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Research Article

Relationship between subjective cognitive functioning and fluid and crystallized cognitive abilities in bipolar disorder

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Abstract

Objective: People with bipolar disorder (BD) often show inaccurate subjective ratings of their objective cognitive function. However, it is unclear what information individuals use to formulate their subjective ratings. This study evaluated whether people with BD are likely using information about their crystallized cognitive abilities (which involve an accumulated store of verbal knowledge and skills and are typically preserved in BD) or their fluid cognitive abilities (which involve the capacity for new learning and information processing in novel situations and are typically impaired in BD) to formulate their subjective cognitive ratings. **Method:** Eighty participants diagnosed with BD and 55 control volunteers were administered cognitive tests assessing crystallized and fluid cognitive abilities. Subjective cognitive functioning was assessed with the Cognitive Failures Questionnaire (CFQ), daily functioning was rated using the Multidimensional Scale of Independent Functioning (MSIF) and the Global Assessment of Functioning Scale (GAF), and quality of life was assessed with the Quality of Life in Bipolar Disorder scale (QoL.BD). **Results:** The BD group exhibited considerably elevated subjective cognitive complaints relative to controls. Among participants with BD, CFQ scores were associated with fluid cognitive abilities including measures of memory and executive function, but not to crystallized abilities. After controlling for objective cognition and depression, higher cognitive complaints predicted poorer psychosocial outcomes. **Conclusions:** Cognitive self-reports in BD may represent a metacognitive difficulty whereby cognitive self-appraisals are distorted by a person's focus on their cognitive weaknesses rather than strengths. Moreover, negative cognitive self-assessments are associated with poorer daily functioning and diminished quality of life.

Keywords: Neuropsychology; cognition; neurocognition; metacognition; functional outcome; quality of life

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Introduction

Cognitive impairment is a common clinical feature in people with bipolar disorder (BD) (Keramatian et al., 2021; Miskowiak et al., 2018), and it is associated with diminished daily functioning and quality of life (QoL) (Baune & Malhi, 2015; Depp et al., 2012; Koene et al., 2022; Mackala et al., 2014). However, cognitive impairment in BD is not uniform across different cognitive domains. Based on the two-component theory of intellectual development (Cattell, 1963; Horn & Cattell, 1966), contemporary assessment approaches distinguish between crystallized cognitive abilities (representing an accumulated store of verbal knowledge and skills and thus more heavily influenced by education and cultural exposure) and fluid cognitive abilities (involving the capacity for new learning and information processing in novel situations, and especially influenced by biological processes and less dependent on past exposure) (Heaton et al., 2014; Kaufman & Kaufman, 2004). Neuropsychological research in BD indicates that fluid cognitive abilities such as attention, memory, executive function, and processing speed are preferentially impaired relative to crystallized abilities such as vocabulary and verbal comprehension (Ko et al., 2022; Mann-Wrobel et al., 2011; Torres et al., 2007).

Despite robust evidence of neuropsychological deficits on objective cognitive tests, subjective cognitive self-reports of people with BD generally correspond poorly or inconsistently to their objective cognitive performance (Burdick et al., 2005; Demant et al., 2015; Lima et al., 2018; Svendsen et al., 2012; Toyoshima et al., 2019a; Van der Werf-Eldering et al., 2011). To a certain degree, the poor correspondence between objective and subjective cognitive measures may relate to the likelihood that these measures may not be tapping into fully overlapping constructs. That is, objective cognitive assessments sensitively and specifically delineate cognitive processes in a controlled laboratory environment, whereas subjective cognitive questionnaires probe cognitive

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functioning in everyday and home/living environments. Nevertheless, the discrepancy between objective and subjective cognitive functioning in BD may also be related to several interrelated factors. First, cognitive self-ratings in BD may reflect underlying mood symptoms which bias individuals to view themselves or their abilities in a negative light. The finding that subjective cognitive ratings frequently correlate with depressive symptoms provides some support for this explanation (Harvey et al., 2015; Lin et al., 2019; Van der Werf-Eldering et al., 2011). A further possibility is that the poor correspondence between objective and subjective cognition in BD may reflect poor insight or awareness into one's own cognitive functioning, which can be conceptualized as a metacognitive failure that results in inaccurate cognitive self-ratings (David et al., 2012; Roux et al., 2021; Torres et al., 2016; Torres et al., 2021; Van Camp et al., 2019). The degree to which depression may underlie or contribute to a metacognitive deficit, however, remains unclear. Nevertheless, the finding that even euthymic individuals with BD tend to underestimate their cognitive functioning suggests that metacognitive difficulties may not be fully driven by depressed mood (Torres et al., 2021).

Regardless of whether driven by depression, poor metacognition, or both, the basis for the inaccurate cognitive self-reports in people with BD remains unclear. Specifically, it is not known what information people with BD utilize to formulate their subjective cognitive self-ratings. It is possible that individuals with BD may be relying on two potential primary sources to make their cognitive judgments, including either (1) their more impaired fluid cognitive skills/functioning or (2) their more intact crystallized cognitive skills/functioning. Clarification of the information that individuals use to make their subjective cognitive judgments could provide insights into the nature of metacognitive difficulties in BD and how these problems should be addressed. For example, people with BD may be exclusively focusing on their impaired fluid cognitive difficulties when they formulate their cognitive self-appraisals, possibly at the expense of considering their own cognitive strengths. Alternatively (and less likely), if subjective cognitive judgments are based exclusively on perceived intact crystallized cognitive skills, these judgments may be inaccurate because they are not reflective of the person's current cognitive struggles or functioning. Each of these scenarios may underlie faulty metacognition in BD, which could in turn lead to poor daily outcomes. Unfortunately, existing studies assessing the relationship between objective and subjective cognitive functioning have almost exclusively utilized fluid cognitive tests that tend to be more sensitive to cognitive impairments associated with the illness (Burdick et al., 2005; Demant et al., 2015; Lin et al., 2019; Luo et al., 2020; Toyoshima et al., 2017, 2019a), whereas use of crystallized cognitive tests has been rare.

The purpose of the present study was to investigate the type of information that people with BD likely utilize in formulating subjective cognitive ratings about their general cognitive functioning. To accomplish this, we evaluated the magnitude of correlation between subjective ratings of general cognitive function and objective measures of crystallized cognitive function (which tend to be more intact in BD), as well as between subjective ratings and fluid cognitive abilities (which are most impaired in BD). We hypothesized that subjective–objective correlations would be significant for cognitive domains in which people with BD show more pronounced cognitive deficits (fluid abilities), relative to cognitive domains where they show less impairment (crystallized abilities). This would imply that people with BD are focusing on their cognitive limitations, rather than their cognitive strengths, when generating subjective cognitive appraisals. A second objective was to assess whether subjective cognitive ratings would be predictive of psychosocial outcomes including daily functioning and QoL, even after controlling for mood symptoms and objective cognitive functioning.

Method

Participants

The study was conducted at the Mood Disorders Centre in the Department of Psychiatry, University of British Columbia (UBC). Participants were recruited from outpatient and inpatient hospital clinics, regional mood disorder groups and associations, local community mental health centers, and online advertisements. People with BD were required to be aged 17 years or older, have a primary *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*), diagnosis of BD type I or II, to be fluent in English, and to be sufficiently clinically stable to undergo cognitive assessment. Exclusion criteria included a history of serious neurological disorder or brain injury or alcohol or substance misuse in the past month. Participants completed a standardized protocol which included documentation of clinical history, symptom ratings and other clinical measures, and a structured clinical interview. Individuals with BD had received a documented chart diagnosis of BD by a treating psychiatrist or physician, and the diagnosis was confirmed by a clinical psychologist (IJT) and trained research assistant during a structured clinical interview utilizing strict *DSM-5* criteria.

A healthy volunteer comparison group was recruited from the community through online and community postings. Healthy volunteers were also given a structured interview and were required to be aged 17 or older and fluent in English, but were excluded if they had a history of serious neurological disorder/brain injury, psychiatric disorder, diagnosed psychiatric disorder in first-degree relatives, or history of alcohol or substance use in the past month. All participants provided written informed consent, and the study received ethics approval from the UBC Clinical Research Ethics Board. This study was completed in accordance with the Helsinki Declaration of 1975, as revised in 2008. The sample for the present analysis overlapped with a previous study investigating prediction and postdiction cognitive ratings on specific neuropsychological tests (Torres et al., 2021); however, the present study involved a larger sample size and included data from the Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982).

Objective cognitive functioning

A neuropsychological battery assessing both crystallized and fluid cognitive skills was utilized, and the categorization of cognitive measures into each of these two broad domains was based on prior work utilizing similar neuropsychological batteries (Cassetta et al., 2020; Heaton et al., 2014).

Three tests were used to assess crystallized abilities. To estimate premorbid intellectual functioning through single-word reading ability, the North American Adult Reading Test (NAART) estimated full-scale IQ score was utilized (Blair & Spreen, 1989). Verbal knowledge/vocabulary was assessed using the Kaufman Brief Intelligence Test–2 (K-BIT-2) (Kaufman & Kaufman, 2004) Verbal Knowledge subtest, and verbal comprehension/reasoning was assessed using the K-BIT-2 Riddles subtest.

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Seven tests were used to measure fluid abilities. To assess fluid nonverbal reasoning, the K-BIT-2 Matrices subtest was used. Verbal learning/memory was assessed with the Rey Auditory Verbal Learning Test (RAVLT) (Lezak, 2004), utilizing total words recalled across learning trials 1–3. Nonverbal memory was assessed using the Extended Complex Figure Test (ECFT) Delayed Recall Score (Fastenau, 2003). Visual–spatial construction ability was assessed using the ECFT Copy Trial score. Mental processing speed was assessed with the Trailmaking Test part A, and attentional shifting ability was measured using Trails B (Reitan & Wolfson, 1985). To assess abstract conceptual learning ability, a computerized version of the Halstead Category Test was employed (Choca et al., 2009). This test requires participants to determine the underlying concept for each of 208 stimuli that are presented consecutively on a computer screen. The task was slightly modified (for purposes of another study) by requiring participants to provide confidence ratings of their performance after each trial (data not presented here). The total correct score out of 208 items was utilized.

Subjective cognitive functioning

Subjective cognitive functioning was measured with the CFQ, a self-report questionnaire that assesses failures and lapses in everyday cognitive functioning (Broadbent et al., 1982). The CFQ has also been commonly used to study subjective cognition in BD (Burdick et al., 2005; Demant et al., 2015; Groenman et al., 2022; Van der Werf-Eldering et al., 2011). Each of the 25 items on the scale is rated from 0 (never) to 4 (very often), for a total score ranging between 0 and 100 with higher scores reflecting poorer subjective ratings of cognitive functioning. The CFQ has been demonstrated to load onto a single factor (Goodman et al., 2022).

Daily functional outcome

Functional outcome was assessed with the MSIF, a structured interview scale assessing a person's functioning during the previous month in the primary environments of work, educational, and residential. The MSIF was developed for use in patients with psychiatric disorders and validated in samples with BD (Berns et al., 2007; Jaeger et al., 2003). The MSIF requires the rater to consider the client's role expectations, level of support, and performance in order to derive a global rating for each of the three environments. We used the Overall Global rating which represents a summary rating across the three major functional environments, using the following anchors: 1 = essentially normal functioning, 2 = very mild disability, 3 = somewhat disabled, 4 = moderately disabled, 5 = significantly disabled, 6 = extremely disabled, 7 = totally disabled. As a secondary measure of functioning, we utilized the Global Assessment of Functioning Scale (GAF), a clinician-rated scale of psychological, social, and occupational functioning which is rated from 0 (lowest) to 100 (highest) based on anchors describing varying levels of functioning (Endicott et al., 1976).

QoL

QoL was assessed with the Quality of Life in Bipolar Disorder (QoL.BD) scale, a self-report questionnaire measuring well-being across multiple life domains in individuals living with BD (Michalak & Murray, 2010). The items are answered on a 5-point Likert scale, with higher scores reflecting higher QoL. We used the total score based on the sum of items across the 12 primary domains (four questions per domain), which yields scores ranging from a minimum of 48 to a maximum of 240.

Mood symptoms

Mood symptoms were assessed by a trained rater utilizing the Hamilton Depression Rating Scale (HAMD) (Hamilton, 1960) and the Young Mania Rating Scale (YMRS) (Young et al., 1978).

Statistical analysis

Raw scores for each of the 10 cognitive measures were converted into *z*-scores based on demographic-adjusted normative data derived from the cognitive test manuals. Composite cognitive scores were computed for crystallized ability (by averaging *z*-scores for the three crystallized measures) and for fluid abilities (by averaging *z*-scores for the seven fluid measures). Group differences in objective and subjective cognitive scores were assessed using *t*-tests. Based on the presence of 10 primary objective cognitive measures, a Bonferonni adjusted alpha level of $p < .005$ was used. Pearson correlation coefficients were utilized to evaluate the relationship between the CFQ and objective cognitive measures. Partial correlations were also calculated, controlling for depressive symptom scores and for fluid composite scores (for the individual crystallized measures) or crystallized composite scores (for the fluid measures). In order to assess the relative contributions of the crystallized and fluid composite scores to predicting CFQ scores, a regression model was constructed entering these two predictors as independent variables and the CFQ as the dependent variable.

Hierarchical multiple regressions were utilized to assess predictors of the three primary psychosocial outcomes, including MSIF, GAF, and QoL.BD scores. In the first model, HAMD scores and fluid and crystallized composite scores were entered as predictors of outcome. The CFQ was subsequently entered into the model to assess this variable's unique contribution to predicting each of the three primary outcomes. Assumptions for regression were assessed by visualizing scatterplots between independent variables and the dependent variable, visualizing residual plots, and utilizing collinearity, Durbin–Watson, and Cook's Distance statistics.

Results

Demographics and clinical characteristics

The BD group had a mean age of 38.4 years (SD = 10.2), mean duration of illness of 21.6 years (SD = 11.3), mean education of 15.0 years (SD = 2.1), and 76% had a diagnosis of BD type I. Mood rating scales indicated that participants with BD showed a low level of depressive and manic symptoms (Table 1). A total of 18%, 3%, and 0% of the sample were in a current depressive, hypomanic, or manic episode. A substantial proportion of people in the BD group had a history of psychosis as well as history of alcohol/substance use comorbidity, and the majority were treated with mood stabilizers or antipsychotics. Details of demographic and clinical features are presented in Table 1.

Individuals with BD were comparable to controls with regard to mean age, years of education, premorbid IQ, and sex (Table 1). There was a slightly higher proportion of non-white individuals among controls relative to patients ($X^2 = 7.09$, $p = 0.03$); however, the proportion of individuals who learned English as their first language was comparable between groups ($X^2 = 1.85$, $p = 0.17$).

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Table 1. Demographics and clinical variables for participants with BD and healthy controls

	Patients ($n = 80$)	Healthy controls ($n = 55$)
Age, years, mean (SD)	38.4 (10.2)	37.1 (10.6)
Education, years, mean (SD)	15.0 (2.1)	15.7 (1.9)
North American Adult Reading Test, mean (SD)	109.0 (7.9)	107.8 (7.8)
Female, n (%)	51 (64)	35 (64)
Ethnicity*, n (%)		
White	68 (85)	37 (67)
Asian	3 (4)	8 (15)
Other	9 (11)	10 (18)
English first language, n (%)	66 (83)	40 (73)
Current employment/student status*, n (%)		
Employed (at least half time)	33 (41)	34 (62)
Student	9 (11)	7 (13)
None	38 (48)	14 (26)
Duration of illness in years, mean (SD)	21.6 (11.3)	
Psychiatric rating scales, mean (SD)		
Young Mania Rating Scale	1.6 (2.7)	
Hamilton Depression Rating Scale	5.5 (4.2)	
Global Assessment of Functioning Scale	69.2 (14.3)	
Multidimensional Scale of Independent Functioning***	2.0 (1.2)	1.1 (0.30)
Quality of Life – BD	162.1 (28.9)	
History of psychosis, n (%)	39 (49)	
History of alcohol/substance abuse, n (%)	50 (63)	
Medications, n (%)		
Mood stabilizer	65 (81)	
Antipsychotic	42 (53)	
Antidepressant	37 (46)	
Benzodiazepine	16 (20)	

*$p < .05$; ***$p < .001$ difference between patients and controls.

People with BD had lower current employment/schooling rates than controls ($X^2 = 6.95$, $p = 0.03$).

Group differences in objective and subjective cognitive functioning

Table 2 summarizes the objective and subjective cognitive data between groups.

People with BD showed numerically poorer performance than controls on most objective cognitive measures, especially fluid abilities. However, after correction for multiple comparisons, these differences did not reach statistically significant levels. Nevertheless, within the bipolar group, mean crystallized composite scores were significantly higher than mean composite fluid scores, $t(79) = 2.08$, $p = .04$. Regarding subjective cognition, there was a significant difference between groups in CFQ scores indicating more subjective cognitive complaints in participants with BD relative to controls, $t(133) = 7.15$, $p < .001$.

Associations between CFQ and objective cognitive functioning

Figure 1 displays the Pearson correlations between CFQ scores and each of the objective cognitive measures in participants with BD. There was no significant correlation between the CFQ and any of the three crystallized cognitive measures (all $p > 0.05$). In contrast, there were significant correlations between the CFQ score and most fluid cognitive measures, including K-BIT-2 Matrices, RAVLT Learning, ECFT Copy, and ECFT Delay scores (Figure 1). In all cases, increased cognitive complaints were associated with poorer cognitive performance. As above, the partial correlation analyses controlling for depression and the fluid composite score failed to reveal a significant association between any of the crystallized tests and CFQ (all $p > .25$). However, after controlling for depression and crystallized composite score, there was a significant association between CFQ and K-BIT-2 Matrices, $r(76) = -0.25$, $p = .03$, RAVLT Learning, $r(76) = -0.23$, $p = .04$, ECFT Copy, $r(76) = -0.37$, $p < .001$, and a trend for ECFT Delay $r(76) = -0.21$, $p = .06$. With regard to fluid and crystallized composite scores, there was a significant association between CFQ scores and fluid skills ($r = -0.30$, $p = .008$), but not between CFQ scores and crystallized skills ($r = -0.13$, $p = 0.25$). Moreover, in the regression model, fluid, $t(77) = -2.45$, $p = .02$, but not crystallized composite scores, $t(77) = -0.18$, $p = .86$, significantly predicted CFQ scores. There was no significant relationship between CFQ scores and any of the cognitive variables in the control group.

Predictors of psychosocial outcomes

Table 3 displays the correlation matrix between predictors (depressive symptoms, crystallized and fluid composite scores, CFQ score) and the three psychosocial outcomes in people with BD. Most of the predictors were significantly associated with all the psychosocial outcomes, with the exception that crystallized ability was not associated with any of the three outcomes, and fluid ability was not associated with QoL.BD scores (Table 3).

Table 4 summarizes the results of the multiple regression analyses for each of the three primary psychosocial outcomes. After controlling for the effects of residual depressive symptoms and crystallized and fluid composite scores, CFQ was a significant predictor of MSIF scores, such that increased cognitive complaints were associated with poorer functioning. These findings were replicated when GAF served as the dependent variable (Table 4). Similarly, after controlling for depression and fluid and crystallized

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Table 2. Objective and subjective cognition in participants with BD and controls

	BD ($n = 80$) Mean (SD)	Controls ($n = 55$) Mean (SD)	t/U	p	Cohen's d
Crystallized abilities	0.31 (0.57)	0.25 (0.65)	0.57	0.57	0.10
NAART	0.60 (0.53)	0.52 (0.52)	0.92	0.36	0.16
K-BIT-2 VK	0.32 (0.69)	0.17 (0.83)	1.12	0.27	0.20
K-BIT-2 Riddles	0.01 (0.79)	0.06 (0.87)	−0.36	0.72	−0.06
Fluid abilities	0.13 (0.77)	0.32 (0.62)	−1.52	0.13	−0.27
K-BIT-2 Matrices	0.38 (0.96)	0.50 (0.80)	−0.80	0.42	−0.14
RAVLT Learning	0.46 (1.08)	0.53 (0.95)	−0.42	0.68	−0.07
ECFT Delay Recall[a]	0.08 (0.90)	0.36 (0.73)	−1.79	0.08	−0.33
ECFT Copy[b]	0.80 (0.90)	1.17 (0.60)	2231	0.02	−0.46
Trails A	0.08 (1.18)	0.06 (1.11)	0.12	0.90	0.02
Trails B	−0.23 (1.17)	−0.05 (0.97)	−0.98	0.33	−0.17
Category Test[c]	−0.63 (1.69)	−0.13 (1.49)	−1.76	0.08	−0.31
Subjective cognition					
CFQ	43.2 (17.2)	24.7 (10.2)	7.15	< .001	1.25

Note. NAART = North American Adult Reading Test, K-BIT-2 = Kaufmann Brief Intelligence Test Second Edition, VK = verbal knowledge, RAVLT = Rey Auditory Verbal Learning Test, ECFT = Extended Complex Figures Test, CFQ = Cognitive Failures Questionnaire
[a]$n = 45$ in control group.
[b]$n = 45$ in control group; Mann–Whitney U reported.
[c]$n = 54$ in control group.
Reported p-value is prior to correction for multiple comparisons.

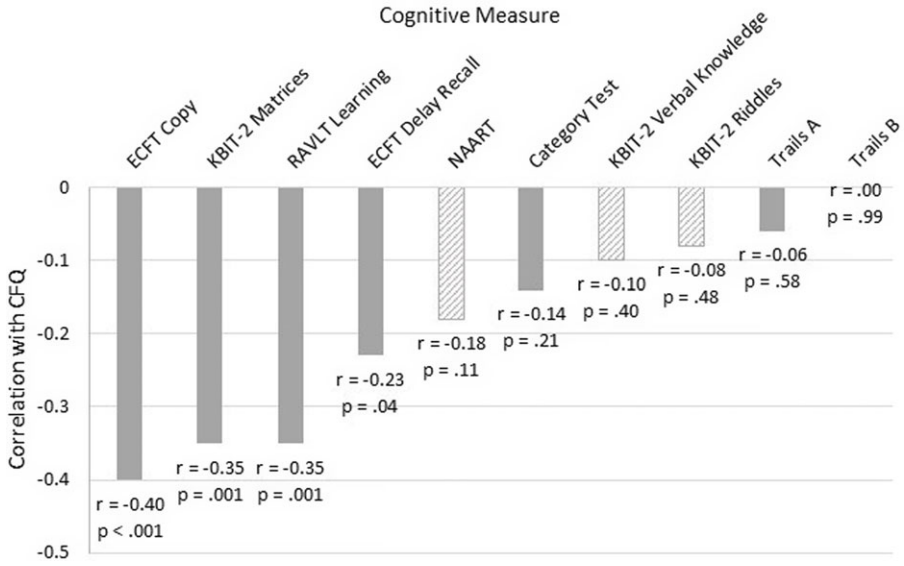

Figure 1. Correlations between Cognitive Failures Questionnaire (CFQ) scores and objective cognitive functions in bipolar disorder sample. Light-shaded bars represent crystallized cognitive skills, and dark-shaded bars represent fluid cognitive skills. NAART = North American Adult Reading Test, K-BIT-2 = Kaufmann Brief Intelligence Test Second Edition, RAVLT = Rey Auditory Verbal Learning Test, ECFT = Extended Complex Figures Test.

composite scores, CFQ was a significant predictor of QoL.BD scores, such that increased cognitive complaints were associated with poorer quality of life.

Discussion

The primary goal of this study was to investigate the association between subjective cognitive functioning and objective cognitive performance across different cognitive domains to clarify how people with BD formulate their cognitive self-appraisals. We found that individuals with BD showed highly elevated cognitive complaints relative to people without BD that were out of proportion to objective cognitive functioning differences between the patient and control groups. This finding is consistent with prior studies that demonstrate elevated cognitive complaints even in euthymic BD (Lin et al., 2019; Luo et al., 2020; Martinez-Aran et al., 2005; Simjanoski et al., 2021).

Furthermore, we found that cognitive complaints were preferentially associated with fluid cognitive abilities including verbal and nonverbal learning/memory, as well as some aspects of executive functioning (fluid nonverbal reasoning, visual construction). In contrast, there was no significant association between cognitive complaints and crystallized cognitive skills. This suggests that individuals with BD base their cognitive self-appraisals on impaired fluid cognitive skills, without reference to their generally preserved crystallized skills. Moreover, these self-assessments may reflect a person's perception that their cognition is diminished relative to a prior level. This is consistent with the finding that in the BD group crystallized skills, which often index premorbid abilities, were higher than fluid skills, which are likely to represent acquired cognitive problems.

These findings are broadly in accord with previous studies in BD that have also reported significant associations between subjective cognitive functioning and fluid cognitive skills including

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Table 3. Correlation matrix between predictors and psychosocial outcomes

	MSIF	GAF	QoL.BD	HAMD	CRYST	FLUID
GAF	-.77***					
QoL.BD	-.40***	.58***				
HAMD	.43***	-.74***	-.73***			
CRYST	-.17	.16	.00	-.07		
FLUID	-.27*	.22*	.12	-.11	.38***	
CFQ	.51***	-.53***	-.54***	.48***	-.13	-.30**

*$p < .05$; **$p < .01$; ***$p < .001$.

various aspects of memory and/or executive function (Aydemir & Kaya, 2009; Demant et al., 2015; Lin et al., 2019; Luo et al., 2020; Rosa et al., 2013; Xiao et al., 2015). Nevertheless, not all studies report significant correlations between subjective cognition and fluid memory or executive skills (Burdick et al., 2005; Lima et al., 2018; Toyoshima et al., 2019a; Van der Werf-Eldering et al., 2011). This variation in results may be related to methodological differences among studies along characteristics including power/sample size, symptom status of patient sample, subjective cognition measure used, objective neuropsychological tests used, and component of memory or executive function that was studied. Even within our study, not all fluid tests correlated with the CFQ. We note that all of the fluid measures that showed significant correlations with CFQ were measures that were untimed and that two of the three fluid measures that did not correlate with CFQ were timed. It may be that if patients can still complete a task accurately even if it takes longer for them to do it, their subjective perception may be that they don't have a problem. In contrast, if they struggle on a task that has no time limits they may be more inclined to perceive their performance as problematic, and hence their ratings may correlate more with their diminished performance on these untimed fluid tasks. Regardless, consistent with our findings, most prior work does support a consistent association between subjective cognition and objective fluid skills of memory and executive functioning.

A novel contribution of the present study is that crystallized skills were not associated with subjective cognition. In one of the few previous studies that utilized a crystallized cognitive measure, Rosa et al. (2013) also failed to find a significant association between subjective cognitive complaints and expressive vocabulary ability. In sum, the finding that cognitive self-ratings correlate with fluid abilities suggests that individuals with BD utilize information about their cognitive weaknesses (e.g., memory and executive functioning) in formulating their cognitive self-ratings. In contrast, they do not appear to focus on their intact crystallized skills such as vocabulary/verbal knowledge, verbal reasoning/comprehension, or single-word reading.

The preferential focus on cognitive weaknesses, which leads to highly elevated cognitive complaints, coupled with the absence of focus on cognitive strengths, is consistent with the view that subjective ratings in BD may reflect a metacognitive failure. That is, people with BD may have a distorted, negatively biased sense of their own cognitive functioning. Moreover, this negatively oriented metacognitive difficulty may be reflective of a broader bias toward the processing of negatively valenced information in BD (Gopin et al., 2011), or the presence of implicit negative self-associations or self-schemas that characterize individuals with BD even in the euthymic state (Granger et al., 2021; Jabben et al., 2014).

To what extent does this negative cognitive self-view relate to depressive symptoms? On the one hand, consistent with prior work, depression was strongly correlated with cognitive complaints, indicating that even subsyndromal depression associates with cognitive complaints (Lin et al., 2019; Van der Werf-Eldering et al., 2011). Nevertheless, the hierarchical regression analyses consistently revealed that even when depression and objective cognitive functioning (both crystallized and fluid) were controlled, elevated cognitive complaints in BD still had a negative impact on both objective indices of daily functioning (MSIF, GAF) as well as self-reports of QoL (QoL.BD). Prior studies in BD have also reported a relationship between elevated cognitive complaints and poorer functioning (Grover et al., 2023; Jensen et al., 2015) and diminished QoL (O'Rourke et al., 2021; Tatay-Manteiga et al., 2019), even after controlling for depressive symptoms (Demant et al., 2015; Luo et al., 2020; Toyoshima et al., 2019b; Xiao et al., 2016).

The present findings are also in line with prior work indicating that euthymic individuals with BD predominantly underestimate their cognitive ability/performance relative to controls (Torres et al., 2021) and that underestimations are associated with poorer functioning (Miskowiak et al., 2016). Together, these findings provide support for the hypothesis that negative cognitive self-appraisals are not exclusively a function of depressive symptoms, as they still exert a negative impact on peoples' lives and functioning even when depression is controlled. As such, these negative cognitive self-views may represent a behavioral marker for a trait-related feature associated with BD. The question relating the source of this trait (i.e., whether it reflects a premorbid vulnerability marker or a "scar" related to cumulative mood episodes) cannot be addressed in the present study and would likely require longitudinal investigation. Regardless of the source, the strong and consistent association between CFQ scores and psychosocial outcomes suggests that efforts to address or modify these negative cognitive self-referents through cognitive remediation (CR) and similar therapies should be prioritized. Increasingly, CR therapies developed for use in BD emphasize the need to incorporate assessment and modification of metacognitive components (Tsapekos et al., 2020, Tsapekos et al., 2023). Based on the findings from the present study, one approach may be to assess for negative cognitive self-appraisals so that they can be evaluated and modified to better align with a person's goals or actual cognitive functioning/performance. This might entail (1) conducting objective and subjective cognitive assessments; (2) reviewing and comparing these with the client, highlighting discrepancies; (3) allowing the client to identify strengths rather than exclusively focusing on weaknesses; and (4) helping the client challenge negative self-appraisals by testing these assumptions through simulated or real-life scenarios. Such realignment may have the potential to lessen the impact of negative cognitive self-appraisals and improve overall functioning and QoL.

The present findings should be viewed in the context of several study limitations. First, the mean education level for both groups was relatively high, which in part reflects the demographic profile of individuals who are typically interested in participating in research studies. This may impact the generalizability of our findings and suggests that further work should be conducted in samples with a wider range of education level. This factor may also account for the fact that the objective cognitive differences between people with BD and controls in the present study were not as large as is typically observed in other studies. Nevertheless, this fact underscores the robustness of the findings herein. That is, prominent patient–control differences in subjective cognitive

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Table 4. Hierarchical regression models for predictors of MSIF, GAF, and quality of life

		Adjusted R^2	R square change	B	95% confidence interval	β	t	p
MSIF								
Model I		.208	.238					< .001
	Constant			1.49	[1.06, 1.91]		7.01	< .001
	HAMD			0.12	[0.06, 0.17]	0.41	4.02	< .001
	Crystallized			−0.13	[−0.59, 0.33]	−0.06	−0.56	.58
	Fluid			−0.31	[−0.65, 0.03]	−0.20	−1.83	.07
Model II		.290	.088					.003
	Constant			0.65	[−0.01, 1.32]		1.96	.05
	HAMD			0.07	[0.01, 0.13]	0.25	2.29	.03
	Crystallized			−0.13	[−0.56, 0.31]	−0.06	−0.57	.57
	Fluid			−0.18	[−0.51, 0.16]	−0.11	−1.06	.29
	CFQ			0.025	[0.01, 0.04]	0.35	3.12	.003
GAF								
Model I		.552	.569					< .001
	Constant			81.84	[78.07, 85.62]		43.14	< .001
	HAMD			−2.44	[−2.95, −1.93]	−0.72	−9.52	< .001
	Crystallized			1.48	[−2.63, 5.59]	0.06	0.72	.48
	Fluid			2.21	[−0.83, 5.25]	0.12	1.45	.15
Model II		.577	.029					.023
	Constant			87.53	[81.43, 93.64]		28.55	< .001
	HAMD			−2.13	[−2.70, −1.57]	−0.63	−7.56	< .001
	Crystallized			1.45	[−2.54, 5.45]	0.06	0.73	.47
	Fluid			1.30	[−1.77, 4.36]	0.07	0.84	.40
	CFQ			−0.17	[−0.31, −0.02]	−0.20	−2.32	.023
QoL.BD								
Model I		.521	.539					< .001
	Constant			190.28	[182.41, 198.14]		48.16	< .001
	HAMD			−4.95	[−6.01, −3.88]	−0.73	−9.27	< .001
	Crytallized			−4.24	[−12.80, 4.31]	−0.08	−0.99	.33
	Fluid			2.81	[−3.53, 9.14]	0.08	0.88	.38
Model II		.565	.048					.004
	Constant			205.10	[192.64, 217.56]		32.80	< .001
	HAMD			−4.15	[−5.29, -3.0]	−0.61	−7.21	< .001
	Crystallized			−4.31	[−12.46, 3.83]	−0.09	−1.06	.30
	Fluid			0.42	[−5.83, 6.66]	0.01	0.13	.90
	CFQ			−0.44	[−0.73, −0.14]	−0.26	−2.97	.004

Note. MSIF = Multidimensional Scale of Independent Functioning, HAMD = Hamilton Depression Rating Scale, CFQ = Cognitive Failures Questionnaire, GAF = Global Assessment of Functioning, QoL.BD = Quality of Life in Bipolar Disorder Scale.

functioning were observed even when groups were relatively similar with regard to their objective cognitive performance. Finally, another potential interpretation of these data might be that correlations between fluid abilities and CFQ scores are significant because the content of items on the CFQ (or similar scales) reflects daily cognitive mishaps that are more related to these types of abilities (e.g., memory, executive function). However, the fact that fluid cognition–CFQ correlations were not observed in our control group, and are not typically observed in healthy populations (Carrigan & Barkus, 2016; Goodman et al., 2022), argues against the idea that the item content is driving the observed findings. Despite this, it is likely that fluid skills are indeed preferentially involved in many everyday functions, and thus decrements in fluid skills that are observed in clinical populations are likely to correlate strongly with diminished daily functioning (Cassetta et al., 2020).

In sum, these data support the idea that cognitive self-reports in BD may represent a metacognitive difficulty, as cognitive self-appraisals appear distorted by self-focus on cognitive weaknesses, rather than cognitive strengths. Findings also confirm that subjective cognitive ratings are associated with subsyndromal depressive symptoms. However, depression does not fully explain this metacognitive difficulty, as even when depression and objective cognitive function are accounted for, more subjective cognitive complaints are still predictive of poor psychosocial outcomes in terms of daily functioning and quality of life.

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