current symptoms. Current symptom awareness ratings were made for symptoms judged as present by the patient's treating clinician. Presence of symptoms was determined by treating clinicians using the 17-item Symptom Checklist that comes with the SUMD. The average number of symptoms judged as present in the current sample was  $10.1 \pm 4.7$ , suggesting that despite being stabilized our patients were still rather symptomatic at the time of the study. Trained research assistants (graduate level clinical psychology students) administered the SUMD. Intraclass correlation coefficients for the raters were 0.85 for global awareness of mental disorder, and 0.81 for unawareness of current individual symptoms.

### 2.2.3. Neuropsychological and metacognitive assessment

Administration of the WCST followed the standard administration instructions. However, prior to getting the feedback, we also asked our subjects (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 do or do not want that sort to be “counted” toward their overall performance score on the test. Each “volunteered” sort received a bonus of 10 cents if correct, but an equal penalty if wrong. Thus, in addition to the standard “forced response” measures that reflect the patient’s ability to perform the sorting task, our procedure also yielded measures of “free response” performance that depended on the patient’s metacognitive knowledge. The key metacognitive variables that were derived were (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; (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 judgments distinguished between correct and incorrect sorts, evaluated with a Kruskal–Goodman gamma correlation calculated across all sorts between the level of confidence and the correctness of the sort; (5) *Control sensitivity*, i.e., the degree to which the control process was dependent on the monitoring process, assessed with a gamma correlation calculated across all sorts between the level of confidence and the decision to venture the sort; and (6) *Monetary gains*, the amount of monetary rewards gained, calculated as the difference within all ventured sorts between those that were correct and those that were incorrect. Given the additional tasks, only the first 64 cards were administered.

Prior to administration of the metacognitive version of the WCST, subjects’ understanding of the concept of level of confidence was assessed with a questionnaire specifically designed for this study. The questionnaire was comprised of five brief vignettes describing a person characterising her level of confidence with respect to a certain answer she

gave (e.g., “Mary was asked about the name of her mother. After answering the question, she was asked how sure she was this was her mom’s name. She said she was absolutely sure this was her name”). The patient was then asked to mark on the same 0–100% scale used in the study the number that best depicts the level of confidence of that hypothetical subject. Subjects took the WCST only after they assigned an appropriate number for each the five vignettes.

### 2.2.4. Assessment of IQ

The WAIS-R Similarities and Block Design subtests of the WAIS-R were administered as an estimate of IQ. The Similarities subtest was selected because the Hebrew version of the WAIS-R does not include a standardized translation of Vocabulary, which is the verbal subtest commonly used for this purpose (Brooker and Cyr, 1986; Silverstein, 1982). Trained research assistants (graduate level clinical psychology students) administered the WCST and the IQ tests (under the supervision of DK). To ensure blindness, the neuropsychological and cognitive tests were performed by different research assistants than those who did the interview of insight.

### 2.3. Statistical analyses

Initially, to establish the strength and directionality of associations between poor insight and the cognitive versus metacognitive measures, a set of bivariate Spearman rank order correlation were calculated. The Spearman rank-ordered methodology was used because many of the SUMD and WCST variables did not meet the normality assumption. Next, to evaluate the unique contribution of cognitive vs. metacognitive measures to the prediction of poor insight, we conducted a sequential series of linear regression model-fitting analyses. For each of the two general measures of insight (i.e., mean score on the first three general items of the SUMD and mean score of awareness of individual symptoms), two separate regression models were initially created, each containing only those variables in the respective predictor domain (cognitive and metacognitive). A subsequent, final regression model was created for each of the two insight measures in which the predictors from both domains were included.

### 3. Results

Mean ratings on the SUMD general scales were  $2.35 \pm 1.52$  for awareness of mental disorder,  $2.12 \pm 1.73$  for awareness of medications effect, and  $2.15 \pm 1.43$  for awareness of social consequences. These ratings, which reflect moderately impaired level of insight, are generally similar to those reported in other first-episode samples (Mohamed et al., 1999). Similarly, the average level of WCST (64 cards) performance of participants in this study (number of categories completed =  $1.57 \pm 1.50$ , percentage of perseverative responses =  $18.57 \pm 10.31$ ) was comparable to that of similar samples in the literature, suggesting that the additional metacognitive tasks did not substantially affect WCST performance.

Table 1 presents data on the relationships between the several scores of the SUMD and key conventional scores of the WCST on one hand (performance

quantity), and with the metacognitive measures on the other (performance accuracy). The conventional WCST scores had zero to low correlations with the various SUMD items that assess insight into current illness, with none of them reaching significance. Moreover, the three correlations that did approach significance were in the opposite direction to what has been hypothesized. That is, better performance on these measures was associated with poorer insight (recall that lower scores on the SUMD mean better insight). In contrast, 14 of the 20 correlations among the new metacognitive measures and the same SUMD measures were in the moderate to large range ( $0.30 < r < 0.67$ ), with nine of them reaching significance and another three approaching significance. All but one of these correlations (the near-significant correlation between monetary gains and awareness of medication effect) were in the hypothesized direction.

Table 1

Spearman correlations of awareness of illness with conventional and metacognitive WCST scores in 30 patients with first-episode schizophrenia

	Awareness of mental disorder	Awareness of medication effect	Awareness of social consequences	Overall awareness	Awareness of current symptoms
<i>Performance quantity: conventional WCST scores</i>					
Quantity score <sup>a</sup>	0.12	0.35 <sup>§,b</sup>	0.15	0.18	-0.23
Number of categories	0.11	0.36 <sup>§,b</sup>	0.15	0.22	-0.09
Trials to first category	0.09	-0.33 <sup>§,b</sup>	-0.24	-0.18	0.19
Perseverative responses (%)	-0.08	-0.21	-0.18	-0.15	0.11
Perseverative errors (%)	-0.12	-0.25	-0.20	-0.19	0.12
<i>Performance accuracy: new free-choice metacognitive measures</i>					
Accuracy score <sup>c</sup>	0.06	0.30	0.05	0.13	-0.27
Free choice improvement <sup>d</sup>	-0.41*	-0.44*	-0.40*	-0.44*	-0.14
Global monitoring <sup>e</sup>	-0.14	-0.19	-0.46*	-0.31	-0.08
Monitoring resolution <sup>f</sup>	-0.06	0.03	-0.17	-0.06	-0.41*
Control sensitivity <sup>g</sup>	-0.38*	-0.67**	-0.37 <sup>§</sup>	-0.52**	-0.33 <sup>§</sup>
Monetary gains	0.16	0.35 <sup>§,b</sup>	0.03	0.17	-0.30
<i>IQ estimates</i>					
WAIS-R: Similarities	0.14	0.09	-0.10	-0.01	-0.51*
WAIS-R: Block Design	0.28	0.36 <sup>§,b</sup>	0.14	0.27	0.06

<sup>a</sup> Percent of correct sorts out of total number of trials.

<sup>b</sup> Correlations' sign is in the opposite direction of what has been hypothesized.

<sup>c</sup> Percent of correct sorts out of total number of "volunteered" trials.

<sup>d</sup> The difference between the Accuracy and the Quantity scores.

<sup>e</sup> The difference between the total number of correct sorts and the total number of sorts asked to be counted.

<sup>f</sup> Kruskal–Goodman gamma correlation between the level of confidence in the correctness of each sort and its actual correctness.

<sup>g</sup> Kruskal–Goodman gamma correlation between the level of confidence in the correctness of each sort and the decision to "venture" it.

\*  $p < 0.05$ .

\*\*  $p < 0.001$ .

§  $p < 0.10$ .

To control for a potential confounding effect of IQ, we repeated these correlations, partializing the WAIS-R Block Design and Similarities scores. The partial correlations of insight with the cognitive and metacognitive variables, when IQ is held fixed, did not differ substantially from their simple correlations. Most notably, there were no sign reversals. Six of the partial correlations between insight and the new metacognitive variables remained significant, and another three marginally significant. Four of the partial correlations between poor insight and the conventional cognitive measures did reach significance when controlling for IQ. However, the direction of these correlations was in sharp contrast to the study's hypothesis.

Similarly, to control for a potential confounding effect of medications, we recalculated the correlations in Table 1, partializing out medications dosage, expressed in defined daily dose (DDD<sup>1</sup>, World Health Organization Collaborating Center for Drug Statistics, 2000). Overall, the pattern and significance of the partial correlations remained unchanged, suggesting that medications do not play an important moderating role between insight and deficits at either the cognitive or metacognitive levels.

Next, to evaluate the relative importance of cognitive vs. metacognitive measures to the prediction of poor insight, we used a sequential set of multiple regression analyses. Table 2 presents the amount of variance in insight accounted for by each set of predictors both *separately* (i.e., independent of the other set of predictors) and *uniquely* (i.e., over and above the variance explained by the other set). As can be seen, the model containing the five conventional WCST scores (quantity, number of categories completed, percentage of perseverative responses, and percentage of perseverative errors) accounted for a rather small proportion of variance in poor insight (10% in general insight, and 19% in awareness of current symptoms). In contrast, the model containing the new metacognitive variables (accuracy, free-choice gain, global monitoring, monitoring resolution, control sensitivity, and monetary gains) as predictors

Table 2

R-squares and uniqueness indices obtained in sequential multiple regression analyses predicting insight

	Overall awareness		Awareness of current symptoms	
	R <sup>2</sup>	Uniqueness index <sup>a</sup>	R <sup>2</sup>	Uniqueness index <sup>a</sup>
Model 1: conventional WCST predictors alone (quantity score, number of categories, perseverative responses, perseverative errors).	0.10	0.12	0.19	0.19
Model 2: metacognitive predictors alone (improvement score, global monitoring, monitoring resolution, control sensitivity, monetary gains).	0.56**	0.54**	0.36	0.33
Model 3: All predictors from both domains.	0.66*		0.52	

<sup>a</sup> Uniqueness index indicates the percentage of variance accounted for by that set of predictors beyond the variance accounted by the other set.

\* $p < 0.05$ .

\*\* $p < 0.001$ .

accounted for moderate (36% in awareness of current symptoms) to high (56% in general insight) portions of the variance in poor insight. When predictors from both domains were entered in a final model, the amount of accounted variance reached 66% in general insight and 52% in awareness of current symptoms.

The findings regarding the uniqueness indices generally matched those for the R-squares. The conventional WCST scores accounted for only small and nonsignificant proportion of the unique variance in poor insight (12% in general insight and 19% in awareness of symptoms). In contrast, the new metacognitive measures accounted for larger parts of the unique variance in poor insight, with their uniqueness index for general insight even reaching significance. Interestingly, the independent and unique variances in poor insight accounted for by each set of variables were very similar, suggesting a minimal overlap between the two sets of predictors.

Finally, in order to find the most economic overall model, we conducted a stepwise regression with all predictors from both sets. For general insight, the most

<sup>1</sup> The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. This is a technical unit of measurement and does not necessarily reflect the actual amount or dose used.

economic model included free-choice improvement (standardized beta =  $-0.52$ ,  $p < 0.005$ ), control sensitivity (standardized beta =  $-0.44$ ,  $p < 0.01$ ), and global monitoring (standardized beta =  $-0.30$ ,  $p < 0.10$ ), that together accounted for 51% of the variance. For awareness of current symptoms, the most economic model included monitoring resolution (standardized beta =  $-0.30$ , n.s.) and monetary gains (standardized beta =  $-0.32$ , n.s.), that together account for 26% of the variance.

#### 4. Discussion

Preliminary findings from this pilot study suggest that poor insight is more strongly related to deficits at the metacognitive level than to cognitive deficits per se. In addition, they propose that prediction of poor insight can be dramatically improved by adding the new metacognitive measures to the conventional WCST measures. Finally, and most strikingly they suggest that addition of the new metacognitive measures not only does not reduce the predictive power of the conventional cognitive measures, but may actually even improve it. Taken together, the current findings suggest that free-choice performance accuracy, which depends on metacognitive skills of monitoring and control, is an important mediator between basic level cognitive skills and the clinical phenomena of poor insight. In fact, they also suggest that it may be at least equally, if not even more, relevant for poor insight than forced response performance quantity, which depends on cognitive functioning per se. Needless to say, however, due to the pilot nature of our study, this possibility should be considered tentative.

Our results suggest that the association between metacognition and poor insight can not be fully accounted for by IQ. This conclusion, however, should be made with caution because estimation of IQ in this study was done with Similarities which is not a good proxy for Vocabulary and is also known to be more influenced by schizophrenia than Vocabulary. On the other hand, it should be noted that, unlike Block Design, Similarities did have a highly significant correlation with insight (which was also in the expected direction). Thus, its use as IQ estimate in this study has more likely worked against rather than in

favor of our hypothesized IQ-free link between metacognition and poor insight.

It should be emphasized that the present findings are not trivial in the sense of reflecting mere association among awareness measures in two different domains. First, experimental measures of monitoring and control processes on a sort-by-sort basis are quite different from straightforward, face valid global judgments of one's own level of performance (and hence are less susceptible to bias or coaching). Second, in line with Danion et al.'s (2001) findings, our results revealed several poor insight patients who displayed a unique and rather dramatic split between their monitoring and control processes. Namely, their decisions regarding which sorts they want to volunteer appeared at times to be independent of their self-monitoring processes.

The current findings seem to have implications for the theoretical issue of the relationship between metacognition and executive functioning. What they suggest is that despite being rather similar, metacognition is not identical with executive functioning, at least not with current "forced response" conceptions of it. The executive system modulates lower level schemas according to the subject's intentions (Norman and Shallice, 1986). Without it, task performance loses flexibility and becomes stimuli bound. However, our data suggests that the very existence of flexible schemas does not automatically entail that the subject is aware (beyond chance level) when these schemas are correct and when they are wrong.

A main advantage of the current study is that the relative superiority of metacognitive measures compared to conventional WCST measures was detected in a single integrated process, rather than by comparison of correlations from two separate sets of tests. A key question in this regard, however, is to what extent the additional metacognitive tasks affect WCST performance. As already mentioned, the average level of WCST performance of participants in this study was comparable to that of similar samples in the literature, providing an indirect evidence to a minimal if any effect of such kind. In addition, data we have in a more recent study in which we gave patients both versions of the test within 2 weeks from each other (in a counterbalanced design) does not reveal any major or consistent differences in performance on the two versions of the test.

The study's main limitation is its small sample size. Thus, replication and further validation of the new method, applied to other neuropsychological domains, in larger and more heterogeneous samples is necessary. However, this is one of the first studies of first-episode patients, and thus it adds new data to the literature. If further validated, the new paradigm may provide a novel accuracy-oriented approach to neuropsychological models of other clinically meaningful phenomena, in which free-choice and self-directed action are inherent elements, such as decision-making competence and treatment compliance. Ultimately, the new approach can provide an empirical foundation for future studies relating such measures to brain function and structure in these patients.

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### References

- Amador, X.F., Strauss, D.H., 1990. The Scale to Assess Unawareness of Mental Disorder (SUMD). Columbia University and New York State Psychiatric Institute, New York, NY.
- Amador, X.F., Flaum, M., Andreasen, N.C., Strauss, D.H., Yale, S.A., Clark, S.C., Gorman, J.M., 1994. Awareness of illness in schizophrenia, schizoaffective and mood disorders. *Arch. Gen. Psychiatry* 51, 826–836.
- Brooker, B., Cyr, J., 1986. Tables for clinicians to use to convert WAIS-R short forms. *J. Clin. Psychol.* 42, 982–986.
- Danion, J.M., Gokalsing, E., Robert, P., Massin-Krauss, M., Bacon, E., 2001. Defective relationship between subjective experience and behavior in schizophrenia. *Am. J. Psychiatry* 158, 2064–2066.
- David, A.S., 1999. "To see ourselves as others see us". *Aubrey Lewis's insight. Br. J. Psychiatry* 175, 210–216.
- David, A.S., Kemp, R., 1997. Five perspectives on the phenomenon of insight in psychosis. *Psychiatr. Ann.* 27, 791–797.
- Drake, R.J., Lewis, S.W., 2003. Insight and neurocognition in schizophrenia. *Schizophr. Res.* 62, 165–173.
- Faraone, S.V., Seidman, L.J., Kremen, W.S., Pepple, J.R., Lyons, M.J., Tsuang, M.T., 1995. Neuropsychological functioning among the nonpsychotic relatives of schizophrenic patients: a diagnostic efficiency analysis. *J. Abnorm. Psychology* 104, 286–304.
- First, M.B., Spitzer, R.L., Gibbon, M., Williams, J.B., 1996. *Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-IV)*. New York State Psychiatric Institute, Biometrics Research, New York, NY.
- Klatzky, R.L., Erdelyi, M.H., 1985. The response criterion problem in tests of hypnosis and memory. *Int. J. Clin. Exp. Hypn.* 33, 246–257.
- Koren, D., Seidman, L.J., Harrison, R.J., Lyons, M.J., Kremen, W.S., Caplan, B., Golstein, J.M., Faraone, S.V., Tsuang, M.T., 1998. Factor structure of the Wisconsin Card Sorting Test: dimensions of deficit in schizophrenia. *Neuropsychology* 12, 289–302.
- Koriat, A., Goldsmith, M., 1994. Memory in naturalistic and laboratory contexts: distinguishing the accuracy-oriented and quantity-oriented approaches to memory assessment. *J. Exp. Psychol. Gen.* 123, 297–316.
- Koriat, A., Goldsmith, M., 1996. Monitoring and control processes in the strategic regulation of memory accuracy. *Psychol. Rev.* 103, 490–517.
- McGlynn, S.M., Schacter, D.L., 1997. The neuropsychology of insight: impaired awareness of deficits in a psychiatric context. *Psychiatr. Ann.* 27, 806–811.
- Mohamed, S., Fleming, S., Penn, D.L., Spaulding, W., 1999. Insight in schizophrenia: its relationship to measures of executive functions. *J. Nerv. Ment. Dis.* 187, 525–531.
- Nelson, T.O., Narens, L., 1996. Why investigate metacognition? In: Metcalfe, J., Shimamura, A.P. (Eds.), *Metacognition. Knowing About Knowing*. The MIT Press, Cambridge, MA, pp. 1–26 (1991).
- Norman, D.A., Shallice, T., 1986. Attention to action: willed and automatic control of behaviour. In: Davidson, R.J., Schwartz, G.E., Shapiro, D. (Eds.), *Centre for Human Information Processing. Consciousness and Self-Regulation*, vol. 4. Plenum, New York, pp. 1–18.
- Seidman, L.J., Kremen, W.S., Koren, D., Faraone, S.V., Goldstein, J.M., Tsuang, M.T., 2002. A comparative profile analysis of neuropsychological function in schizophrenia and bipolar psychoses. *Schizophr. Res.* 53, 31–44.
- Silverstein, A., 1982. Two- and four-subtest short forms of the WAIS-R. *J. Consult. Clin. Psychol.* 50, 415–418.
- World Health Organization Collaborating Center for Drug Statistics, 2000. *Guidelines for ATC Classification and DDD Assignment*. World Health Organization Collaborating Center for Drug Statistics, Oslo, Norway.