The Relationship between Self-Esteem, Emotion Regulation, and Feedback Processing in People with Bipolar Disorder Compared to Healthy Control Subjects

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Abstract

People with bipolar disorder (BD) often experience impaired metacognition which impacts the ability to process feedback (FP), and difficulties with self-esteem (SE) and emotion regulation (ER). As yet, few studies have been conducted into the relationship between SE, ER and FP in people with BD compared to healthy controls (HC). Even though improved SE, ER and metacognition suggest increased well-being, health, and psychosocial functioning. This study assessed whether SE and ER predict FP, and explored herein the possibility of group differences. We hypothesized group differences for SE, ER, and FP, and expected SE, ER and group to be predictors of FP.

The study comprised 34 Dutch participants, 18 with BD and 16 HC, aged 21-58 years. We assessed SE, ER, and FP using the Self-Esteem Rating Scale-Short Form (SERS) questionnaire, the Emotion Regulation Questionnaire (ERQ), and a computerized version of the Wisconsin Card Sorting Test (WCST), respectively. For the first hypothesis, a Multivariate Analysis of Covariance (MANCOVA) was used, for the others a hierarchical multiple regression analysis.

Results showed no group differences for the variables. Also, SE and ER could not predict FP, nor could group. The non-significance is consistent with certain research though in contrast with other studies, indicating ambiguousness and uncertainty still exists concerning the relationship between these variables, especially concerning FP as a metacognitive function. Future research could determine which variable negatively influences the relationship. Eventually, treatment could be developed to manage these influences with the aim to improve functioning, health, and well-being in people with BD.

Keywords: bipolar disorder, self-esteem, emotion regulation, feedback processing, metacognition

Contents

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Bipolar disorder (BD) is a psychological disorder characterized by emotional instability and fluctuations in mood (Green et al., 2007). People are diagnosed with BD subtype I if they have experienced at least one manic episode resulting in social and/or professional dysfunction, according to the DSM-5 of the American Psychiatric Association (APA, 2014). Manic episodes are periods with an unusually elevated or irritable mood, and increased goal-oriented activity or energy, lasting at least one week. Manic symptoms include decreased need for sleep, being overly talkative, grandiosity, and increased distractibility. On the other hand, people are diagnosed with subtype II if they experienced a hypomanic and a depressive episode. A hypomanic episode has similar, though less severe, symptoms as a manic episode and does not result in social or professional dysfunction. A depressive episode has at the minimum five depressive symptoms for at least two weeks, e.g., depressed mood, loss of interest, decreased concentration and psychomotor agitation or retardation (APA, 2014). Generally, people with BD have increased activity, decreased concentration and attention, and increased impulsivity compared to healthy control subjects (HC) (APA, 2015). The increased impulsivity or inattention goes hand in hand with the presence and severity of manic symptoms such as elevated mood and grandiosity (Ozten & Erol, 2019; Strakowski et al., 2009).

The depressive and manic symptoms related to BD are linked to poorer performance on tests which measure cognition, as well as lower self-reported cognitive functioning (Lima et al., 2018; Vöhringer, 2013). Research shows that BD is accompanied by neurocognitive deficits in multiple cognitive domains, with verbal memory, executive functioning and attention especially impaired (Lima et al., 2018; Sachs et al., 2020). A meta-analytic study finds executive dysfunction to be the most prevalent cognitive deficit overall in people with (euthymic) BD, followed by dysfunction in attention and working memory (Cullen et al., 2016). A longitudinal study of people with BD observes a decrease in executive functioning over time, linked to (sub)depressive symptoms and duration of BD (Torrent et al., 2012). Interestingly, Torrent et al. (2012) determine verbal memory dysfunction (measured at the beginning) to be the foremost predictor of low cognitive functioning at a later date in people with BD. Also, Cullen et al. (2016) determine that severity and duration of BD, and antipsychotics are associated with a more severe global cognitive impairment in people with euthymic BD. Furthermore, having a history of psychotic symptoms and of manic episodes is

moderately related to a greater cognitive impairment (Bora, 2018). Also, even after remission, cognitive impairments persist in people with BD (Lima et al., 2018). Additionally, the meta-analysis of Bora (2018) demonstrates that people with BD subtype II appear to have similar cognitive deficits compared to people with subtype I, just slightly less severe.

Moreover, deficits in emotional functioning present themselves in people with BD (Green et al., 2007). People with BD exhibit elevated or more frequent negative and positive affectivity (i.e. a disposition to experience respectively negative or positive emotional states) on various measures compared to HC (Lemogne et al., 2011; Lima et al., 2018). Research suggests that BD is more strongly associated with negative emotions as compared to positive ones (Lima et al., 2018). Furthermore, in BD the ability to regulate or manage these emotions is impaired (Green, et al., 2007; Phillips et al., 2008). Emotion regulation (ER) involves the control and modulation of the subjective and physiological experience of emotion so as to achieve one's goal (Green et al., 2007). ER begins with an evaluation of emotional cues which trigger a set of response tendencies composed of a range of biological, social, behavioral, and cognitive mechanisms (Green et al., 2007). Generally, ER appears in the form of ER strategies, e.g., cognitive reappraisal and expressive suppression (Gross & John, 2003; John & Gross, 2004).

Expressive suppression (ER-ES) is described as the suppression of external emotional expression, e.g., maintaining a neutral facial expression while you are scared (Dryman et al., 2018). Usually, ER-ES is a ER strategy that applies ER only after the emotion has been produced (Dryman et al., 2018). On the other hand, cognitive reappraisal (ER-CR) is used during a situation where emotions are being produced (Aldao & Nolen-Hoeksema, 2012). People use ER-CR to alleviate the, often negative, felt emotions and to lessen their impact on the ongoing situation by rethinking about and reinterpreting the situation (Dryman et al., 2018). For instance, when someone is anxious during an exam about the outcome, they can think "I studied and practiced to the best of my ability, now all I can do is try", reducing their feeling of anxiety. Research suggest people who use ER-CR are more aware of their emotions, and are able to share and express emotions more easily. Using ER-CR more often is linked with greater levels of quality of life; a higher self-esteem, optimism, and satisfaction with life (Brewer et al., 2016; Dryman et al., 2018). Research indicates that ER-CR is an adaptive ER strategy; people using ER-CR adapt to their situation in a positive and productive way, resulting in positive outcomes, e.g., elevated interpersonal functioning, increased social support, increased psychological well-being, and decreased experience of

negative affect (Aldao & Nolen-Hoeksema, 2012; Brewer et al., 2016). Frequently, ER-CR is integrated in treatment methods to diminish psychological symptoms and to improve well-being in people with a psychological disorder (Brewer et al., 2016). ER-ES, however, is considered a maladaptive ER strategy, using this strategy to an emotion-eliciting situation brings about adverse and damaging outcomes; including decreased autonomic flexibility, increased cognitive vulnerabilities, memory difficulties, and reduced social support (Aldao & Nolen-Hoeksema, 2012; Brewer et al., 2016). Furthermore, maladaptive ER strategies are more strongly associated with psychopathology than adaptive ones (McMahon, & Naragon-Gainey, 2018). The use of a maladaptive strategy such as ER-ES is linked to an increase in symptoms and to the occurrence and persistence of various psychological disorders, e.g. anxiety disorders and depression (Aldao & Nolen-Hoeksema, 2012; McMahon, & Naragon-Gainey, 2018). The study of Gruber et al. (2012) into ER-CR and ER-ES shows that compared to HC, people with BD exert more energy trying to use these strategies, use them more impulsively, and are less able to impulsively regulate their emotions.

The study of Green et al. (2007) indicates that the impairment in ER of people with BD potentially occurs as BD is associated with neurocognitive deficits in distinct neural networks necessary for ER (cerebello-striatal-prefrontal). Ordinarily, ER consists of cooperation between limbic, brainstem, and cortical networks, with regions such as prefrontal cortex regulating emotion processing systems in cognitive control of emotional experience (Green, et al., 2007). However, research shows that abnormalities are present in prefrontal sub-regions in people with BD, which are related to impaired cognitive control over ER (Phillips et al., 2008). The study of Phillips et al. (2008) indicates that the sub-regions affected suggest impairment in the use of the more automatically and unconsciously done ER. In addition, there is indication for deficits in metacognitive functioning for people with BD (Popolo et al., 2017; Favaretto et al., 2020). Metacognition can be defined as awareness, ability to reflect on and control of one's own thinking, or as the cognitive processes related to the appraisal, control, and monitoring of thinking (Tas et al., 2014; Weil et al., 2013). One aspect of metacognition appears to be the ability to process explicit or external feedback (feedback processing; FP), which is thought to be an executive function (Arbel et al., 2018; Chorba & Was, 2015; Souchay & Isingrini, 2004). People use FP to critically evaluate themselves, to consequentially adjust their behavior if necessary, e.g., to avoid damaging situations or behavior and search for beneficial alternatives (Ferdinand et al., 2016). Using FP allows for change which can result in better prospective outcomes (Arbel et al., 2018;

Ferdinand et al., 2016). Research suggest a strong positive correlation between metacognition and executive functions such as FP (Souchay & Isingrini, 2004). Moreover, there seems to be a close resemblance between these concepts; e.g., both are considered higher-order cognitive processes that perform cognitive evaluation and regulation, present themselves in the frontal cortex, are top-down strategies, are needed for conscious (re)actions, and are used for problem solving (Arbel et al., 2018; Chorba & Was, 2015; Ferdinand et al., 2016). Altogether, this suggest a large overlap in function for these concepts and it indicates they might predominantly perform identical processes (Chorba & Was, 2015).

Only these last few years has any research been done to examine metacognitive abilities in people with BD. Recent research of Popolo et al. (2017) has found that impaired metacognition is mostly related to negative symptoms of BD. Moreover, depressive symptoms negatively influence metacognitive abilities in people with BD, and vice versa (Østefjells et al., 2017; Van Camp et al., 2019). Furthermore, in people with BD compared to HC, Torres et al. (2021) observe metacognitive discrepancies in their awareness of cognitive functioning and their awareness of performance, in global cognition and in several cognitive domains (e.g., verbal memory). In research of Lysaker et al. (2018) metacognition is outlined as processes related to the awareness, monitoring, reflection, and direction of self. Similarly, self-esteem (SE) is the evaluation of oneself followed by an emotional reaction towards oneself (Abdel-Khalek, 2016). SE refers to an individual's perception or subjective appraisal of one's own self-worth, one's feelings of self-respect and self-confidence (Abdel-Khalek, 2016). Unsurprisingly, a higher metacognitive ability is associated with an increased harmonized and sound sense of self (Lysaker et al., 2018), whereas a lower or negative metacognitive ability is a predictor of low SE (Kolubinski et al., 2019). Interestingly, the study of Haffner et al. (2018) investigates a BD treatment intervention (Metacognitive Training) that aims to improve metacognition and psychosocial functioning by working on SE, among other things. Importantly, the use of this metacognitive intervention indicates an increased overall psychosocial functioning and physical health for people with BD (Haffner et al., 2018). The intervention attempts to bolster the SE of people with BD by having them discern their personal strengths, by providing information on the extent of SE in their lives, and by speaking about the difficulties they may face in regards to their SE (Haffner et al., 2018). Frequently, BD is characterized by dysfunction and instability of SE or changes in belief about the self (Knowles et al., 2007; Rantala et al., 2021). In manic episodes it can present itself as a grandiose self-belief or an inflated SE (high or positive SE; SE-P), and in

depressive episodes as a low or negative SE (SE-N) (Knowles et al., 2007). The study of Knowles et al. (2007) found instability of SE and of affect in people with BD, even when symptoms were in remission. Additionally, SE-N appears to have a positive effect on the prevalence of depressive and manic symptoms in people with BD (Atuk & Richardson, 2021; Haffner et al., 2018).

The study of Kernis (2005) indicates SE to be a modest positive predictor for psychological health, well-being, and (mal)adaptive behavior. Other research demonstrates that overall SE is positively related to psychological well-being (Neff, 2011). The meta-analysis of Orth and Robins (2014) determines that SE-P predicts well-being in multiple areas, e.g., health, social, and work. Paradise and Kernis (2002) have assessed both SE level and SE stability, and have found that SE-P linked to greater well-being compared to SE-N. Besides, they have observed significant interactions of SE level and SE stability on several subscales of well-being, e.g., self-acceptance (Paradise & Kernis, 2002).

Moreover, the study of Brewer et al. (2016) suggests that ER affects psychosocial functioning, including well-being, positively and that strategies ER-CR and ER-ES predict certain psychosocial outcomes. As mentioned previously, ER-CR is associated with an increase in psychological well-being, and ER-ES with an increase in psychological symptoms (Brewer et al., 2016). Also, a more frequent use of ER-CR is linked positively to overall higher well-being outcomes; namely higher positive affect, life satisfaction, and perception of social support (Verzeletti et al. 2016). Contrastingly, using ER-ES more often is more positively related to lower overall well-being, which includes higher negative affect, lower psychological health, and an increased feeling of social and emotional isolation (Verzeletti et al., 2016).

Currently, for people with BD, few evidence-based intervention options are available to treat impairments in cognition, for instance to treat impairments in the executive function FP (Arbel et al., 2018; Miskowiak et al., 2017). Even though treatment and improvement of cognitive impairments in BD lead to increased quality of life, greater psychosocial functioning, recovery of cognitive functions, and decreased costs to society (Miskowiak et al., 2017; Riedel et al., 2018). People with BD with impaired cognition (e.g., impaired FP) experience reduced functional capacity, more stress and poorer quality of life (Miskowiak et al., 2017; Torres et al., 2021). Moreover, metacognitive impairments are a negative predictor for quality of life (Torres et al., 2021).

Yet, little is known about the relationship between SE, ER, and FP in people with BD compared to HC. Ultimately, the aim of this study is to explore this relationship. Potentially, the findings can then be used to improve the, according to Cooke et al. (1996), decreased overall self-reported well-being and functioning of people with BD. This could possibly be achieved by using the findings to detect, manage, or diminish any negative influencing variables on this relationship, all of which could be used to further enhance existing BD treatment interventions or to help with the development of new interventions. A central aspect of treatment interventions is aiming to improve the well-being of a person and reducing symptoms of disorder (Huppert, 2009). An improvement to well-being protects people from recurrence of psychological symptoms and increases psychological health (Keyes et al., 2010). Besides, impaired psychological and physical health is strongly linked to a decrease in well-being or life satisfaction (Dear et al., 2002). In conclusion, a study of SE, ER, and FP seems necessary to be able to properly treat people with BD in the future.

In this study, the focus will be on the variable FP, since it is greatly underresearched in people with BD, especially as a metacognitive ability (Favaretto et al., 2020). Moreover, it is unknown if SE and ER might predict FP, a higher-order cognitive process ability (Arbel et al., 2018). As mentioned previously, a study researching an intervention that attempts to increase metacognitive function does so by trying to improve SE, suggesting a possible predicting effect of SE on metacognition (Haffner et al., 2018). Besides, research into the use of ER strategies suggests they affect FP, considering they engage with feedback in different ways (Grundmann et al., 2021). Also yet undetermined, is if this predictive relationship between SE, ER, and FP might also be affected by differences between the BD and HC groups. Studies demonstrably state that the BD group relates to dysfunction of SE, to impaired ER, and impairments in metacognition (Green, et al., 2007; Phillips et al., 2008; Popolo et al., 2017; Rantala et al., 2021). However, it is still unclear if group, added to the predictive relationship, might also have a predicting effect on FP. More specifically, the following three research questions will be studied. First, we will investigate the differences between people with BD and HC on SE, ER, and FP. Compared to HC, we expect that people with BD have a higher SE-N and a lower SE-P, use ER-ES more often and ER-CR less often, and score lower on FP. Secondly, we will investigate whether SE and ER predict FP, where we expect that SE-P and ER-CR positively predict FP, whereas SE-N and ER-ES negatively predict FP. Finally, we will explore whether this predictive relationship between SE, ER and FP is different for people with BD and HC.

Method

Participants

The participants took part in a large-scale project with various tests of the university hospital in Groningen (i.e., Universitair Medisch Centrum Groningen [UMCG]). However, only the groups, tests and corresponding data relevant for this thesis will be discussed here. The project was reviewed and approved by the Medical Ethics Review Board of the UMCG. Also, it was done congruent with the ethical guidelines of the Declaration of Helsinki. The people who participated in this project were HC and people with BD subtype I (diagnosed in accordance with DSM-IV criteria). All participants were of Dutch nationality and had been recruited and assessed by the lead researcher (van der Meer, L.) and colleagues in the academic year of 2009/2010. Recruiting of HC was done via social media and posters, and recruiting of people with BD via several mental health institutions and organizations, and the project's website. For their participation in the project, participants received a monetary dispensation of 7.50 euros per hour.

We tested 34 participants and gathered their data to use in the analyses of SE, ER, and FP; with 18 people (52.9%; 10 women) in the group with BD and 16 people (47.1%; 7 women) in the group with HC. The age of the 34 participants ranged from 21 to 58 years (men: M = 38.18, SD = 11.77; women: M = 35.29, SD = 13.46). Collected data of 3 participants (2 women) of the BD group was left out of the analyses on account of missing data due to the participants' non-response to items on several tests or due to technical issues.

Materials

The materials comprised three questionnaires and a task, which assessed the performances of the two groups. The questionnaires and the FP task were programmed in E-Prime, in Dutch, and presented on a computer to participants. The Self-Esteem Rating Scale-Short Form (SERS) questionnaire measured SE, the Emotion Regulation Questionnaire (ERQ) measured ER, and the task measured FP. Moreover, a questionnaire with demographic questions was used to gather information on, among other things, age (in years) and sex (male and female).

The SERS, a 20-item self-report questionnaire, was used to assess SE, how someone views their own worth as a human being. The scores on the items ranged from 1 (strongly disagree) to 7 (strongly agree). The items embodied either a positive or negative way people see themselves, resulting in two outcome variables (two subscales). A negative item stated "I feel ashamed about myself", whereas a positive one said "I feel that I make a good expression

on others". Ten of the items were negatively worded and their combined scores produced a mean score of a participant on the variable Negative Self-Esteem (SE-N). The other ten items were worded positively, which computed into a mean score of a participant on the variable Positive Self-Esteem (SE-P). This SERS, with the clear distinction between positive and negative, was developed by Lecomte et al. (2006). Lecomte et al. (2006) translated their shorter version into French and English, and found that a translated version was indistinguishable from the English one in regards to the factor structure and content. The internal alpha coefficient of the French version was 0.91 for the positive subscale, and 0.87 for the negative subscale (Lecomte et al., 2006). The study suggested that their SERS – no matter the language – had a high validity, even more so than the original 40-item SERS with regards to construct validity. All of the goodness of fit indices were either equivalent to or above the prescribed 0.90. Also, the findings indicated a satisfactory internal consistency, an acceptable test-retest reliability, and a sufficient convergent validity with another SE measure, the Rosenberg Self-Esteem Scale. Besides, it could discern outcomes of HC from those with a psychological disorder (Lecomte et al., 2006).

The ERQ, a 10-item self-report questionnaire, measured the way someone regulates their emotions. The scores on each item ranged from 1 (strongly agree) to 7 (strongly disagree). It involved two aspects of emotional life; emotional experience, how you feel internally, and emotional expression, how you show your emotions in the way you behave. The ERQ measured two distinct ER strategies (two subscales) to assess ER, i.e., the ER strategies ER-CR and ER-ES. For example, an item regarding ER-CR stated "When I want to feel more positive emotions, I change the way I'm thinking about the situation". On the other hand, an item concerning ER-ES stated "When I am feeling positive emotions, I am careful not to express them". For both subscales, a score was computed by taking the average of each subscale's scores. A high score on one of the subscales would indicate a more frequent use of that ER strategy, and vice versa. According to the study of Gross and John (2003), the following psychometric properties of the ERQ were all sufficient: factor structure, test-retest reliability (over three months, for both subscales: $r = .69$), internal consistency (ER-CR: $\alpha = .79$; ER-ES: $\alpha = .73$), discriminant and convergent validity (Karreman & Vingerhoets, 2012).

The task that measured FP was an adapted and computerized version of the Wisconsin Card Sorting Task (WCST) by de Vos, et al. (2015). Similarly to the WCST, the task involved the sorting of cards, where each item or sort contained one card that had to be sorted

onto one of the four presented options. Participants had to choose one of the options, three of which had different card rules, each with a category. Subsequently, they had to sort according to their chosen card rule, which changed after ten correct sorts in that category. Participants were not made aware of the three existing categories, i.e., color, shape, or the number of displayed figures. This version incorporated a feedback moment per sort, which allowed for the assessment of the ability to process explicit feedback. Particularly, it enabled us to measure a participant's performance on the variable FP, since the task measured their responses (correct or incorrect) subsequent to the moments of feedback. The feedback was either positive or negative, and came after the participant had to decide, for the first time, to include or exclude their current sort into their total score so far (see Appendix). The feedback consisted of a picture of a person presenting a hint in a speaking balloon, e.g., "That was a smart move!", or "That was not a smart move!". The hint was in regards to the accuracy of a participant's score on that sort, at that moment. If a participant incorrectly sorted the cards subsequently negative feedback would be shown, and inversely, if they sorted correctly positive feedback would be displayed. Afterwards, the task presented the participant another chance to change their sort, by once more presenting the option to include it into their total score thus far or to exclude it. Thereafter, it showed whether their sort was correct or incorrect and it showed the participant's total score up to that point.

Finally, the scores of the participants on explicit FP were collected and then computed into their score on correct use of FP. To accomplish this, we looked at the two 'correct' approaches participants could take that would result in the correct response (the correct sort), after receiving either negative or positive feedback. Firstly, after receiving negative feedback, they could change their (incorrect) response to the correct response and include it into their total score. Secondly, after receiving positive feedback, they could keep their (correct) response unchanged and then include it into their total score. The scores of these 'correct' approaches were added and contrasted with the combined scores on the two 'incorrect' approaches. The 'incorrect' approaches being the two approaches participants could take that result in the incorrect response, namely: after receiving negative feedback not changing their (incorrect) response to the correct one, and after receiving positive feedback changing their (correct) response to the incorrect one. Ultimately, this led to a percentage score of correct use of FP per participant by dividing the combined score on the 'correct' approaches by the combined score on the 'incorrect' approaches, times a 100%.

Considering this adapted and computerized version of the WCST is newly developed, no psychometric information is yet available for it. The study of Miranda et al. (2020) assessed the conventional WCST and found the convergent validity of most indices to be sufficient (*r* between .26 and .50; three indices $r < .26$). Also, the internal consistency (α = .93) and the discriminant validity of most indices were demonstrated to be superb (AUC between .80 and .90; two indices $r < .60$) (Miranda et al., 2020).

Procedure

Each participant was assessed for about two hours, at the UMCG, where they participated in various tests of the project. The assessments of the above-stated materials lasted about 45 to 60 minutes and were done on a computer. Before testing began, the participants – the BD group as well as the HC group – were given a paper-and-pencil informed consent form to fill out. The people who consented to be tested were asked to fill out the questionnaires concerning SE and ER. At all times, the participants were not informed as to the true purpose of each test, i.e., to measure ER and SE respectively. Moreover, they were given a demographic questionnaire to fill out, which included questions in regards to age and sex. Additionally, the participants took part in the computerized task to assess their level of FP.

Method of Analysis

Using the previously mentioned materials we measured the variables SE, ER, and FP as well as age and sex for the two groups (group HC and group with BD). Furthermore, SE and ER both had two subscales that had to be determined; SE-N, SE-P, ER-CR and ER-ES. The acquired data was then analyzed using version 26 of the Statistical Package for the Social Sciences (SPSS). A factorial multivariate analysis of covariance (MANCOVA) was applied to answer the first research question: the differences between the group with BD and the group with HC per variable. Here, group was the independent variable and SE, ER, and FP were the dependent variables, with age as a continuous covariate and sex as fixed factor.

To answer the second research question, a hierarchical multiple regression analysis was performed to report any predicting effects of SE and ER on FP. The analysis comprised four models, with FP as the dependent variable. The first consisted of age and sex, the second added SE-N and SE-P, and the third added ER-CR and ER-ES as predictors. A fourth model, to answer the third research question, used group as additional predictor to uncover any group differences. Moreover, assumptions essential to the stated data analyses were investigated

beforehand. If a violation of assumption occurred, it was corrected and thereafter reported in the results and limitations section of the discussion.

Results

In Table 1, the descriptive statistics of each of the variables are presented for both groups as well as for all participants in total, except for categorical variable sex. The study analyzed data of 34 participants of which 17 were women (50%), with 16 people (43.8% women) in the HC group and 18 people (55.6% women) in the BD group.

Table 1

Descriptive Statistics of Group HC and BD per Variable of the 34 participants

	Group HC			Group BD			Total		
Variables	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
SE-N	19.75	5.30	16	29.33	14.10	18	24.82	11.78	34
SE-P	54.50	5.49	16	52.22	9.39	18	53.29	7.76	34
ER-CR	28.81	6.22	16	26.22	9.10	18	27.44	7.88	34
ER-ES	10.38	4.69	16	13.06	5.84	18	11.79	5.42	34
FP	97.16	3.06	16	97.39	2.63	18	97.28	2.80	34
Age	32.44	11.23	16	40.56	12.69	18	36.74	12.53	34

Note. Descriptive statistics per variable per group with total also given, of 34 participants. Data of three participants, belonging to the group with BD, was excluded due to missing data. *M*, *SD* and *n* stand for mean, standard deviation, and sample size, respectively.

The first research question was whether there were significant differences between the two groups per variable, with age as covariate and sex as fixed factor. Firstly, we checked the assumptions of the MANCOVA. The Box M's test did not find a violation of the assumption of equality of observed covariance matrices of the dependent variables across groups (p = .48). The Tests of Normality showed transgressions of the assumption of normal distribution within groups of the dependent variables ($p < .05$), except for variables SE-P and ER-CR (p = .33; p = .07). Here, the Shapiro-Wilks test of normality was utilized as it is considered the most powerful, no matter the distribution and sample sizes, though still low in power for sample sizes smaller than 30 participants (Razali & Wah, 2011). As correction for the transgression, Wilk's Lambda was used since it gives more robust findings for violated assumptions of normal distribution in comparison to other test statistics (Ateş et al., 2019).

Thereafter, we ran the analysis and no significant main effect for group was found for the variables, (F (5, 25) = 1.58, p = .20; Wilk's Λ = .76, partial η^2 = .24). Also, for the second and third research question, we checked the assumptions of the hierarchical multiple regression analysis and no violations were found. For instance, the assumption of multicollinearity was not transgressed, since no multicollinearity was present given that the variance inflation factor (VIF) values were all less than 10 (Khorasani, & Zeyun, 2014). Moreover, no transgression of the assumption of independence of residuals occurred considering the Durbin-Watson value was 1.79 (between 1.5 and 2.5), meaning that no autocorrelation in residuals was observed (Khorasani, & Zeyun, 2014). For the second research question, we investigated whether SE and ER are predictors for FP. As seen in Table 2, no significance was found for this predictive relationship ($p > .05$). Furthermore, for the third research question, we assessed the possibility of group as a predictor for FP while taking into consideration other possible predictors, enclosed in the above-stated predictive relationship. The findings of this third research question were not significant as well ($p > .05$; see Table 2).

Table 2

Results of the Hierarchical Multiple Regression Analysis with SE and ER as Predictors and FP as Dependent Variable

Model	Variable	*df*	R^2	*F*	*p*
1	Age	(2, 31)	.20	.02	.98
	Sex				
2	Age	(4, 29)	2.90	.34	.85
	Sex				
	SE-N				
	SE-P				
3	Age	(6, 27)	2.34	.26	.95
	Sex				
	SE-N				
	SE-P				
	ER-CR				
	ER-ES				
4	Age	(7, 26)	2.74	.30	.95

Sex
SE-N
SE-P
ER-CR
ER-ES
Group

Note. Hierarchical multiple regression consisting of four models, with FP as dependent variable. First model contained predictors age and sex, second added subscales of SE (SE-N, SE-P), third added subscales of ER (ER-CR, ER-ES), and fourth added group as predicting variable. *Df*, R^2, *F*, and *p* represent the degrees of freedom, the proportion of the variance for the dependent variable explained by the variables in the model, variation between sample means, and probability value, respectively.

Discussion

The purpose of this thesis was to gain insight into the relationship between SE, ER, and FP in people with BD compared to HC. Both SE and ER were further specified into two subscales; SE-N, SE-P, ER-CR, and ER-ES. The first research question looked into the differences between the two groups for all of these variables. When compared to HC, we expected people with BD to have a higher SE-N and a lower SE-P, to use ER-ES more often and ER-CR less often, and to score lower on FP. However, people with BD did not significantly differ from HC on the variables SE, ER, and FP. Secondly, we investigated whether SE and ER predict FP. We expected SE-P and ER-CR to predict FP positively, and SE-N and ER-ES to predict FP negatively. Our data did not confirm these hypotheses as evidenced by the non-significant findings shown in Table 2. The variables SE and ER did not predict FP. For the third research question we explored the possibility that the group with BD and the group with HC differed from each other on the aforementioned prediction. We hypothesized group to be a predictor for FP, while taking into account other possible predictors included in the above-mentioned predictive relationship. Yet, group was not found to be a significant predictor for FP in this relationship. Additionally, in this study no age or sex differences were observed for the variables, and age and sex did not have a predicting effect on FP.

Unexpectedly, no differences between the groups with BD and HC were observed for SE, ER, and FP. This despite the fact that multiple studies assessed differences in at least SE

and ER for both subscales between these groups (SE: Atuk & Richardson, 2021; Haffner et al., 2018; Knowles et al., 2007; Rantala et al., 2021; ER: Green, et al., 2007; Gruber et al., 2012; Phillips et al., 2008). Furthermore, research revealed differences between people with BD and HC on metacognitive functions, such as FP (Popolo et al., 2017; Favaretto et al., 2020). Nevertheless, no group differences were found for FP, which may be attributed to the psychometric properties of the FP measure. As seen in Table 1, the FP measure produced exceedingly high FP means. Apparently all participants had extremely high scores on FP. Conceivably, the task that assessed FP might not have been effective in measuring the construct FP, meaning it could have low construct validity (O'donnell et al., 1994). Considering the high average mean of FP, it is plausible that the difficulty of the task was simply too low to properly measure FP. The adapted version used in this study had two moments per item where participants were asked whether they wanted their sort to be included. This would make it relatively effortless to change their response to the correct one in either one of these moments. On top of that, the complexity of the task was low, which in studies was determined to increase performances (Líu & Li, 2011). For example, this version presented feedback that indirectly revealed the correct response in an uncomplicated manner via hints. The hints were repetitive and contained feedback that directly related to their response in the previous slide, with only two possible variations. Furthermore, this study did not consider response time as a variable, therefore the participants could have taken their time per slide. Crucially, they could have had more time for FP. Time was found to be in a positive relationship with the difficulty of a (processing) task (Goldhammer et al., 2014). As a result, the difficulty of the task and of (correct use of) FP could have been decreased. Altogether, this probably inordinately improved the accuracy of participants on FP. Hence, results pertaining the variable FP should be heavily scrutinized and should ostensibly be disregarded as they do not reflect the intended concept. That said, group differences for FP do not necessarily have to exist, even though several studies did find differences between BD and HC on metacognitive functions (Popolo et al., 2017; Favaretto et al., 2020). It could be that since FP as a metacognitive function has only been recently discovered not enough research has been done into this phenomenon as yet, especially in regards to people with BD. Case in point, in contrast with earlier research that observed impaired metacognition in people with BD (Popolo et al., 2017; Favaretto et al., 2020), the study of Lysak et al. (2018) found no difference between BD and HC groups in metacognitive functioning. However, it may also be the case that due to inserting all variables into one single MANCOVA model the

statistical power was simply too low, resulting in a reduced chance to detect any significant differences (Button et al., 2013; Field, 2013).

Besides, this study's findings on SE could perhaps be explained by the instability and fluctuation of SE in people with BD (Knowles et al., 2007; Rantala et al., 2021). Kernis (2005) distinguishes between SE level and SE stability. The level of SE consists of a person's representations of their general and typical feelings of self-worth (Kernis, 2005). Whereas stability of SE refers to the extent of short-term fluctuations that an individual experiences in contextually based, immediate feelings of self-worth (Kernis, 2005). Possibly, the participants with BD exhibited increased (short-term) variability of SE that was not detected by the SERS, which only measures ten items of SE-N and of SE-P. Perhaps a more nuanced measure is required to assess the greater complexity of SE in people with BD in comparison to HC. As for the lack of group differences on the ER strategies, the study of Gruber et al. (2014) provides potentially interesting findings. They determined homogenous outcomes on ER-CR for the HC and BD groups; for both groups ER-CR was linked with decreased reactivity of emotion on negative and positive affect, physical response, and facial expressions (Gruber et al., 2014). Another study observed a great amount of variation in use of ER strategy, following positive or negative emotions, within people with depressive and other internalizing symptoms (Park, 2021). Moreover, Park (2021) could discern subgroups with distinct and different profiles of positive or negative ER propensities. Imaginably, the BD and HC groups showed indistinguishable variation of ER strategy use.

Besides, no predictive effect of SE and ER on FP was assessed. Perchance, instead of directly affecting FP, SE and ER could be indirectly predicting FP. Alternatively, no predictive effect of SE and ER on FP was detected since FP is considered to be necessary for SE and ER (Park, 2021; Kolubinski et al., 2019). Park (2021) indicated FP to have a predictive effect on SE. In addition, Kolubinski et al. (2019) found decreased metacognitive abilities (e.g., FP) to have a negative predictive effect on SE. This potentially frames FP as the predictor for SE and ER. Furthermore, no predicting effect was found for group on FP. Apparently, the group with BD and the group with HC did not differ from each other on the predictive relationship between SE, ER, and FP. The study of Linke et al. (2011) into feedback in people with BD observed that the last active episode (manic or depressive) impacted how sensitive people with BD were to feedback. People with BD who last had a depressive episode had more of a reaction to negative feedback, whereas those who experienced a manic episode were more sensitive to positive feedback (Linke et al., 2011).

This indicates that people with BD use FP differently depending on their last episode. Moreover, it may help explain the non-significant findings of group, since we used merely one variable to represent FP and no separate positive or negative FP outcomes were analyzed. Also, we did not take the influence of the last episode into account. Therefore, for people with BD, the variability of FP outcomes was probably fairly high resulting in a similar mean of FP in comparison to the FP mean of HC. In future, research on FP should take into consideration that people with BD may differ in sensitivity to (positive or negative) feedback. Not to mention that analysis of more than one feedback outcome is probably needed to produce a clearer insight into FP in people with BD.

Limitations & Future Research

A substantial short-coming of this study is the violated assumption of normality for most of the dependent variables in the MANCOVA, which had to be corrected. However, this increased the possibility of Type I and Type II errors, and reduced the power of analysis (Allen & Bennet, 2008). Moreover, the sample sizes of each group consisted of merely 17 participants. The small sample sizes decreased the possibility of generalization to the population (Allen & Bennet, 2008). Therefore, distinct inferences and interpretations should not be made by the analysis results of the small sample sizes (Tipton et al., 2017). In addition, the small sample sizes reduced the power of the study, decreasing the ability to determine effects and increasing the possibility that the null hypotheses were falsely accepted (Field, 2013; Uttley, 2019). Thus, any result of the MANCOVA should be carefully observed and interpreted. On the other hand, this study has several points of strength. For example, we thoroughly checked all assumptions, reported any violations and applied appropriate corrections where necessary. Additionally, the assumptions of the hierarchical multiple regression analysis were not violated. Moreover, using a hierarchical multiple regression analysis allowed for the assessment of the importance of each of the predicting variables on the dependent variable, while taking the other predicting variables into account (Field, 2013). Another strength is that we could decide at what point to insert certain predicting variables, as it permits the modelling of complex relationships (Field, 2013).

In this study digitalized testing was utilized. The adapted and computerized version of the WCST was used as an exploratory study into FP. Not only was it a computerized version of an already existing task, it also integrated feedback via hints. It used a completely new and innovative way to attempt to assess FP. Although it appeared to have low construct validity for FP, such an adaptive approach could be refined or redone in future research. Further

studies with a comparable approach could potentially increase construct validity for the assessment of FP. Moreover, they could further delve into the intricacies and nuances of metacognitive processes such as FP and assess it in people with (neuro)psychological disorders. Metacognitive functions were still mostly unknown and unexplored at the time of this study. There was still a deficiency in research into metacognition, particularly regarding people with a psychological disorder who potentially have impaired metacognition. Future research could develop a method of assessment of impaired metacognition in people with BD, as well as for metacognitive assessment in others. Furthermore, it could help with the development of treatment programs, for example for people with BD. These treatment programs could then take impaired metacognition into account and help with alleviating and managing symptoms caused by this impairment.

Conclusion

In this thesis, we focused upon exploring the relationship between SE, ER and FP in people with BD and HC. However, no significance was found. The goal was (and is) to help with the improvement of well-being, health, and functioning of a person with BD. An accurate assessment of these variables and of the underlying processes and relationships, could be a first step in the development of new treatment interventions or could enrich already existing treatment methods for people with BD. Future research may improve the ability to detect any influential factors involved in cognitive impairment in BD, to subsequently try to minimize or manage any negative influence on the overall well-being, health, and functioning of an individual with BD.

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Appendix

The FP task

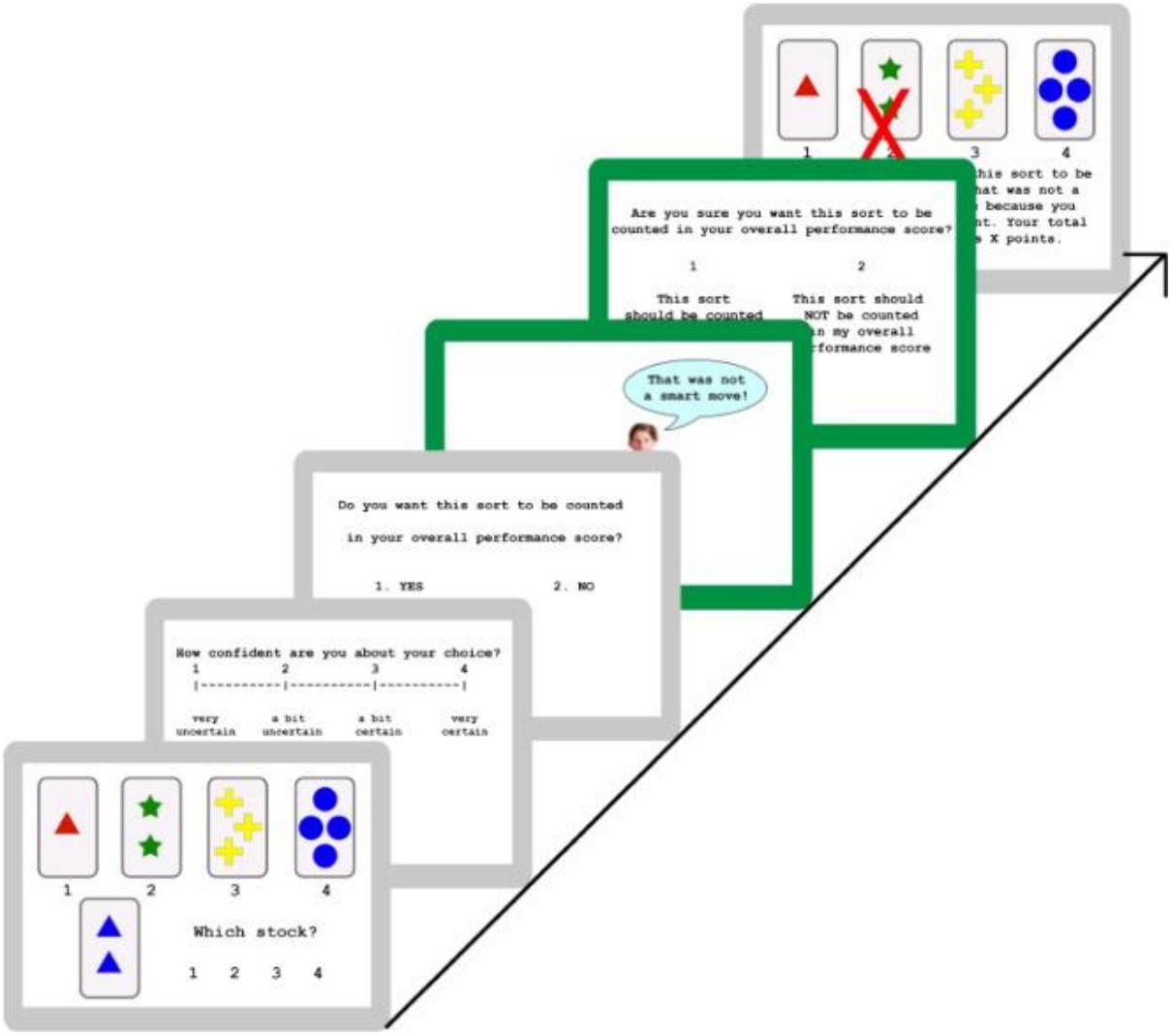

Figure 1. This adapted version used a computerized version of the WCST. The added slides by de Vos et al. (2015) in green here, constitute the feedback moment used to assess FP. The fourth slide gives the participant either positive or negative feedback on their sort by presenting a hint. The fifth slide provides the participant a second chance, where they can reconsider if they still want to include the sort into their overall total score thus far or not. In the sixth slide, the participant is shown if that sort was correct or incorrect (incorrect in Figure 1), and also their total score up to that point.