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Negative Mood States as a Correlate of Cognitive Performance and Self-assessment of Cognitive Performance in Bipolar disorder versus Schizophrenia

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Abstract

Introduction: Mood states have been reported to manifest a cross-sectional correlation with self-assessment accuracy across functional domains and psychiatric conditions. Ecological momentary assessment (EMA) provides a strategy to examine the momentary course and correlates of mood states. This study tested the association of moods assessed longitudinally with accuracy of immediate self-assessments of cognitive test performance in participants with schizophrenia and bipolar disorder.

Methods: 240 well-diagnosed participants with schizophrenia and bipolar disorder completed a subset of tests from the MATRICS Consensus Cognitive Battery and an immediate self-assessment of cognitive performance. Differences between actual and self-reported performance were used to index the accuracy of self-assessment. Daily smartphone EMA, 3x per day for 30 days, sampled

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Author contributions.

Drs. Depp, Harvey, Moore, and Pinkham designed the IA study. Dr. Dalkner and Dr. Harvey ran the data analyses in consultation with Dr. Pinkham and wrote the first draft of the manuscript. All other authors contributed to the paper in addition to writing, including supervising collection of data.

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, Minerva Pharma, Roche Pharma, and Sunovion Pharma. He receives royalties from the Brief Assessment of Cognition in Schizophrenia and the MATRICS Consensus Battery. 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.

participants' momentary moods (sad, happy, relaxed, anxious), aggregated into positive affect and negative affect (NA).

Results: Bipolar participants had better cognitive performance, but both samples had equivalent mis-estimation. Repeated-measures analyses found that NA did not manifest significant variability over time either between or within participants in the two diagnostic groups. Within-group analyses found that higher average NA was associated with greater mis-estimation and poorer cognitive performance in participants with bipolar disorder, but not in those with schizophrenia.

Conclusion: Negative moods had a significant association with impairments in self-assessment of cognitive performance in participants with bipolar disorder. Our study did not confirm previous cross-sectional findings of more accurate self-assessment associated with greater NA in schizophrenia. These findings suggest that cross-sectional assessments , particularly self-reports, may lead to different results than aggregated data from longitudinal evaluations.

Keywords

Schizophrenia; Bipolar Disorder; Cognitive functioning; Introspective Accuracy; Negative Affect; Ecological Momentary Assessment

1. Introduction

Cognitive impairments in the domains of attention, verbal learning, and executive function are very common in participants with serious psychiatric disorders such as schizophrenia or bipolar disorder and are associated with a reduction in psychosocial functioning (Cowman et al., 2021; Harvey and Strassnig, 2012; Knight Baune, 2018; Leifker et al., 2009; Tsapekos et al., 2021). The concept of behavioral definitions of psychosocial functioning can traced back to when Katz et al. (1963) defined psychosocial functioning in terms of activities of daily living. The World Health Organization's International Classification of Functioning, Disability and Health (ICF) describes functioning and disability as the outcome of a complex, multidimensional interaction between a person's health condition(s) and context (environmental and personal factors; WH0, 2001). Accordingly, functioning is defined by the patient's ability to perform activities in six specific domains (e.g., Cognition, Mobility, Self-care, Getting along, Life activities, and Participation) which have served as the basis for a number of widely used disability assessments, such as the World Health Organization Disability Assessment Scale (WHO-DAS; Üstün et al., 2010).

WHO-DAS measured psychosocial disability can be identified in participants with both bipolar disorder and schizophrenia (Strassnig et al.,2018). The prevalence rates for cognitive impairments using a 5th percentile impairment threshold in bipolar disorder are between 5.3–57.7% for executive function, 9.6–51.9% for attention and working memory, 23.3–44.2% for speed and reaction time, and 8.2–42.1% for verbal memory (Cullen et al., 2016). Participants with schizophrenia often show more severe and pervasive cognitive deficits (Bortolato et al., 2015) with approximately 80% of participants exhibiting clinically significant deficits (McCleery and Nuechterlein, 2022). However, it appears that subjective cognitive impairments do not always correspond to objective ones in bipolar disorder (Faurholt-Jepsen et al., 2020), schizophrenia (Keefe et al., 2006) or in mixed samples of

inpatients (Moritz et al., 2004), and that greater disjunction between subjective and objective cognitive deficits is a predictor of reduced psychosocial world functioning and quality of life (Gould et al., 2015; Hill et al., 2017). In addition to reduction in functioning and clinical problems caused by cognitive impairments (Bortolato et al., 2015), cognitive deficits are associated with a higher risk for somatic diseases including hypertension, diabetes, and metabolic syndrome in schizophrenia (Hagi et al., 2021; Harvey and Strassnig, 2012) as well as in bipolar disorder (Dalkner et al., 2021). Researchers have concluded that developing insight into the mechanism of self-awareness is a useful target in treatment models for people with severe psychiatric disorders (Moritz Lysaker, 2018). Therefore, current research has started to address whether accuracy of self-assessment of cognitive abilities, known as introspective accuracy (IA), affects social and psychological functioning in the same way as actual impairments in cognition and how IA is related to mood and clinical symptom parameters in various psychiatric disorders.

Our definition of IA is based on the congruence between judgments of the quality of performance and objective data regarding performance. Recent studies concluded that reduced IA was associated with poor outcomes including impairments in social functioning, depressive symptoms, and everyday functioning (Pinkham et al., 2018; Silberstein Harvey, 2019; Springfield Pinkham, 2020). Recently, Tercero et al. (2021) used a metacognitive Wisconsin Card sorting test and were able to show that momentary IA differed in participants with schizophrenia and bipolar disorder. The discrepancy between actual cognitive test performance and momentary self-assessments was more impactful in schizophrenia, in that the participants tended to be more reliant on self-generated impressions of performance than objective feedback on their performance when generating a global self-assessment of their overall abilities at the end of the task.

In addition, IA for social cognitive abilities was found to be a better predictor of functional outcome measures than actual social cognitive test performance (Silberstein et al., 2018), replicating previous findings regarding neurocognition and IA (Gould et al., 2015). Accordingly, Fischer et al. (2020) observed that self-reported social functioning is related to metacognitive performance and concluded that the metacognitive capacity moderates the effects of symptoms on functioning, independent of the effects of neurocognition. In a recent meta-analysis, Rouy et al. (2021) concluded that in metacognition research on schizophrenia, the inclusion of mood and clinical symptoms is needed, but still lacking.

Ecological Momentary Assessment (EMA) is an efficient way to collect real-time information about functioning, productivity, and clinical symptoms in the actual environment of the participants. Information on activities, social interaction, or current mood states can be queried several times a day via smartphone, resulting in a quantitative collection of data on functioning, productivity, and disability over time, which can then be correlated with other clinical data. Previous EMA studies in schizophrenia and bipolar disorder investigated affective experiences and effects on mobility and concluded that momentary emotions and affect play a crucial role in participants' everyday life and mobility (Mote and Fulford, 2020; Parrish et al., 2020; Strassnig et al. 2021a,b). In addition, Merikangas et al. (2019) showed that momentary ratings of decreased activity in bipolar disorder were significantly associated with later sad moods and were related to earlier sad

moods on a trend level. In another study, momentary sad moods predicted fewer productive activities and more unproductive and passive activities in participants with bipolar disorder, with both momentary sadness and the number of unproductive activities independently predicting independent ratings of real-world social functioning (Harvey et al., 2022). In this context, it is important that ratings of negative mood states, commonly referred to Negative Affect (NA; Watson et al., 1988) such as sadness and anxiety can be used to predict psychiatric symptoms including posttraumatic stress, substance abuse, depression, and suicide history (Bradley et al., 2011). However, EMA studies of affective experiences and the impact on cognitive performance and self-assessment of such performance are scarce. One recent study found that smartphone-based, patient-rated cognitive impairments were associated with greater perceived stress, lower quality of life, and functional capacity in participants with bipolar disorder (Faurholt-Jepsen et al., 2020). In a previous analysis on an earlier version of this data set (before the COVID-19 pandemic), Jones et al. (2021) showed that 20% of participants with schizophrenia reported never experiencing any momentary sad moods over up to 90 EMA assessments and these same participants overestimated their cognitive and everyday functioning. Two cross-sectional studies (Harvey et al. 2017; 2019) found that participants with schizophrenia who reported a complete absence of sadness (at a single in-person assessment) significantly overestimated their functioning compared to observer ratings and that greater cross-sectional severity of sadness was associated with more agreement between self-reports and observer ratings. In a cross-sectional study in bipolar depression with similar methods (Harvey et al., 2015), higher levels of self-reported sadness were associated with underestimating cognitive abilities and everyday functioning compared to clinician ratings, suggesting different tendencies across bipolar disorder and schizophrenia in the associations of mood state and self-assessment accuracy.

To date there has been no study that examined the associations of negative mood states sampled longitudinally over time with cognitive test performance and self-assessment of that performance in participants with schizophrenia and bipolar disorder. We examined the longitudinal course of NA with EMA assessments, examining between-subjects effects with repeated-measures analysis of variance and within-subjects effects with mean sum of squared differences (MSSD) analyses. Based on cross sectional findings we hypothesized that:

1. participants with schizophrenia with higher levels of NA would manifest less impairments in IA;
2. Participants with bipolar disorder with greater NA would have greater impairments in IA;
3. NA would have limited association with cognition in schizophrenia, because clinical symptoms and mood states are generally not associated with cognitive performance (McCleerey and Nuechterlein, 2022);
4. Higher NA might be associated with poorer cognitive performance in participants with bipolar disorder.

This final prediction is in line with previous results suggesting more common sadness correlates with poorer functional outcomes (Judd Akiskal, 2003) and the findings of slightly

worse performance in neuropsychological assessments in symptomatic, as compared to euthymic, participants with bipolar disorder (Malhi et al., 2007; Wingo et al., 2009).

Methods

2.1 Participants

For this study, 240 DSM-5 diagnosed participants with schizophrenia or schizoaffective disorder, or bipolar disorder (Type I or II) were recruited from three study 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. The study was approved by each University's respective ethics committee, and all participants provided written informed consent. All participants were screened for potential eligibility using the following criteria: (1) clinically stable (for a minimum of six weeks no hospitalizations or extended ambulance contact and a stable medication regimen; (2) no history of or current medical or neurological disorders that may affect brain functioning; (3) no history of intellectual disability (IQ <70); (4) no history of substance use disorder; (5) no visual or hearing impairments that interfere with assessment, and (6) no lack of proficiency in English. In addition, individuals with bipolar disorder also had to meet stage 3 or higher indicating at least one mood episode recurrence or incomplete remission from a first episode according to the staging model by Frank et al. (2015). For a detailed description of the study protocol please see our previous reports (Durand et al., 2021; Harvey et al., 2021; Jones et al., 2021; Strassnig, et al., 2021b). This is an updated data set that includes all data collected to date.

Previous reports on the earlier version of the sample have examined EMA measures of avolition, utilization of feedback to improve performance on cognitive tests, the correlation of momentary mood states with global judgments of cognitive and functional abilities, the role of confidence in performance serial tests such as the Wisconsin card sorting test, and the correlation of EMA and clinically rated moods and symptoms. The current sample includes 25 participants with schizophrenia who are new since the previous publications and 43 participants with bipolar disorder.

2.2 Instruments

2.2.1 Neurocognitive performance and measurement of introspective accuracy—

A cognitive, clinical, and functional assessment was performed at the end of the 30-day EMA period described as below. The cognitive tests were tasks from the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008) to assess psychomotor processing speed (Trail Making Test Part A, Semantic fluency (Animal Naming Test), auditory working memory (Letter-Number Sequencing), and verbal learning and memory (Hopkins Verbal Learning Test). These tasks were selected because of their high correlation with composite scores for the MCCB and their brief duration (about 15 minutes total assessment time). We administered the symbol coding test, but since this test was not administered remotely, it was not collected for a proportion of the sample and is not included in these analyses. Immediately after completion of each task participants were

asked to rate their performance. For each test, participants were provided with a realistic range of possible performance, for example: Hopkins Verbal Learning test: "*There are a total of 36 possible correct responses on this test. How many did you get correct*?" Trail Making Test IA Question: "*How many seconds did it take you to complete the task?* (ex. 0.00)". We subtracted actual performance from self-reported performance, resulting in positive difference values reflecting overestimation and negative values reflecting underestimation.

2.2.2 EMA procedures—As detailed in our previous reports (Durand et al., 2021; Jones et al., 2021; Strassnig, et al., 2021b), a Samsung smartphone with Android OS was used to collect the EMA data. Participants either used their own device or a device was provided to them for use during the 30-day EMA period. Participants received text messages with weblinks to EMA surveys 3 times daily for 30 days. Survey data were not stored on the device but was sent to an encrypted, Health Insurance Portability and Accountability Act-compliant, cloud storage location in Amazon Web Services. Participants did not need to have a Wi-Fi connection to send data to the cloud as the study provided them with a data plan. This system allowed researchers to access participant data in real time and monitor their progress daily (Amazon Webservices). The text notifications occurred at stratified random intervals that varied from day to day within, on average, 4.0-hour windows starting at approximately 9:00AM and ending at 9:00PM each day. The first and last daily assessment times were adjusted to accommodate each participant's typical sleep and wake schedules. All responses were time-stamped and were only allowed within a 1-hour period following the signal, although participants had the option of silencing alarms for 30-minute intervals (e.g., driving, naps, classes). An in-person training session (typically <20 min) was provided on how to operate and charge the device and respond to surveys, including the meaning of all questions and response choices. We selected this one-hour window prior to the start of this study in contrast to other intervals (e.g., 15 minutes) because of our findings in previous studies that participants commonly engaged in only one activity in the past hour (Strassnig et al., 2021a,b) and were also either home or away for the entire past hour in 85% of the surveys returned (Granholm et al., 2020; Parrish et al., 2020).

2.2.3 Mood Sampling—EMA surveys were check-box questions asking about behaviors performed in specified time periods. The first survey queried about "today" and the next two queried "Since the last survey". The first question in each survey asked about the participant's location, home vs. away. The next screen queried as to with whom the person was. Options for this question included: alone, spouse or partner, friends, other family members, pets, healthcare providers, caregivers, other known people, and unknown people. Being with a pet, but not a human, was considered "alone." Then, a customized home alone, home with someone, or away survey was delivered. The subsequent screens then asked what the participant was doing, with response options including an array of 34 different activities ranging from working for pay, cleaning the house, watching television, or doing "nothing."

Questions about momentary moods were delivered at each survey. Moods were queried in sequence, so that sadness, happiness, anxiety, and relaxation were all queried with a 1 (Completely absent)–7 (Extremely Severe) scale. In line with previous studies of negative

affect, we averaged the mood reports for sadness and anxiety into a single “Negative Affect“ (NA) index.

2.3 Clinical Assessments.

All participants were assessed on the day of their cognitive testing with structured clinical rating scales for depression, Mania, and Psychotic Symptoms.

2.3.1. Clinical ratings of Mood Symptoms—Participants were rated with the Montgomery-Asberg Depression Rating scale (MADRS; Montgomery and Asberg, 1979) and the Young Mania Rating Scale (YMRS; Young et al., 1978). We present endpoint scores on these measures and relate these endpoint scores to EMA measures. Raters were trained to high levels of inter-rater reliability and generated ratings while unaware of the results of the EMA surveys.

2.3.2 Schizophrenia-Related Symptoms.—Severity of symptoms was evaluated with the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987), which was administered in its entirety by trained raters and on the same day as the cognitive assessments. These raters had extensive experience in other studies of participants with severe mental illness and were trained to high reliability (ICC>.80) by the study PI (Pinkham). The PANSS consists of 30 items and each item was scored on a 7-point Likert scale ranging from 1 to 7:

2.3.3 Negative Symptom Models.—Khan and colleagues (2017) generated a two-factor model of negative symptoms measured by the PANSS, identifying dimensions of expressive deficits and experiential deficits. This model is clinically relevant as the reduced emotional experience factor has been shown to predict variance in everyday functioning in very large samples (Harvey et al., 2017). The items in the *PANSS Reduced Emotional Experience* factor are: Emotional Withdrawal (N2), Passive/Apathetic Social Withdrawal (N4) and Active Social Avoidance (G16).

2.4 Statistical analysis

2.4.1 Cognitive performance and IA.—We created composite scores for both cognition and IA. As the symbol coding test was not administered remotely, we aggregated the other four tests which were available for the entire sample. For cognition, we created test x test standard scores in the entire sample and averaged them into a single score. For IA, we took the difference of self-reported performance and actual performance for each of the four tests, turned the difference scores into an absolute value, and then created standard scores and averaged them. Thus, higher scores on cognitive performance reflect better performance and higher scores on IA reflect higher levels of inaccuracy compared to actual performance. As a validity check on the creation of standard scores, we also created a single principal component score for cognitive performance and used a Pearson correlation to compare it to the standardized score. The correlation was r=.98 in both samples, so we used the standard score for ease of interpretation.

2.4.2 Mood State Variability.—Mixed model repeated measures (MMRM) analyses were used to examine variability in NA over time. We used mixed effects hierarchical linear modeling (HLM) wherein we examined the time course of the NA reports. For these initial analyses, we entered Day (1–30) and Survey (1–3) as repeated-measures, diagnosis as fixed factor, and subject as a random intercept. We used the Generalized Linear Models (GLM) program from SPSS version 28 (IBM corporation, 2022). We used the omnibus test to determine that the fitted model improved on the intercept-only model. There was considerable redundancy/reciprocity between NA and PA: in the entire sample, the mixed model association (adjusting for random intercept, Day, and Session) between the [up to] 90 PA ratings and momentary NA ratings was $\chi 2(6)=3025.70$, $p<1.0 \times 10^{-5}$,B=−.62.

To examine between-subjects effects we used the daily scores on NA in the model above. Mean square of successive difference (MSSD), or the sum of consecutive observation differences squared, was calculated as a measure of within-person variability (Jahng et al., 2008). This index was calculated as the average difference between successive EMA responses on NA., yielding single value per day which was averaged over all days with surveys answered. As an example of this variable, an index score of 1 would mean that the average **difference** between successive responses was 1 ($1^2=1$) and an average difference from item to item of 2 would yield a value of 4. Note that the lowest level of resolution of the scale is 1.0. MSSD was calculated with R version 3.6.0.

In the event of non-significant time-course effects on NA, we planned to use a regression strategy, creating an NA mean score for each participant across all observations and regressing those means on cognitive performance and IA. Only cases who did not complete the endpoint cognitive assessments were excluded. Missing survey data for cases who completed the endpoint assessments were addressed by using full-information maximum likelihood procedures.

There were two outliers in the schizophrenia sample. They had scores of misestimation of 9.0 SD, because they gave delusional responses on the self-reported TMT A (15 minutes and 12 minutes), despite test performance that was not exceptional and were therefore excluded for analyses of introspective accuracy.

3. Results

There was a total of 21,019 surveys sent and 15,423 answered (73%) with all needed information. Table 1 gives the demographic information for the sample. There were differences in age, educational attainment, and mothers' education; participants with bipolar disorder were younger and had higher scores on the educational variables. Indicators of disability also were more substantial in the participants with schizophrenia and all three PANSS variables were more severe in this sample as well. No differences were seen in MADRS scores and the participants with bipolar disorder had higher YMRS scores, although their scores were in the remitted range other than for 1 participant.

In order to understand the importance of the demographic variables that differed between the samples, we computed Pearson Product moment correlations within each sample between

age, years of education, mothers' years of education, and the three critical outcomes variables: composite cognitive performance, absolute value IA errors, and mean scores on NA. For the participants with schizophrenia, younger age and more education were correlated with better scores on composite cognition (*r*'s=−.25 and .34, *p*<.002). Mothers' education was not correlated with composite cognitive performance, (*r*=.049, *p*=.63). Reduced emotional experience, but none of the other clinical or mood variables, manifested a nominally significant correlation with composite cognitive performance, r=−.19, p=.035. None of the demographic variables correlated with absolute introspective accuracy or with average NA. For the participants with bipolar disorder, the findings were essentially identical. Younger age and more education were correlated with better scores on composite cognition (*r*'s=−.39 and .38, *p*<.001). Mothers' education was not correlated with composite cognitive performance, (*r*=.12, *p*=.11). Reduced emotional experience, but none of the other clinical variables, manifested a nominal correlation with composite cognitive performance, r=.23, p=.025, None of the demographic variables correlated with absolute IA or with average NA.

Supplemental table 1 presents medication information on participants. Given the nature of our study, we could not confirm whether participants were adherent to the medications that they were prescribed and did not perform any additional analyses on those data.

The cognitive and self-report scores of the participants are presented in Table 2. Participants with bipolar disorder had better cognitive performance than participants with schizophrenia on all tasks and on the composite. There was only one difference in self-reported performance, however, with the participants with bipolar disorder reporting that they performed better on letter-number sequencing. There were no differences in absolute value IA across the samples. The absolute IA score was significantly greater than 0 for both participants with schizophrenia, t(125)=12.98 p<.001, and bipolar disorder, t(113)=14.85, p<.001, reflecting a statistically significant mis-estimation of performance. When the two demographic variables that correlated with composite cognitive performance were entered as covariates in an analysis of covariance comparing testing diagnosis on composite cognitive performance, the effect of diagnosis was still significant, F (1,238)=12.69, p<.001. However, the covariate effects of both age, F(1,238)=25.04, p<.001, and education, F (1,238)=31.66, p<.001, were statistically significant. For the reduced emotional experience PANSS variable, there was also a significant covariate effect, F(1,238)=10.88, p<.001, which did not eliminate the effects of diagnosis on composite cognitive performance, F(1,238)=10.96, p<.001.

Table 2 also shows the frequencies of NA ratings (averaged across the two items) in both samples. As can be seen in the table, there was a considerably greater prevalence of low NA ratings compared to higher ones. There were no group differences in mean NA across the two samples.

3.1. Time Effects on EMA Negative Affect Variables

As can be seen in Table 3, the omnibus test for overall analysis of day and time of day variables on NA was not statistically significant, suggesting no between-subjects differences associated with longitudinal NA. For analyses of the MSSD, there were no significant group

differences in the MSSD for NA. The mean MSSD for both groups was less than 1.0, and the overall sample MSSD did not differ significant from a value of 1, meaning that on average the survey to survey differences were 1.0 or less, which is the smallest level of resolution possible with the 1–7 point mood scale. Thus, there was limited evidence of within-subjects variation in NA.

As there were no significant time-related effects in NA from the HLM and MSSD analyses, we created an average NA score for each participant, using all non-missing surveys and used the SPSS version 28 non-linear regression subprogram “curve fitting” to correlate mean NA scores for the participants, separated by diagnosis, with the corresponding mean values of absolute value IA and composite cognitive performance. For analyses of both IA and cognitive performance, we entered both linear and quadratic terms and examined the significance of the two models. Linear terms entered the model first and then quadratic terms entered the equation, in order to determine if non-linear effects were significant after consideration of linear effects. Table 4 presents the results of the analyses and Figure 1 presents scatterplots of the results. As can be seen in the table, there were no significant linear nor quadratic effects for the correlation of NA with either cognition or IA in the participants with schizophrenia. In contrast, for the participants with bipolar disorder, there were significant linear and quadratic correlations with introspective accuracy, with higher NA predicting greater absolute inaccuracy scores for IA in the linear model and the highest levels of NA also suggesting acceleration in prediction in the quadratic model. Interestingly, for prediction of cognition, the quadratic effect was significant and the linear effect was not. Looking at the curve for the data, it suggests that participants with the lowest average NA and the highest average NA both had slight reductions in cognitive performance.

4. Discussion

This study supported the hypothesis that the experience of negative affect has an association with IA which differs across schizophrenia and bipolar disorder, with the association of NA and IA across the two samples diverging completely. Consistent with recent studies demonstrating overestimation of cognitive function in both participants with schizophrenia and bipolar disorder (Tercero et al., 2021), we observed immediate overestimation of performance in both groups. Higher levels of NA averaged over the sampling period were associated with greater challenges in IA in participants with bipolar disorder. In contrast to previous cross-sectional studies, there was no increase in IA accuracy in participants with schizophrenia with a higher mean severity of NA. For cognitive performance, there were two effects of note: participants with schizophrenia demonstrated essentially no correlation between NA and cognitive performance, while in the bipolar group those participants who reported the complete absence of NA had poorer cognitive performance than those with moderate NA intensity ratings and the highest NA ratings correlated with poorer cognitive performance. This non-linear association suggests that very low NA ratings, which would be expected to be somewhat less common in bipolar disorder, may have cognitive ability correlates. In general, the association between NA, IA, and cognition seemed interpretable in participants with bipolar disorder.

While the lack of an NA→IA relationship may seem inconsistent with the studies cited above, wherein low scores on the Beck Depression Inventory were associated with overestimation of abilities, momentary judgments of immediately proximal test performance may be a different process than that of generation of a global self-rating of competence in a broad domain such as social functioning, work skills, or cognition. In our previous study, momentary judgments of task performance were inaccurate in both schizophrenia and bipolar disorder, but participants with bipolar disorder generated self-assessments of their overall task performance that were correlated with their number of correct task responses, but the participants with schizophrenia did not (Tercero et al., 2021). The discrepancy from previous cross-sectional results in participants with schizophrenia may also be related to the fact that those studies used a single self-assessment on a depression scale, rather than an aggregation of momentary mood state ratings. The lack of temporal variation in NA does still not preclude response bias in cross sectional judgments. There could very well be a global self-assessment bias wherein the overall belief that one is never sad is associated with the idea that one has no other life challenges as well.

Previous cross-sectional studies have suggested that there are modest cognitive performance differences between participants with bipolar disorder during euthymia and during affective episodes. These results are consistent with those findings, which were also captured at a single point in time. There are a few previous momentary studies of affective experience in bipolar disorder (Merikangas et al., 2019; Mote and Fulford, 2020; Strassnig, et al., 2021b), but none have linked predominant mood states to the ability to accurate gauge immediately proximal task performance. We found that between subjects' variation in mood states over time were minimal and that within-person variation in mood states was also limited. Given the level of chronicity and disability seen in the sample, these low ratings on NA may themselves reflect challenges in momentary assessments of mood states, possibly indicating challenges with "emotional introspective accuracy".

Given the magnitude of over-estimation of cognitive abilities in both samples and the previous data suggesting adverse impacts on everyday functioning, therapeutic interventions targeting mis-estimation and response bias seem critical. Previous reviews have suggested that the impact of mis-estimation of skills on disability is as great as the impact of cognitive impairments (Harvey et al., 2019). Mervis et al (2022) suggested that integrative therapies are making progress in terms of their development, but also cautioned that the increasing the accuracy of self-assessments may lead to adverse impacts on self-esteem and depression. Therapies targeting response biases and making decisions on the basis of inadequate information have been shown to be broadly effective in psychotic conditions (Penney et al., 2022) and digitally delivered variants of these interventions are available (Bruhns, et al., 2022).

There are some limitations that must be considered. First, as noted above, the distribution of NA reports was skewed in the direction of lower scores. Further, there no time effects or appreciable evidence of within-subjects variance in reports of NA, suggesting that in these two samples the experience of NA has trait-like qualities. In previous studies of participants with bipolar disorder assessed on a weekly or monthly basis, months with no mood symptoms at all were not uncommon, comprising about 40% of the months sampled

(Judd et al., 2005). This finding is consistent with limited day to day variance in negative affect. These previous findings of many months with no mood symptoms, across polarity, also suggest that low scores on NA are not completely implausible in bipolar disorder. There is about 25% missing survey data, nonetheless, this study is one of the largest studies using an EMA assessment in the psychiatric setting and the first to aggregate predominant mood experience over a month and relate it to self-assessment accuracy Future research with real-time momentary assessments of mood states, cognitive performance, and the accuracy of momentary judgments of performance will get even closer to the accuracy of self-assessment and any possible associations with the quality of cognitive performance. It could be argued that a healthy comparison group would be important in such a study. However, in our previous case-control study with healthy controls, (Granholm et al, 2020), the mean NA score across 49 surveys was 1.6, which is considerably lower than the participants in this study. In fact, the modal score for healthy controls in both sad (72%) and anxious (74%) was a score of 1 on the 7-point scale, which was more than twice as common as scores of 1 in our current sample.

4.1 Conclusions

Over-estimation of cognitive performance was substantial in both participants with schizophrenia and bipolar disorder, with no diagnostic differences in overall inaccurate IA. More intense NA mood states aggregated from momentary assessments were correlated with both cognitive task performance and self-assessment of that performance in participants with bipolar disorder, with no similar relationships seen in participants with schizophrenia. Momentary reports of mood states were skewed toward lower severity scores in both samples and did not vary notably over time or at within subjects levels. Later research will have to fine tune the assessment of misestimation and momentary mood states, perhaps by using repeated cognitive performance assessments, IA estimates, and immediately generated global impressions of performance linked in real time to the current mood states.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Bortolato B, Miskowiak KW, Köhler CA, Vieta E, Carvalho AF 2015. Cognitive dysfunction in bipolar disorder and schizophrenia: a systematic review of meta-analyses. Neuropsychiatric Dis. Treat 11, 3111–3125. 10.2147/NDT.S76700

Bradley B, DeFife JA, Guarnaccia C, Phifer J, Fani N, Ressler KJ, Westen D 2011. Emotion dysregulation and negative affect: association with psychiatric symptoms. J. Clin. Psychiatry 72(5), 685–691. doi:10.4088/JCP.10m06409bl [PubMed: 21658350]

Bruhns A, Lüdtke T, Moritz S, Bücker L 2022. A Mobile-Based Intervention to Increase Self-esteem in Students With Depressive Symptoms: Randomized Controlled Trial [published correction appears in JMIR Mhealth Uhealth 10(5):e39448] doi:10.2196/26498

Cowman M, Holleran L, Lonergan E, O'Connor K, Birchwood M, Donohoe G 2021. Cognitive predictors of social and occupational functioning in early psychosis: A systematic review and meta-analysis of cross-sectional and longitudinal data. Schizophr. Bull 47:1243–1253.10.1093/schbul/sbab033 [PubMed: 33761534]

Cullen B, Ward J, Graham NA, et al. 2016. Prevalence and correlates of cognitive impairment in euthymic adults with bipolar disorder: A systematic review. J Affect Disord 2016;205:165–181. doi:10.1016/j.jad.2016.06.063 [PubMed: 27449549]

Dalkner N, Bengesser SA, Birner A, Fellendorf FT, Fleischmann E, Großschädl K, Lenger M, Maget A, Platzer M, Queissner R, Schönthaler E, Tmava-Berisha A, Reininghaus EZ 2021. Metabolic syndrome impairs executive function in bipolar disorder. Front. Neurosci 984. 10.3389/fnins.2021.717824

Durand D, Strassnig MT, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD 2021. Self-reported social functioning and social cognition in schizophrenia and bipolar disorder: Using ecological momentary assessment to identify the origin of bias. Schizophr. Res230. 17–23. 10.1016/j.schres.2021.02.011 [PubMed: 33667854]

Faurholt-Jepsen M, Miskowiak KW, Frost M, Christensen EM, Þórarinsdóttir H, Bardram JE, Vinberg M, Kessing LV 2020. Patient-evaluated cognitive function measured with smartphones and the association with objective cognitive function, perceived stress, quality of life and function capacity in patients with bipolar disorder. Int. J. Bipol. Disord 8(1), 1–12. 10.1186/s40345-020-00205-1

Fischer MW, Dimaggio G, Hochheiser J, Vohs JL, Phalen P, Lysaker PH 2020. Metacognitive Capacity Is Related to Self-Reported Social Functioning and May Moderate the Effects of Symptoms on Interpersonal Behavior. J. Nerv. Ment. Dis208: 138–142. 10.1097/NMD.0000000000001117 [PubMed: 31821215]

Frank E, Nimgaonkar VL, Phillips ML, Kupfer DJ 2015. All the world's a (clinical) stage: Rethinking bipolar disorder from a longitudinal perspective. Mol. Psychiatry 20: 23–3110.1038/mp.2014.71 [PubMed: 25048003]

Gould F, McGuire LS, Durand D, Sabbag S, Larrauri C, Patterson TL, Twamley EW, Harvey PD 2015. Self-assessment in schizophrenia: Accuracy of evaluation of cognition and everyday functioning. Neuropsychology 29: 675–682. 10.1037/neu0000175 [PubMed: 25643212]

Granholm E, Holden JL, Mikhael T, Link PC, Swendsen J, Depp C, Moore RC, Harvey PD 2020. What Do People with Schizophrenia Do All Day? Ecological Momentary Assessment of Real-World Functioning in Schizophrenia. Schizophr. Bull 46. 242–251 10.1093/schbul/sbz070

Hagi K, Nosaka T, Dickinson D, Lindenmayer JP, Lee J, Friedman J,et al. 2021. Association between cardiovascular risk factors and cognitive impairment in people with schizophrenia: a systematic review and meta-analysis. JAMA Psychiatry, 78(5), 510–518. doi:10.1001/jamapsychiatry.2021.0015 [PubMed: 33656533]

Harvey CD, Moore R, Depp CA, Ackerman RA, Pinkham AE, Harvey PD 2022. The association of momentary sad moods, concurrent productive behaviour, and global functional outcomes: a 30-day ecological momentary assessment study of people with bipolar illness. Cogn. Neuropsychiatry 27(5):342–355. doi:10.1080/13546805.2022.2070464 [PubMed: 35499098]

Harvey PD, Deckler E, Jones MT, Jarskog LF, Penn DL, Pinkham AE 2019. Autism symptoms, depression, and active social avoidance in schizophrenia: Association with self-reports and informant assessments of everyday functioning. J. Psychiatric Res 115. 36–42. 10.1016/j.jpsychires.2019.05.010

Harvey PD, Khan A, Keefe RSE 2017. Using the Positive and Negative Syndrome Scale (PANSS) to Define Different Domains of Negative Symptoms: Prediction of Everyday Functioning by Impairments in Emotional Expression and Emotional Experience. Innov Clin Neurosci;14(11–12):18–22. [PubMed: 29410933]

Harvey PD, Miller ML, Moore RC, Depp CA, Parrish EM, Pinkham AE 2021. Capturing clinical symptoms with ecological momentary assessment: Convergence of momentary reports of psychotic and mood symptoms with diagnoses and standard clinical assessments. Innov. Clin. Neurosci 18. 24–30.

Harvey PD, Paschall G, Depp C 2015. Factors influencing self-assessment of cognition and functioning in bipolar disorder: A preliminary study. Cogn. Neuropsychiatry 20, 361–371. 10.1080/13546805.2015.1044510 [PubMed: 26057868]

Harvey PD, Strassnig M 2012. Predicting the severity of everyday functional disability in people with schizophrenia: Cognitive deficits, functional capacity, symptoms, and health status. World Psychiatry 11: 73–79. 10.1016/j.wpsyc.2012.05.004 [PubMed: 22654932]

Harvey PD, Strassnig MT, Silberstein J 2019. Prediction of disability in schizophrenia: Symptoms, cognition, and self-assessment. J Exper. Psychopathol, 10(3), 2043808719865693. 10.1177/2043808719865693

Harvey PD, Twamley EW, Pinkham AE, Depp CA, Patterson TL 2017. Depression in schizophrenia: Associations with cognition, functional capacity, everyday functioning, and self-assessment. Schizophr. Bull 43. 575–582.,10.1093/schbul/sbw103

Hill NL, McDermott C, Mogle J, Munoz E, DePasquale N, Wion R, Whitaker E 2017. Subjective cognitive impairment and quality of life: a systematic review. Int. Psychogeriatr 29(12), 1965–1977. [PubMed: 28829003]

IBM Corporation. 2021. Statistical package for the social sciences (SPSS) Edition 26, Armonk, NY 2020

Jahng S, Wood PK, Trull TJ. Analysis of affective instability in ecological momentary assessment: Indices using successive difference and group comparison via multilevel modeling. Psychol Methods 2008 Dec;13(4):354–75. [PubMed: 19071999]

Jones SE, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD 2021. Daily Ecological Momentary Assessments of happy and sad moods in people with schizophrenia and bipolar disorders: What do participants who are never sad think about their activities and abilities? Schizophr Res. Res.: Cogn 26. 100202 10.1016/j.scog.2021.100202

Judd LL, Akiskal HS 2003. Depressive episodes and symptoms dominate the longitudinal course of bipolar disorder. Curr. Psychiatry Rep 5: 417–418. 10.1007/s11920-003-0077-2 [PubMed: 14609495]

Judd LL, Akiskal HS, Schettler PJ, Endicott J, Leon AC, Solomon DA, Coryell W, Maser JD, Keller MB 2005. Psychosocial disability in the course of bipolar I and II disorders: A prospective, comparative, longitudinal study. Arch. Gen. Psychiatry; 62. 1322–1330.10.1001/archpsyc.62.12.1322 [PubMed: 16330720]

Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW 1963. Studies of illness in the aged:. The Index of ADL: A standardized measure of biological and psychosocial function. JAMA, 185: 914–919 [PubMed: 14044222]

Kay SR, Fiszbein A, Opler LA, 1987. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr. Bull 13(2), 261–276. [PubMed: 3616518]

Keefe RS, Poe M, Walker TM, Kang JW, Harvey PD. 2006. The Schizophrenia Cognition Rating Scale: an interview-based assessment and its relationship to cognition, real-world functioning, and functional capacity. Am J Psychiatry;163(3):426–432. doi:10.1176/appi.ajp.163.3.426 [PubMed: 16513863]

Khan A, Liharska L, Harvey PD, Atkins A, Ulshen D, Keefe RSE 2017. Negative Symptom Dimensions of the Positive and Negative Syndrome Scale Across Geographical Regions: Implications for Social, Linguistic, and Cultural Consistency. Innov. Clin. Neurosci 14(11–12), 30–40.

Knight MJ, Baune BT 2018. Executive Function and Spatial Cognition Mediate Psychosocial Dysfunction in Major Depressive Disorder. Front. Psychiatry 9: 00539. 10.3389/fpsyt.2018.00539

Leifker FR, Bowie CR, Harvey PD 2009. Determinants of everyday outcomes in schizophrenia: The influences of cognitive impairment, functional capacity, and symptoms. Schizophr. Res115: 82–87. 10.1016/j.schres.2009.09.004 [PubMed: 19775869]

Malhi GS, Ivanovski B, Hadzi-Pavlovic D, Mitchell PB, Vieta E, Sachdev P 2007. Neuropsychological deficits and functional impairment in bipolar depression, hypomania and euthymia. Bipol. Disord. 9: 114–125. 10.1111/j.1399-5618.2007.00324.x

Merikangas KR, Swendsen J, Hickie IB, Cui L, Shou H, Merikangas AK, et al. . 2019. Real-time Mobile Monitoring of the Dynamic Associations among Motor Activity, Energy, Mood, and Sleep in Adults with Bipolar Disorder. JAMA Psychiatry 76: 190–198. 10.1001/jamapsychiatry.2018.3546 [PubMed: 30540352]

Mervis JE, Vohs JL, Lysaker PH 2022. An update on clinical insight, cognitive insight, and introspective accuracy in schizophrenia-spectrum disorders: symptoms, cognition, and treatment. Exp. Rev. Neurotherapeutics, 22(3), 245–255. 10.1080/14737175.2022.2049757

McCleery A, Nuechterlein KH 2022. Cognitive impairment in psychotic illness: prevalence, profile of impairment, developmental course, and treatment considerations. Dial. Clin. Neurosci 21: 239–248. 10.31887/DCNS.2019.21.3/amccleery

Montgomery SA, Asberg M, 1979. A new depression scale designed to be sensitive to change. Br. J. Psychiatry 134, 382–389. [PubMed: 444788]

Moritz S, Ferahli S, Naber D. 2004. Memory and attention performance in psychiatric patients: lack of correspondence between clinician-rated and patient-rated functioning with neuropsychological test results. J Int Neuropsychol Soc 10(4), 623–33. doi: 10.1017/S1355617704104153. [PubMed: 15327740]

Moritz S, Lysaker PH 2018. Metacognition–what did James H. Flavell really say and the implications for the conceptualization and design of metacognitive interventions. Schizophr. Res201, 20–26. 10.1016/j.schres.2018.06.001 [PubMed: 29903626]

Mote J, Fulford D 2020. Ecological momentary assessment of everyday social experiences of people with schizophrenia: A systematic review. Schizophr Res 216:56–68. 10.1016/j.schres.2019.10.021 [PubMed: 31874743]

Nuechterlein KH, Green MF, Kern RS, Baade LE, Barch DM, Cohen JD, et al. 2008. The MATRICS consensus cognitive battery, part 1: Test selection, reliability, and validity. Am J. Psychiatry 165 203–213. 10.1176/appi.ajp.2007.07010042

Parrish EM, Depp CA, Moore RC, Harvey PD, Mikhael T, Holden J, Swendsen J, Granholm E 2020. Emotional determinants of life-space through GPS and ecological momentary assessment in schizophrenia: What gets people out of the house? Schizophr. Res224.67–73. 10.1016/j.schres.2020.10.002 [PubMed: 33289659]

Penney D, Sauvé G, Mendelson D, Thibaudeau É, Moritz S, Lepage M 2022. Immediate and Sustained Outcomes and Moderators Associated With Metacognitive Training for Psychosis: A Systematic Review and Meta-analysis. JAMA Psychiatry;79(5):417–429. doi:10.1001/jamapsychiatry.2022.0277 [PubMed: 35320347]

Pinkham AE, Klein HS, Hardaway GB, Kemp KC, Harvey PD 2018. Neural correlates of social cognitive introspective accuracy in schizophrenia. Schizophr. Res202, 166–172. 10.1016/j.schres.2018.07.001 [PubMed: 30077432]

Rouy M, Saliou P, Nalborczyk L, Pereira M, Roux P, Faivre N 2021. Systematic review and meta-analysis of metacognitive abilities in individuals with schizophrenia spectrum disorders. Neurosci. Biobehav. Rev 126: 329–337. 10.1016/j.neubiorev.2021.03.017 [PubMed: 33757817]

Schaefer J, Giangrande E, Weinberger DR, Dickinson D 2013. The global cognitive impairment in schizophrenia: Consistent over decades and around the world. Schizophr Res. 150:42–50.. 10.1016/j.schres.2013.07.009 [PubMed: 23911259]

Silberstein J, Harvey PD 2019. Impaired introspective accuracy in schizophrenia: an independent predictor of functional outcomes. Cogn Neuropsychiatry;24(1):28–39. doi:10.1080/13546805.2018.1549985 [PubMed: 30477401]

Silberstein JM, Pinkham AE, Penn DL, Harvey PD 2018. Self-assessment of social cognitive ability in schizophrenia: Association with social cognitive test performance, informant assessments of social cognitive ability, and everyday outcomes. Schizophr. Res.199: 75–82. 10.1016/j.schres.2018.04.015 [PubMed: 29673732]

Springfield CR, Pinkham AE 2020. Introspective accuracy for social competence in psychometric schizotypy. Cogn. Neuropsychiatry 25(1), 57–70. 10.1080/13546805.2019.1683524 [PubMed: 31645224]

Strassnig MT, Harvey PD, Miller ML, Depp CA, Granholm E 2021a. Real world sedentary behavior and activity levels in patients with schizophrenia and controls: An ecological momentary assessment study. Ment. Health Phys. Act 20. 100364. 10.1016/j.mhpa.2020.100364

Strassnig M, Kotov R, Fochtmann L, Kalin M, Bromet EJ, Harvey PD 2018. Associations of independent living and labor force participation with impairment indicators in schizophrenia and bipolar disorder at 20-year follow-up. Schizophr Res;197:150–155. doi:10.1016/j.schres.2018.02.009 [PubMed: 29472164]

Strassnig MT, Miller ML, Moore R, Depp CA, Pinkham AE, Harvey PD 2021b. Evidence for avolition in bipolar disorder? A 30-day ecological momentary assessment comparison of daily activities in bipolar disorder and schizophrenia. Psychiatry Res 300: 113924. 10.1016/j.psychres.2021. [PubMed: 33848963]

Tercero BA, Perez MM, Mohsin N, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD 2021. Using a Meta-cognitive Wisconsin Card Sorting Test to measure introspective accuracy and biases in schizophrenia and bipolar disorder. J. Psychiatric Res 140: 436–442. 10.1016/j.jpsychires.2021.06.016

Tsapekos D, Strawbridge R, Cella M, Wykes T, Young AH 2021. Predictors of psychosocial functioning in euthymic patients with bipolar disorder: A model selection approach. J. Psychiatric Res 143: 60–67. 10.1016/j.jpsychires.2021.08.013

Ustün TB, Chatterji S, Kostanjsek N, et al. 2010. Developing the World Health Organization Disability Assessment Schedule 2.0. Bull World Health Organ ;88(11):815–823. doi:10.2471/BLT.09.067231 [PubMed: 21076562]

Watson D, Clark LA, Carey G 1988. Positive and negative affectivity and their relation to anxiety and depressive disorders. J Abnorm Psychol 97(3), 346–53. doi: 10.1037//0021-843x.97.3.346. [PubMed: 3192830]

Wingo AP, Harvey PD, Baldessarini RJ 2009. Neurocognitive impairment in bipolar disorder patients: Functional implications. Bipol. Disord 11: 113–12510.1111/j.1399-5618.2009.00665.x

World Health Organization. The International Classification of Functioning, Disability and Health (ICF) 2001; Geneva, WHO (http://www.who.int/classifications/icf/en/)

Young RC, Biggs JT, Ziegler VE, Meyer DA 1978. A rating scale for mania: reliability, validity and sensitivity. Br. J Psychiatry ;133:429–35. doi: 10.1192/bjp.133.5.429. [PubMed: 728692]

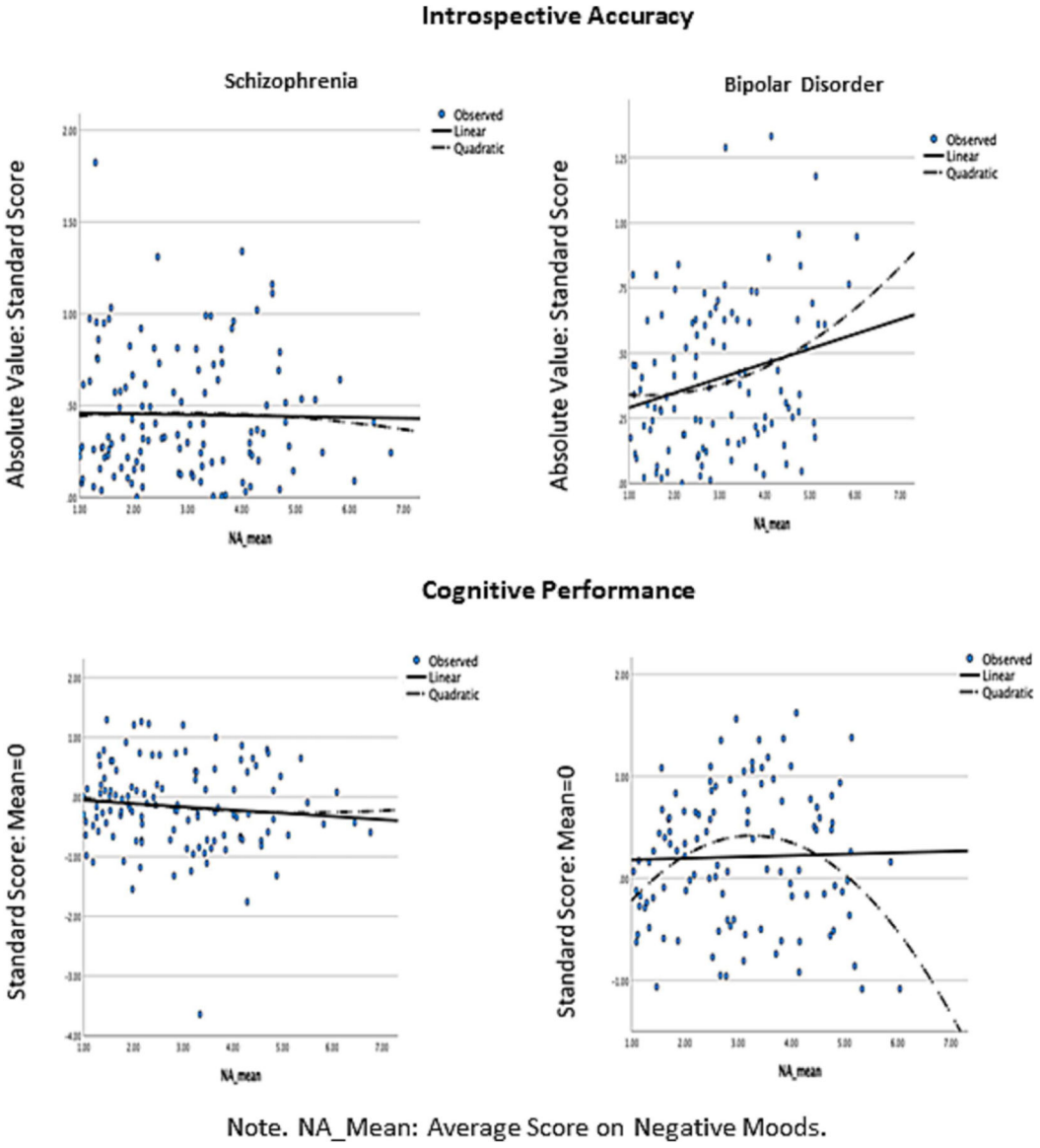

Figure 1.

Linear and Quadratic Term Analyses of the Correlations of Absolute Value Introspective accuracy and Composite Cognitive Performance with Aggregate Scores on Negative Affect Across Diagnoses of Schizophrenia and Bipolar Disorder.

Table 1.

Demographic and clinical information for the Schizophrenia and Bipolar Participant samples

		SCZ	BD	Statistics, *p*
N		126	114	
Age [M (SD)]		41.91 [10.74]	38.45 [11.69]	*t*=2.38, .018
Sex (% Female)		49%	68%	χ^2=8.05, .02
Racial status	White (%)	35%	57%	χ^2=22.24, <.001
	Black (%)	52%	24%	
	Other (%)	17%	19%	
Ethnicity	(% Hispanic)	22%	27%	χ^2=0.62, .43
Years of Education [M, SD]		12.67 [2.39]	14.23[2.42]	*t*=5.02, <.001
Mother's Education		12.67 [3.16]	13.77 [3.23]	*t*=2.59, .007
Employment	Full Time	8%	27%	χ^2=14.07, <.001
	Part Time	22%	24%	
	Unemployed/Disabled	70%	49%	
Unemployed for more than 12 months (%)		87%	76%	χ^2=4.01, .045
MADRS [M, SD]		10.71 (10.86)	13.40 (10.57)	*t*=1.93, .055
YMRS [M, SD]		1.01 (3.48)	3.15 (4.63)	*t*=4.06, <.001
PANSS Positive symptoms [M, SD]		15.88 (5.04)	10.32 (4.23)	*t*=10.10, <.001
PANSS Reduced experience [M, SD]		6.23 (4.08)	4.69 (2.21)	*t*=4.82, <.001
PANSS Reduced expression [M, SD]		5.99 (2.46)	4.76 (2.29)	*t*=3.97, <.001

Note: SCZ=Schizophrenia, BD=Bipolar Disorder, MADRS= Montgomery–Åsberg Depression Rating Scale, YMRS=Young Mania Rating Scale, PANNS=Positive and Negative Syndrome Scale

Table 2.

Actual and self-reported Cognitive Test Performance and Frequency of Momentary negative affect ratings Across Schizophrenia and Bipolar Participants

	Schizophrenia n = 126		**Bipolar Disorder n = 114**		***T* (*p*),*d***
	M	***SD***	***M***	***SD***	
Trail Making Test Part A (sec)	35.59	18.75	31.38	11.86	2.10 (037), .27
SR TMT A	26.01	39.03	21.00	16.61	1.20 (.20), .17
Letter-Number Sequencing	12.35	4.04	13.75	3.89	2.70 (.007), .35
SR LNS	13.69	5.68	15.15	5.18	1.99 (.048), .26
Animal Naming Test	20.94	5.74	23.54	5.69	3.50 (<.001), .46
SR ANT	18.94	8.52	19.43	7.59	0.43 (.34),.06
Hopkins Verbal Learning Test	20.75	5.70	23.69	6.22	3.81 (<.001), .50
SR HVLT	19.71	8.10	21.13	8.17	1.39 (.09), .18
Composite Cognition	−.25	1.02	0.28	0.92	4.17 (<.001), .98
Absolute Value IA	0.49	0.42	0.41	0.29	1.64 (.10), .36
All cognitive test scores differed significantly from self-reported cognition scores within the participants with schizophrenia and bipolar disorder (p<.001).					

Frequencies and Averages of NA Severity Scores Across Participants with Schizophrenia and Bipolar Disorder.					
	SCZ		**BD**		
	N	%	*N*	%	
1	2586	32	2184	30	
2	1609	20	1506	20	
3	1429	18	1297	18	
4	1252	16	1213	17	
5	673	8	744	10	
6	240	3	308	4	
7	263	3	119	2	
Total	8052		7371		
	Mean	SD	Mean	SD	*T* (*p*),d
	2.88	1.35	3.01	1.28	0.77 (.22), .10

Note: SCZ=Schizophrenia, BD=Bipolar Disorder, SR=Self-reported, NA=Negative Affect, IA=Introspective accuracy, TMT A=Trail Making Test Part LNS=Maryland Letter-Number Sequencing Test, ANT=Animal Naming Test, HVLT=Hopkins Verbal Learning Test

Table 3.

Time Course of Negative Affect in Schizophrenia and Bipolar Disorder over up to 90 Ecological Momentary Assessment Surveys over 30 days:: Hierarchical Modeling and Mean Sum of Squared Deviations Analyses

Hierarchical Modeling			
	Negative Affect Scores		
	χ^2	*df*	*p*
Omnibus test	41.00	33	.16
Intercept	88.21	1	<.001
Day	22.21	29	.71
Session	8.13	2	.06
Diagnosis	8.16	1	.004
Note: Overall Analysis is nonsignificant			

Mean Sum of Squared Deviations

	Schizophrenia		**Bipolar Disorder**				
MSSD	M	SD	M	SD	t	p	d
	0.72	1.77	0.94	1.54	1.11	.13	.14

Note. A t-test comparing the total sample MSSD to 1.0 was not statistically significant, t(239)=1.63, p=0.11

Table 4.

Results of Non-Linear Regression Analyses Using Aggregate Scores on Negative Affect to Predict Composite Cognitive Performance and Absolute Values of Introspective Accuracy Across Participants with Diagnoses of Schizophrenia and Bipolar Disorder

Schizophrenia								
	R^2	*F*	*df1*	*df2*	*p*		*b1*	*b2*
Cognition								
Linear Term	.01	1.20	1	125	.28		−.05	
Quadratic Term	.01	0.70	1	124	.51		−.14	.01
	R^2	*F*	*df1*	*df2*	*p*		*b1*	*b2*
Introspective Accuracy								
Linear Term	0.00	.041	1	125	.84		−.01	
Quadratic Term	.001	.076	2	124	.93		.029	−.01
Bipolar Disorder								
	R^2	*F*	*df1*	*df2*	*p*		*b1*	*b2*
Cognition								
Linear Term	.01	0.08	1	113	.78		.014	
Quadratic Term	.10	5.59	1	112		**.005**	.81	−.13
	R^2	*F*	*df1*	*df2*	*p*		*b1*	*b2*
Introspective Accuracy								
Linear Term	.06	7.13	1	113		**.009**	.06	
Quadratic Term	.07	4.01	1	112		**.021**	−.04	.02

Note: Non-linear regression analyses in the prediction of negative affect (NA) on cognitive test performance or introspective accuracy (IA) in the two samples.

b1 is the slope of the linear term

b2 is the slope of the quadratic term