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Immediate Post Performance Judgements about Cognitive Performance in Schizophrenia and Bipolar Disorder: Associations with Test performance and Subjective Overall Judgments Regarding Abilities

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Abstract

Introduction: The study aimed to address associations between the accuracy of post assessment judgements of cognitive performance with global self-assessments of psychosocial functioning compared to evaluations generated by observers in schizophrenia and bipolar disorder.

Methods: An abbreviated cognitive assessment based on the MATRICS Consensus Cognitive Battery was administered to 122 individuals with schizophrenia and 113 with bipolar disorder, who were also asked to generate estimates of their performance at the conclusion of each subtest. In addition, self-reports on scales measuring abilities in the domains of cognition, social cognition, and everyday functioning were collected and compared to observer ratings on these same scales.

Results: Both groups overestimated their cognitive function, but in participants with bipolar disorder, there was 30% shared variance between task performance and self-rated task performance (vs. 5% in schizophrenia) and there were significant correlations between self-reported everyday outcomes and both actual and self-assessed task performance. In schizophrenia, immediate judgements were only related to self-rated functioning, not to observer rated functioning. In the participants with bipolar disorder, impairments in self-assessment of performance were correlated with observer ratings of cognitive ability, while they were not in the participants with schizophrenia.

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Conclusions: Individuals with bipolar disorder are better at estimating their cognitive performance and other outcomes including functioning. Correlations between cognitive performance and impairments in introspective accuracy were present in both groups, although impairments in introspective accuracy were related to observer ratings of functioning only in bipolar disorder.

Keywords

neurocognition; metacognition; post-performance judgments; introspective accuracy; schizophrenia; bipolar disorder; functioning

Introduction

Cognitive deficits in serious mental illnesses are well documented and occur across clinical state (Bortolato et al., 2015; Fioravanti et al., 2005; Mann-Wrobel et al., 2011; Torres et al., 2008; Tripathi et al., 2018; Robinson et al., 2006). In schizophrenia, cognitive deficits are denoted as a core characteristic and are a trait marker of the disorder and potential candidate endophenotype (Bora et al., 2014; Park & Gooding, 2014). Similar findings have been seen in bipolar disorder (Arts et al., 2008; Bora et al., 2009a). Comparing schizophrenia and bipolar disorder on the severity of cognitive impairment, a meta-analysis by Bora et al. (2009b) could not find remarkable differences in effect sizes between schizophrenia and affective psychosis. Stefanopoulou et al. (2009) concluded that differences between diagnostic groups are quantitative rather than qualitative, and the profile of impairment in mood disorders and schizophrenia has been reported to be very similar at the time of the first episode (Reichenberg et al., 2009). A very large-scale comparative study of schizophrenia and bipolar disorder (Harvey et al., 2016), found that the factor structure of cognition in schizophrenia and bipolar disorder was best characterized as a single domain, encompassing both diagnoses. Longitudinal studies of cognition in schizophrenia and bipolar disorder suggest minimal to no progressive impairment for most cognitive variables (Fett, et al., 2020; Samamé et al., 2014; Shmukler et al., 2015; Szöke et al., 2008).

Cognitive and social cognitive deficits are a determinant of poor social, occupational, and global functioning in both schizophrenia and bipolar disorder (Bonnín et al., 2010; Bowie et al., 2010; Fett et al., 2011; Gold et al., 2002; Martino et al., 2009; Tabarés-Seisdedos et al., 2008). Most large-scale studies found that the path from cognitive deficits to impairments in functional outcomes is through cognition adversely impacting the ability to perform critical everyday functional skills, referred to as functional capacity (Galderisi et al., 2014; Strassnig et al., 2015).

Metacognition is defined *as thinking about thinking* and describes the ability to self-reflect on one's own cognitive processes (Goupil and Kouider, 2019). Impaired metacognition is common in patients with schizophrenia (Brüne, 2005; Bora et al., 2009c; Lysaker et al., 2013) as well as in patients with bipolar disorder (Bora et al., 2016) and has been related to neurocognitive functioning, especially working memory (Lysaker et al., 2007) as well as verbal memory impairments (Dalkner et al., 2019). Burdick et al. (2005) reported that objective cognitive impairment is not recognized by patients with bipolar disorder. Related

to metacognition, the concept of introspective accuracy (IA) describes the awareness of one's own abilities, skills, performance, and decisions (Harvey and Pinkham, 2015). IA applies broadly to impairments in self-assessment in serious mental illness, which span self-assessments of clinical symptoms (Amador et al., 1993), functional abilities (Durand et al., 2021), cognitive performance (Jones et al., 2021), and social cognitive abilities (Silberstein & Harvey, 2019a, 2019b). In cognitive and social cognitive domains, IA is operationalized as accuracy in self-evaluating performance on neurocognitive/social cognitive tests, which can be measured in real time by asking participants to indicate how they believe they performed on a specific task, immediately after task performance. The dominant IA error appears to be overestimation of abilities relative to various reference points (Gould et al., 2013; Jones et al., 2019), and studies have shown that overestimation of both cognitive (Gould et al., 2015) and social cognitive performance (Silberstein et al., 2018) contribute to impairments in everyday functioning above and beyond the contributions of ability variables.

Previous research on self-assessments (e.g., "How would you rate your overall functioning?") have revealed that cliniciań s judgements of real-world performance may be more accurate than patientś self-assessments (Durand et al., 2015), as indexed by higher correlations with clinician ratings of performance on both tasks of cognitive and functional capacity. One of the possibilities for this discrepancy may be failures in translation immediate information about performance into more global self-assessments. Using a meta-cognitive Wisconsin Card Sorting Test paradigm, Tercero et al. (2021) observed differences between individuals with schizophrenia and bipolar disorder in IA. In this paradigm, participants were asked to perform sorts, judge the accuracy of each sort, and then provide a confidence rating for each judgment. Feedback regarding their accuracy was then provided for each trial. For participants with bipolar disorder, confidence ratings on a trial x trial basis were related to task performance despite a substantial immediate bias toward overestimating the accuracy of the sorts. Judgments of overall performance on the task were associated with both trial x trial confidence and with overall accuracy in performing the task. In schizophrenia, the actual performance on the task minimally correlated with either immediate performance judgments or trial x trial confidence in those judgements. Further, global performance judgments were associated with immediate accuracy judgments and trial x trial confidence judgments but correlated 0 with actual task performance.

We have published two previous papers on these data, both examining data collected with ecological momentary assessment (EMA). In the first, we found that challenges in self-assessment of cognitive abilities, indexed by larger discrepancies between self-reports of performance and actual performance were correlated with more frequent experiences of psychotic experiences, including both delusions and hallucinations, in participants with schizophrenia (Morgan et al, 2022). In the second, we found that more intense experiences of negative mood states were correlated with mis-estimation of cognitive performance examined identically to the Morgan et al. study in participants with bipolar disorder, but not schizophrenia (Dalkner et al., 2023). In those papers, we did not examine the association between IA for cognitive performance and everyday functioning, either self-reported or observer rated.

In this study, we expand to evaluate the association of task performance, immediate post performance self-assessments of cognitive performance across the different on the tasks, and differences between actual performance and self-assessment of performance with everyday functioning, measured by self-reports and observer ratings of everyday functioning. We also included self-reports and observer ratings of cognitive and social cognitive abilities. We had several hypotheses based on previous work. We expected that the immediate judgments regarding performance would be less convergent in schizophrenia compared to bipolar disorder, meaning that individuals with schizophrenia would show poorer IA than individuals with bipolar disorder. We also expected, consistent with our earlier results (Tercero et al., 2021) that overestimation of performance would be common in both groups and related to poorer performance on the objective assessments. We also expected that biases in global self-assessments of competence across domains would converge with response biases toward over-estimation of performance on the immediate post performance self-assessments, with the possibility that actual performance would not predict global self -assessments.

2. Methods

2.1 Participants.

In total, 321 participants (163 schizophrenia, 158 bipolar disorder) were recruited and participated in some elements of the study. Of these participants, the results of end point assessment which was when the cognitive assessments were performed was available for 235 participants (122 schizophrenia, 113 bipolar disorder) with a mean age of 40.2 years (SD = 11.3) ranging from 19.0 to 64.0 years. Missing data included dropping out of the study, being unable to be assessed because of the COVID-19 pandemic or being unable to be assessed remotely on the measures. In sum, 102 participants with schizophrenia and 79 participants with bipolar disorder were fully assessed prior to the pandemic. The participants were recruited at three different sites: The University of Miami Miller School of Medicine (UM), the University of California, San Diego (UCSD), and The University of Texas at Dallas (UTD). UM participants were recruited from the Jackson Memorial Hospital-University of Miami Medical Center and the Miami VA Medical Center. UCSD participants were recruited from the UCSD Outpatient Psychiatric Services clinic, a large public mental health clinic, the San Diego VA Medical Center, and other local community clinics and by word of mouth. UTD participants were recruited primarily from Metrocare Services, a non-profit mental health services organization in Dallas County, TX, and from other local clinics. The study was approved by each University's respective Institutional Review Board, and all participants provided written informed consent.

2.2 Inclusion/Exclusion Criteria.

Patients who met the diagnostic criteria for schizophrenia or bipolar disorder (diagnosed with DSM-5) and who were clinically stable (i.e., no hospitalizations, stable medication regimen with no dose changes >20% for a minimum of 2 weeks) for a minimum of six weeks were included in the study. Individuals with bipolar disorder also had to meet a stage 3 or higher, indicating at least one mood episode recurrence or incomplete remission from a first-episode according to the staging approach by Frank et al. (2014).

Exclusion criteria included: (1) a history of, or current, medical or neurological disorders that may affect cognition (e.g., CNS tumors, seizures, or loss of consciousness for over 15 minutes), (2) a history of, or current, intellectual disability (IQ<70) or pervasive developmental disorder according to the DSM-5 criteria, (3) the presence of substance use disorder not in remission for at least six months, (4) visual or hearing impairments that interfere with assessment, and (5) lack of proficiency in English. Participants with a Wide Range Achievement Test-3rd edition (WRAT-3; Wenzel, 2017) grade Equivalent score of less than 8th grade were also not enrolled.

Measures.

Psychiatric rating scales.

Depressive Symptoms.: The **Montgomery-Asberg Depression Rating Scale** (MADRS; (Montgomery and Asberg, 1979) is a clinician administered rating scale to determine the severity of depressive symptoms. The MADRS contains of 10 items with 7 response options, and the total score was used. Higher scores reflect more depression.

Psychotic Symptoms.: Severity of psychotic symptoms was measured with the **Positive and Negative Syndrome Scale** (PANSS; Kay et al., 1987) consisting of 30 items with 3 subscales: For Positive Symptoms, we used the PANSS items identified using the Marder Factor Analysis. In addition, two negative symptom factors, as suggested by Khan et al. (2017) were used in this study. The *PANSS Reduced Emotional Experience* factor consists of the PANSS items Emotional Withdrawal (N2), Passive/Apathetic Social Withdrawal (N4) and Active Social Avoidance (G16). The *PANSS Reduced Expression* factor included the items Blunted Affect (N1), Poor Rapport (N3), Lack of Spontaneity (N6) and Motor Retardation (G7). We also examined the awareness of illness item, G12, for its correlation with cognitive performance and self-assessment of performance.

All clinical assessment measures were administered by trained raters and generated on the same day as the cognitive testing. The raters had extensive experience in psychiatric rating scales and studies with severe mental illness and were trained to high reliability for both the MADRS and the PANSS (ICC>.80) by the study PI (Pinkham).

Neurocognitive Performance and introspective accuracy probes.: We administered a battery of neurocognitive tests and asked the subjects to rate their performance on a predefined scale immediately after the test (immediate judgements). For each test, participants were provided with a realistic range of possible performance immediate judgements, for example:

Letter-Number Sequencing IA Question: There are a total of 24 points that you could have earned on this task. How many do you think you got? (Min 0 - Max 24).

We subtracted actual performance from self -reported performance, thus leading to positive difference scores reflecting overestimation and negative scores underestimation. The larger the absolute IA value compared to 0, the more discrepant was the self-evaluation of one's own cognitive abilities compared to actual performance (mis-estimation).

The cognitive assessments were a subset of the tasks from the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008).

The **Trail Making Test Part A (TMT A)** is a measure of individual attention and psychomotor speed. Participants are instructed to connect numbers in ascending order as quickly and carefully as possible. We transformed the TMT A and its corresponding IA assessment so that higher scores reflected better performance.

The **Brief Assessment of Cognition in Schizophrenia (BACS) symbol coding is** a valid and sensitive measure of psychomotor processing speed. Using a reference key, participants are asked to pair specific numbers with given geometric figures within 90 seconds.

The **Maryland Letter-Number Sequencing test (LNST)** is a valid and sensitive measure of auditory working memory. The examinees hear a series of letters and digits, and then report back the stimuli with the letters in alphabetical order, and digits in ascending numerical order.

The **Animal Naming Test (ANT)** measures semantic verbal fluency and processing speed. Subjects were asked to list as many animals as they could in one minute

The **Hopkins Verbal Learning Test (HVLT)** is an assessment that consists of three learning trials of a 12-item semantically organized list with the total score as the dependent variable, in line with the typical use of this test in the MCCB. Each form of the HVLT contains four words each from one of three semantic categories and as we only performed one assessment, we used form 1 (animals, previous stones, and places to live).

Interview Based Assessments.: The **Cognitive Assessment Interview (CAI;** Ventura et al., 2010), a patient- and observer-based semi-structured interview, was used to measure the global severity of cognitive impairment with 10 items addressing six cognitive domains (attention/concentration, working memory, verbal learning and memory, reasoning and problem solving, speed of processing and social cognition). We used the total score from the patient report as well as observer ratings as the dependent variables, and higher scores reflected more impairment.

We used the **Observable Social Cognition Rating Scale (OSCARS,** (Healey et al., 2015)) to measure observable social cognition deficits including domains of theory of mind, emotion perception, cognitive rigidity, jumping to conclusions, and attributional style. This 8 item-scale was administered to both the participant and the informant, who generated ratings across the different items. We used the total score as the outcome measure, with higher scores indicating greater impairment.

2.3.4 Real-World Functional Outcomes.: Overall functioning of the participants was assessed with the **Specific Level of Functioning scale** (**SLOF**; Schneider and Struening, 1983), a 43-item interview- based multidimensional assessment to assess a person's skills, assets, and abilities. In this study, the subscales for Interpersonal Functioning (e.g., initiating, accepting, and maintaining social contacts; effectively communicating) and participation in Everyday Activities (shopping, using the telephone, paying bills, use of

leisure time, use of public transportation) were used in the analyses. Vocational functioning was not examined because of the low rate of employment in the sample. For the SLOF, higher scores reflect better performance.

All-sources Observer SLOF, CAI, and OSCARS Ratings.: In this study, we generated ratings on the basis of all sources of information. In our previous studies that recruited at these sites, we discovered that we were only able to obtain a high-quality informant (high contact clinician; caregiver who lived with the participant) for about 75% of potential participants. Rather than reject cases without such an informant, we used an all-sources observer rating procedure as we described before (Harvey et al., 2019). Raters who interviewed the participants on the SLOF, the CAI, and the OSCARS also had access to informant reports, identified as to the source, if available. Raters were instructed to make their ratings on the basis of what they thought was the correct rating, regardless of the source of information, and to consider information from their own observations of the participant when generating their ratings.

Statistics.—Principal component analyses (PCA) in the combined sample were used as a data reduction technique. We included total scores of TMT A, LNS, ANT, and HVLT in the PCA analysis, wherein we generated a single unrotated principal component to use as the composite performance measure. The BAC symbol coding scores were not included in the PCA because of they were not administer to the pandemic-assessed participants because of challenges with remote administration. We generated a similar component for the immediate judgments of performance. Finally, we took the absolute value of the difference between immediate performance judgments and actual and generated a principal component for IA. he correlation between the composite cognitive measure and BACS symbol coding was high in those participants who had symbol coding data collected before the pandemic: r=.64, p<.001.

Group comparisons in performance-based variables were tested by independent t-tests and non-parametric tests. These group comparison results have presented in the previously published papers. However, one or more of the observer rated or self-reported functional measures were missing for 4 participants with schizophrenia and 1 with bipolar illness. Thus, we present the data from the current sample which is modestly different from the previous publications. Between-samples t-tests were used to compared performance and immediate self-assessments of performance across the two diagnostic samples. Paired t-tests were used to test for differences between actual cognitive performance and immediate judgements for all tests within each sample.

To test for associations, we calculated Pearson correlation analyses to examine the correlations between the composite scores of cognition (performance, momentary judgements, difference), and the self-reported and observer rated functioning variables (OSCARS, CAI and SLOF subscales) separately. Correlations were calculated separately in the two samples and tested for the significance of the differences using Fisher’s r to z transformation.

Results

Basic information.

The mean age of study participants was 40 years; 35.7% were African American and 49.0% Caucasian, 58.4% were women and the median estimated total years of education was 13.4 years (SD = 2.5) ranging from 6 to 22 years. Table 1 shows the clinical data and scores on the observer rated functional measures, noting that the demographic information has been previously published for the full sample, which differs minimally from the current one.

Cognitive data.

The means and standard deviations for the cognitive tasks (actual performance and immediate post performance judgements) are presented in Table 2.

The between groups *t*-tests indicated that the participants with schizophrenia performed more poorly on all cognitive tests than the participants with bipolar disorder, all $t>2.06$, all $p<.04$. However, in terms of the difference between performance on the tests and immediate post performance judgments, there was only one diagnostic difference that was significant, animal naming, $t(232)=2.18$, $p=.03$, with the participants with bipolar disorder underestimating their performance by more than the participants with schizophrenia. When the analyses were repeated with analysis of covariance, considering task performance as a covariate because of poorer performance of the participants with schizophrenia, there were no changes across the two samples in diagnostic differences in reports of performance across the tasks.

The correlations between the composite scores for cognitive performance, immediate post performance self-assessments of performance, and absolute values for magnitude of mis-estimation are displayed in Table 3. In individuals with bipolar disorder, cognitive performance correlated positively with the immediate judgments of performance, explaining 30% of variance ($r=.55$) compared to 5% ($r=.22$) in the participants with schizophrenia. The r to z test found that these correlations differed significantly ($Z=2.98$, $p<.001$). Further, the correlation between poorer cognitive performance and higher absolute values for misestimation of performance accounted for 25% of the variance in the participants with schizophrenia and 16% of the variance in participants with bipolar illness and this difference in correlations did not reach statistical significance ($Z=0.84$, $p=.40$).

Associations between Cognitive Performance and Functional Variables

In Table 4, the correlations between composite scores for cognitive performance, self-assessments of performance, and absolute values for mis-estimation of performance and self-reports and observer ratings of cognitive, social cognitive, and real-world functional outcome measures are shown. In schizophrenia, cognitive performance was not significantly correlated with any self-reported functioning variables, while better cognitive performance was correlated with better observer rated functioning on SLOF Activities and the CAI. Momentary judgements of better cognitive performance were significantly correlated with self-reports of better everyday functioning and less impairment on the CAI, reflective of a positive bias in self assessment For the observer ratings, only better functioning in

everyday activities were correlated with immediate post performance judgments of better performance. Greater absolute mis-estimation of cognitive performance was not correlated with any self-reported or observer rated functional variables.

In bipolar disorder, better cognitive performance was correlated with self-reports of better performance on cognitive and social cognitive tasks. Observer ratings of better cognitive and social cognitive performance, as well as better performance in everyday activities were correlated with objective cognitive performance Immediate post performance judgments of better cognitive performance were correlated with self-reports of better performance in cognition (CAI), social cognition (OSCARS), and SLOF everyday activitiesas well as with observer ratings of less cognitive and social cognitive impairment. Finally, greater mis-estimation of cognitive abilities was correlated with self-reports of poorer social cognitive performance. For the observer ratings, greater mis-estimation of cognitive performance was associated with greater observer rated impairment in social cognition, cognition, and interpersonal functioning.

For participants with schizophrenia, the correlations with PANSS G12 and cognitive performance, self-assessment of performance, and absolute introspective accuracy were all small and non-significant, all r<.11, all p>.10. In contrast, higher scores on lack of insight correlated with self-reports of better social cognitive performance, better cognitive performance, and better everyday social functioning. In contrast, observer ratings of worse social cognition and worse interpersonal functioning correlated with high scores on lack of insight.

For participants with bipolar disorder, higher scores on lack of insight were correlated with poorer objective cognitive performance, r=−.28, p<.001, but not with momentary assessments of performance r=−.03, p=.70, or \absolute value mis-estimation, r=−.04, p=.55. Interestingly, none of the self-reported or observer reported functional variables correlated with clinical ratings of insight,

Associations between Introspective Accuracy and Clinical symptoms.

Overall, mis-estimation of performance was uncorrelated with positive and negative symptoms, as well as depression ratings, in both samples (all r<.13; all p>.05).

Discussion

This study assessed the association between actual cognitive performance and immediate post performance judgments of performance, as well as the relationships of performance and judgments with self-reports and observer ratings of everyday functioning and social cognitive and neurocognitive abilities. Both diagnostic groups demonstrated impaired IA by significantly misestimating performance on specific cognitive tasks. Performance on 7/8 tasks across the groups (other than HVLT scores in the schizophrenia participants) were found to be significantly different from immediate post performance self-assessments. In both diagnostic groups, better cognitive performance was correlated with immediate post performance judgments of cognitive performance; however, the relationship in bipolar disorder was significantly larger than in schizophrenia, suggesting better ability to accurately

self-assess performance. Further, we found that the relationship between poorer cognitive performance and greater overall tendencies toward misestimation of performance was greater in participants with schizophrenia than bipolar disorder, although the differences in correlation coefficients were not statistically significant.

In schizophrenia, cognitive performance was not correlated with self-reports on any of the functioning variables, but the observer ratings of greater impairments in cognitive and everyday activities domains were correlated with poorer cognitive performance. In contrast, immediate post performance judgements of better performance were correlated with self-reports of better functional outcomes on 3 of the 4 measures, as well as with clinical ratings of lack of insight. Consistent with our previous study with the meta-cognitive Wisconsin Card Sorting test Tercero et al. (2021), participants with schizophrenia generated immediate post performance ratings of their performance that shared only 4% variance with actual performance, while sharing 14% variance other self-reports, such as everyday functioning.. Similar to the results of that study, herein participants with schizophrenia appeared to utilize self-generated information (i.e., performance judgments) when generating self-assessments of global functional abilities.

In bipolar disorder, actual performance and immediate post performance judgments had considerable overlap and both were associated with self and observer ratings of cognitive and social cognitive abilities. These findings suggest convergence better cognitive ability and better ability to evaluate performance, leading to convergence with judgements from observers. . Participants with bipolar disorder with greater challenges in introspective accuracy rated themselves as having greater social cognitive challenges. Thus, in our bipolar participants there appears to be both better ability to self-evaluate performance, indexed by more accurate immediate post performance judgments regarding cognitive test performance, and a more observable adverse impact of impairments in introspective accuracy.

These data converge with previous research and theory on information sources and information utilization in momentary decision making in schizophrenia. People with schizophrenia use less information to decide and come to more rapid judgments (Moritz et al., 2017) than healthy people, also not adjusting their effort to task difficulty in time series tasks (Cornacchio et al., 2017). Even when feedback is available, participants with schizophrenia seem to use it less efficiently. A correlation of zero between feedback received on correct performance and global performance judgments does not implicate random responding or inability to recall the task. In the Tercero et al. study, participants with schizophrenia generated an overall task performance estimate that correlated zero with objective performance, for which they had received 64 trials of feedback. However, they highly effectively recalled and aggregated their subjective reports of accuracy, giving a judgment for their overall performance that shared 33% of the variance with the number of WCST sorts that they had reported to be correct on a momentary basis. Participants with bipolar disorder generated overall performance judgments that shared 57% of the variance with the number of correct sorts and only 2% with their momentary judgments. These data suggest considerable divergence in use of feedback to guide task performance and likely suggest directions for intervention.

Limitations.

Several limitations should be considered when interpreting the results. First, although both individuals with schizophrenia and bipolar disorder mis-estimated their performance, we do not know how healthy individuals would have performed in these same momentary judgements. The task of making a parametric estimate of performance on a neuropsychological test is not a common one. However, mis-estimations seem to correlate robustly with other self-assessment outcomes. Second, the composite score for cognition does not include BACS symbol coding, which could not be administered efficiently on a remote basis, although scores on the composite correlated very well with BACS symbol coding in participants who were assessed.

Third, we previously reported that some participants may not generating actual self-assessments, because some participants with schizophrenia in this sample self-reported excellent performance on tasks that can only be performed away from home while being at home continuously (Gohari et al., 2022) Those same participants were also found to be experiencing more common momentary psychotic symptoms, leading us to suggest that some of these self-assessments were actually delusional ideas. Thus, this influence may be operative in some of the self-reports of functioning on the part of the participants with schizophrenia.

Conclusion.

Participants with schizophrenia seem to have a considerable challenge in the generation of self-assessments of their abilities across domains, with these challenges appearing to be more substantial than those seen in participants with bipolar disorder. In fact, they seem to manifest a global bias toward utilization of self-generated information also appeared in the WCST performance. Participants with bipolar disorder mis-estimated their performance on an immediate basis as seen in previous studies but demonstrated convergence between actual performance and immediate performance judgments. These same generated immediate post performance judgments of their performance that were correlated with both self-reported and observer rated global cognitive performance. Thus, intervention strategies may be differentially targeted in the two participant samples, with a focus on utilizing external information in participants with schizophrenia and a more fine-grained intervention targeting accuracy in participants with bipolar disorder.

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Conflict of interest statement.

Dr. Raeanne C. Moore is a co-founder of KeyWise AI, Inc. and a consultant for NeuroUX. Dr. Harvey has received consulting fees or travel reimbursements from Alkermes, Bio Excel, Boehringer Ingelheim, Intra-Cellular Therapies, Minerva Pharma, Otsuka America, Regeneron, Roche Pharma, and Sunovion Pharma. He receives royalties from the Brief Assessment of Cognition in Schizophrenia and the MATRICS Consensus Battery. He has a research grant from Takeda and from the Stanley Medical Research Foundation. He is chief scientific officer of iFunction, Inc. Dr. Pinkham has served as a consultant for Roche Pharma. The other authors have no potential Biomedical Conflicts of Interest.

Data availability statement.

The data that support the findings of this study are available from the corresponding author, [ND], upon reasonable request.

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Table 1:

Clinical Data and Observer Ratings of Cognition, Social Cognition, and Everyday Functioning

	SZ	**BD**		
	***n*=122**	***n*=113**		
	***M* (± *SD*)**	***M* (± *SD*)**	***T***	***p***
Age [years]	41.80 (10.81)	38.45 (11.69)	2.28	.023
MADRS	9.25 (10.08)	12.64 (10.63)	−2.50	.013
PANSS Positive symptoms	13.75 (4.34)	8.79 (3.91)	9.19	<.001
PANSS Reduced experience	6.19 (3.10)	4.65 (2.10)	4.47	<.001
PANSS Reduced expression	5.07 (2.47)	3.51 (.96)	6.44	<.001
OSCARS	20.92 (8.93)	18.12 (7.67)	2.68	.008
SLOF Interpersonal functioning	20.97 (5.77)	21.03 (5.34)	−.09	.928
SLOF Activities	49.52 (7.72)	50.98 (6.66)	−.161	.109
Cognitive Assessment Interview.	3.04 (1.41)	2.53 (1.24)	2.94	.004

Note: SZ=Schizophrenia, BD=Bipolar disorder, MADRS=Montgomery-Asberg Depression Rating Scale, PANSS=Positive and Negative Syndrome Scale, OSCARS=Observable Social Cognition: A Rating Scale,

Table 2:

Cognitive Test Performance and Momentary Judgments across all Cognitive Tests in Schizophrenia and Bipolar Disorder

	SZ				BD			
	n=122				n=113			
	Performance	Immediate Post-Performance Judgement			Performance	Immediate Post-Performance Judgement		
	M (SD)	*M (SD)*	*T (p)*	*Coheńs dz*	*M (SD)*	*M (SD)*	*T (p)*	*Coheńs dz*
TMT A Seconds	35.59 (19.02)	26.00 (39.51)	2.84 (.005)	.29	31.29 (11.88)	21.10 (16.62)	6.35 (<.001)	.70
Symbol Coding	44.93 (11.25)	58.81 (28.57)	−4.89 (<.001)	.57	51.15 (13.60)	58.45 (21.76)	−3.13 (.003)	.31
Letter-Number Span	12.38 (4.06)	13.77 (5.66)	−2.34 (.021)	.28	13.75 (3.91)	15.10 (5.18)	−2.49 (.014)	.29
ANT Animals	21.00 (5.82)	18.87 (8.36)	3.00 (.003)	.29	23.60 (5.68)	19.33 (7.55)	6.18 (<.001)	.63
HVLT Words	20.75 (5.73)	19.80 (8.18)	1.40 (0.17)	.13	23.71 (6.24)	21.10 (8.18)	4.70 (<.001)	.33

Note: SZ=Schizophrenia, BD=Bipolar disorder, TMT A=Trail Making Test Part A, ANT=Animal Naming Test, HVLT=Hopkins Verbal Learning Test; Symbol Coding from the Brief Assessment of Cognition in Schizophrenia, Letter number span from the Maryland Letter-Number Sequencing test; Results from paired-*t*-tests testing differences between actual performance and momentary judgements.

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Table 3:

Inter-correlations between Cognitive Performance, Immediate Post-Performance Judgments, and Absolute Values of IA Differences

SZ	**Immediate Post-Performance Judgement**	**IA (Difference)**
Performance	.22*	−.48***
BD	**Immediate Post-Performance Judgement**	**IA (Difference)**
Performance	.51***	−.40*

Note:

* $p < .05$,

** $p < .01$,

*** $p < .001$;

SZ=Schizophrenia, BD=Bipolar disorder, IA=introspective accuracy (difference between self-reported cognitive performance minus actual cognitive performance); Factors deriving from Principal component analysis including Trail Making Test A, Maryland Letter-Number sequencing test, Animal Naming Test and Hopkins Verbal Learning Test.

Table 4

Correlations of Cognitive Performance, Immediate Post-Performance Judgments, and Self and Observer Ratings of Functioning

SZ	**Self-report**				**Observer Rating**			
	OSCARS	**SLOF INT**	**SLOF ACT**	**CAI**	**OSCARS**	**SLOF INT**	**SLOF ACT**	**CAI**
Cognitive Performance	−.15	.14	.17	−.07	−.12	.13	.31***	−.26**
Immediate Post-Performance Judgement	−.17	.24**	.38***	−.19*	−.09	−.04	.25**	−.16
IA (Difference)	.07	.11	.02	.07	.00	−.10	.01	.02
PANSS Lack of Insight	−.22*	.18*	.00	.18*	.19*	−.21*	.04	−.10
BD	**Self-Report**				**Observer Rating**			
	OSCARS	**SLOF INT**	**SLOF ACT**	**CAI**	**OSCARS**	**SLOF INT**	**SLOF ACT**	**CAI**
Cognitive Performance	−.28**	.18	.15	−.22*	−.33**	.19	.24*	−.42***
Immediate Post-Performance Judgement	−.28**	.17	.20*	−.31**	−.21*	.04	.16	−.34***
IA (Difference)	.27**	−.09	−.06	−.12	.22*	−.21*	−.16	.27*
PANSS Lack of Insight	−.13	−.04	.01	.01	.00	−.12	.05	−.03

Note: significant values in bold,

* $p < .05$,

** $p < .01$,

*** $p < .001$;

SZ=Schizophrenia, BD=Bipolar disorder, IA=introspective accuracy (difference between self-reported cognitive performance minus actual cognitive performance, OSCARS=Observable Social Cognition: A Rating Scale, SLOF INT=Specific Level of Functioning Interpersonal Functioning, SLOF ACT=Specific Level of Everyday Activities, CAI=Cognitive Assessment Interview, PANSS= Positive and Negative Syndrome Scale. For the OSCARS only, lower scores reflect better performance