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Symptoms, course of Illness, and comorbidity as predictors of expressed emotion in bipolar disorder

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ABSTRACT

High levels of expressed emotions (EE) reflect the amount of criticism and/or over-involvement in families and has been linked to relapse risk in various psychiatric disorders including bipolar disorder (BD). Less clear is which factors contribute to the development and/or maintenance of EE. Therefore, we tested whether patient characteristics, specifically clinical features and personality disorder traits in BD predicted key aspects of EE as assessed by patients and their relatives. Patients with remitted BD and their relatives were asked to complete the Family Attitude Scale (FAS) and the Perceived Criticism Measure (PCM). Patient characteristics were assessed with a variety of measures including SCID I and II. The FAS and PCM shared 25% of the variance for patients and 14% for relatives, suggesting a conceptual overlap, but they may not assess identical constructs. The number of previous mood episodes, current self-rated manic symptoms, and comorbid symptoms of Cluster C personality disorder predicted patient-rated FAS. Relative-rated FAS was only predicted by comorbid symptoms of Cluster A personality disorder. In BD, specific patient characteristics seem to be linked to key aspects of EE even when in remission. However, it might depend whether the patient, his/her relative, or a neutral observer assessed EE.

1. Introduction

Expressed emotion (EE) is a psychological concept that reflects the quality of intrafamily relations of patients with psychiatric disorders. EE indicates the amount of critical comments, hostility, and emotional over-involvement that family members express towards a patient (Kavanagh, 1992; Vaughn and Leff, 1976). Originally, the concept of EE has been applied to better understand risk of relapse in individuals with schizophrenia (Butzlaff and Hooley, 1998; Weintraub et al., 2017), but high levels of EE seem to relate to poorer outcome in a number of other psychiatric and somatic disorders, e.g., diabetes (Wearden et al., 2000) eating disorders (Rienecke et al., 2016), obsessive-compulsive disorder (Grover and Dutt, 2011), and unipolar depression (Florin et al., 1992; Hinrichsen and Pollack, 1997; Hooley et al., 1986; Hooley and Teasdale, 1989). Studies that have looked at bipolar disorder (BD) suggest that EE might be an important risk factor for relapse in BD as well (Johnson et al., 2016; O'Connell et al., 1991; Scott et al., 2012; Yan et al., 2004). Specifically, in the very first study on this topic high levels of EE together with negative affective style predicted 91% of the bipolar relapses (Miklowitz et al., 1988). Furthermore, EE significantly moderated the responses to medical (Priebe et al., 1989) and psychosocial treatments (Fredman et al., 2015; Miklowitz et al., 2009) in BD.

While the validity of the EE concept for BD has been shown, we know less about which variables predict EE. It has been intensely discussed whether patient characteristics relate to EE. In a review Hooley (2007) found sparse evidence that specific characteristics of the patient or the illness relate to EE. Also, EE had been found to be strongly associated with relapse in different illnesses, therefore making it questionable that EE is linked to specific symptoms of any psychiatric disorder (Hooley and Gotlib, 2000). On the other hand, Cutting et al. (2006) argue that patients are not passive but interact with their environment, and patient characteristics might mediate how they perceive the world and react to their environment. In line with this idea, it was found that BD symptoms were related to EE (Kim and Miklowitz, 2004; Yan et al., 2004). To our knowledge, there are no studies that examined the association between EE and psychiatric comorbidity in patients with BD. However, there is reason to assume that comorbid personality disorder traits in BD might relate to EE because

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psychopathological personality traits are a frequent phenomenon in BD. For example, Meyer et al. (2006) found in their systematic review that 37% of patients with BD had a diagnosis of a personality disorder, mostly Cluster B (see also Frías et al., 2016). Since interpersonal deficits are core symptoms in individuals with personality disorders, one could assume that personality disorder traits will affect interpersonal interactions and hereby also the familial climate.

The 'gold' standard to assess EE is the Camberwell Family Interview (CFI; Leff and Vaughn, 1985), which is used to score the frequency of certain behaviors and comments made by key relatives of the patient in that interview. The administration of the CFI requires extensive rater training and involves lengthy administration and rating. Therefore, Hooley and Parker (2006) suggested some alternative ways to assess EE, for example, the self-rated Perceived Criticism Measure (PCM). Another self-rating is the Family Attitude Scale (FAS, Kavanagh et al., 1997). Although it is still not clear if these self-reports measure the same construct as the CFI, it has been shown that the FAS was associated with two key elements of EE, namely criticism and hostility, but not with emotional overinvolvement (Kavanagh et al., 2008). There is mixed evidence about the association between the CFI and PCM (Chambless and Blake, 2009; Hooley and Parker, 2006) but it is used to assess one aspect of EE, namely criticism, and reliably predicted relapse (Hooley and Parker, 2006).

In order to further explore these findings, the present study aimed to investigate, if specific patients characteristics related to EE levels reported by patients and their relatives in BD. First, since this has not be done before in this population, we examined the relationship between PCM and FAS in patients with BD and their relatives. Second, we hypothesized that subsyndromal mood symptoms assessed by self- and expert-ratings, severity of BD, and traits of personality disorder predicted high levels of EE.

2. Methods

2.1. Participants

One-hundred-and-forty individuals contacted our study team, because they were interested to participate in a study relating to psychotherapy and BD. These individuals were either referred by local hospitals, psychiatrists, or were self-referrals due to public information in newspapers, brochures or radio (see also Meyer and Hautzinger, 2012). Forty-two individuals did not show up after the initial telephone contact, withdrew consent after the baseline assessment, did not fulfill the inclusion criteria, or did not complete at least one of the EE measures.

Inclusion criteria were a diagnosis of BD and age between 18 and 65. The participants had to give informed consent and to agree to continue their usual psychiatric treatments. Exclusion criteria were the presence of severe depression or mania, i.e., participants with scores ≥ 20 on the Bech-Rafaelsen Melancholia Scale (BRMS; Bech, 2002) or scores ≥ 20 on the Bech-Rafaelsen Mania Scale (BRMAS; Bech et al., 1978) were excluded. Furthermore, patients with a comorbid substance dependency requiring detoxification and/or current psychotic symptoms were also excluded. Patients were asked for informed consent to send a questionnaire to their spouse, or if single or divorced to their partner or closest relative (e.g. mother).

The present study included data of 98 patients. The sample comprised 52 males and 46 females. Of the 98 patients, 40 were married, 39 were single and 19 divorced. 20.4% of the patients indicated an age of onset before age 18. Medication status was unknown for 5.1% of the patients, 15.3% did not use medication, and 78.6% used mood stabilizer, antipsychotics, antidepressants, anxiolytics, or a combination of medication. Based on the SCID-I all participants were in full remission; looking at rating scales, most patients had scores below 15 on the BRMS (90.3%) and the BRMAS (98.9%). Table 1 displays demographical and clinical data of the participants.

Table 1
Demographic and clinical data of patients with BD.

	*N**	*M*	SD
Age	98	42.98	12.18
Mood Symptoms			
BDI	98	13.79	9.35
SRMI	97	20.12	11.92
BRMS	93	5.71	5.24
BRMAS	93	1.58	3.14
Severity			
# of Episodes	78	12.37	16.27
Age of Onset	93	28.43	10.71
Personality disorder traits			
Cluster A	90	25.86	3.52
Cluster B	75	35.63	3.81
Cluster C	90	45.30	9.12
Expressed Emotion			
Patient FAS	96	40.18	16.91
Relative FAS	92	36.24	15.88
Patient PCM	93	5.10	2.21
Relative PCM	89	4.91	1.95

Notes: BDI, Beck Depression Inventory; BRMS, Bech Rafaelsen Melancholia Rating Scale; BRMAS, Bech Rafaelsen Mania Rating Scale; FAS, Family Attitude Scale; PCM, Perceived Criticism Measure; SRMI, Self Rating Mania Inventory.
* Due to missing data *N* varied.

2.2. Measurements

2.2.1. Family Attitude Scale (FAS; Kavanagh et al., 1997)

The FAS contains 30 items that cover 4 key aspects of EE: criticism, hostility, anger and warmth. Statements relating to EE are rated on a 5 point scale ranging from "always" (4) to "never (0). The sum of scores ranges from 0 to 120, with higher scores indicating higher levels of EE. In the original study by Kavanagh et al. the mean FAS score of healthy undergraduate students who rated their mothers was 34.2 (SD = 20.5). The mean FAS score of the mothers, who rated how critical they were to their child, was 25.9 (SD = 16.0). Two versions of the FAS were used in the present study, one for the patients ("He/she thinks, that I am a real burden") and one for relatives ("He/she is a real burden"). The senior author translated the English version into German, and a native English speaker translated this back into English. Any inconsistencies were discussed and removed. In the present study, we obtained Cronbach's α = 0.94 for patients and Cronbach's α = 0.95 for relatives.

2.2.2. Perceived Criticism Measure (PCM; Hooley and Teasdale, 1989)

The rating on a 10 point scale of the question "How critical is your relative of you?" was the best indicator for EE in a number of studies (Hooley and Miklowitz, 2017; Renshaw, 2007). Therefore, we used a 10 point visual analog scale on which the patients were asked to rate the question "How critical has he/her been of you?". The relatives were asked to self-rate their level of criticism: "How critical have you been of him/her?".

2.2.3. Structured Clinical Interview for DSM-IV Axis I and II (SCID; First et al., 1997; Wittchen et al., 1997)

The SCID-I and II are widely used and reliable semi-structured interviews to assess Axis I and II disorders based on the diagnostic criteria of the DSM-IV (APA, 1994). Dimensional scores were created by adding up the number of criteria fulfilled for a specific personality disorder. Dimensional scores for Cluster A could range between 0 and 21 and included the number of fulfilled criteria for paranoid, schizoid, and schizotypal personality disorder. Cluster B scores could range between 0 and 33 and included symptoms of narcistic, borderline, histrionic, and antisocial personality disorder. Cluster C scores comprised the number of symptoms fulfilled for dependent, avoidant, obsessive-compulsive, passive-aggressive, and depressive personality disorder. The dimensional score could range between 0 and 37. The interviewers were all

Table 2
Bivariate listwise correlations between the FAS, PCM, and the clinical variables

$N = 59$	FAS-P	FAS-R	PCM-P	PCM-R	BDI	SRMI	BRMS	BRMAS	Onset	# Epi.	Psychot.
BDI	0.15	0.09	0.03	−0.15	–						
SRMI	0.27*	0.09	0.12	0.28*	0.01	–					
BRMS	0.18	0.19	0.01	−0.06	0.64**	−0.01	–				
BRMAS	0.07	−0.01	−0.05	0.09	−0.32**	0.20	−0.17	–			
Age Onset	0.17	0.34**	0.27*	0.26*	−0.15	−0.17	−0.01	−0.04	–		
# of Episodes	0.29*	0.11	0.11	0.13	0.14	0.15	−0.08	−0.04	−0.02	–	
Psychot. Sym.	−0.17	−0.23	−0.21	−0.08	−0.17	0.02	−0.14	0.22	−0.38**	−0.05	–
BD I vs. BD II	−0.01	−0.02	−0.24	−0.07	0.13	0.20	−0.02	0.23	0.02	−0.12	0.05

$N = 66$	FAS-P	FAS-R	PCM-P	PCM-R	Cluster A	Cluster B	Cluster C
Cluster A	0.16	0.33**	0.16	0.03	–		
Cluster B	0.20	0.26*	0.14	0.12	0.31**	–	
Cluster C	0.42**	0.27*	0.17	0.02	0.47**	0.63**	–

Notes: BDI, Beck Depression Inventory; BRMS, Bech Rafaelsen Melancholia Rating Scale; BRMAS, Bech Rafaelsen Mania Rating Scale; Cluster A/B/C, refers to the relevant DSM-IV personality disorder traits; FAS-P, Family Attitude Scale rated by patients; FAS-R, Family Attitude Scale rated by relatives; PCM-P, Perceived Criticism Measure rated by patients; PCM-R, Perceived Criticism Measure rated by relatives; Psychot. Sym., History of psychotic symptoms (Yes/No); SRMI, Self Rating Mania Inventory;

* $p < 0.05$;

** $p < 0.01$.

extensively trained in two weekend workshops. In addition, all interviews were additionally video-recorded to derive consensus diagnosis if needed.

2.2.4. Beck Depression Inventory (BDI; Beck et al., 1961)

The BDI is a widely used self-report questionnaire that measures the severity of depression. It consists of 21 items that are rated on a four-point scale from 0 to 3. Scores above 9 indicate mild, and scores above 18 indicate moderate depression. In the present study, we used the validated German version that has comparable psychometric properties to the English version (Brieger et al., 2007; Hautzinger et al., 1994).

2.2.5. Self Rating Mania Inventory (SRMI; Shugar et al., 1992)

The SRMI is a 47-item self-rating instrument for manic and hypomanic symptoms and can be used to assess acute symptoms or residual symptoms in remitted states. In the present study the individuals were asked to rate the previous month. Scores above 14 indicate a high probability of acute mania. Internal consistency (Cronbach's $\alpha = 0.94$) and retest reliabilities between 0.79 and 0.93 are high (Shugar et al., 1992).

2.2.6. Bech Rafaelsen Melancholia Scale (BRMS; Bech, 2002; Smolka and Stieglitz, 1999)

The BRMS is an observer-based measure used to assess depressive symptoms. A sum score based on 11 items ranging from 0 (no symptom) to 4 (severe) was calculated. Scores ≤ 14 indicate no or doubtful depression, 15 to 20 indicate mild depression, 21–28 indicate moderate depression, and a score above 28 indicates severe depression (Lam et al., 2005).

2.2.7. Bech Rafaelsen Mania Scale (BRMAS; Bech et al., 1978)

The BRMAS is a widely used 11-item interview to rate manic symptoms on a scale from 0 (not present) to 4 (severe). Similar to the BRMS, scores between 0 and 14 indicate no or doubtful mania, 15 to 20 indicate mild mania, and scores above 20 indicate moderate and severe mania (Lam et al., 2005). Interrater reliabilities are between 0.80 and 0.95 (e.g., Bech, 2002). The combined use of the BRMAS and BRMS is recommended to rate bipolar symptoms (Hautzinger and Meyer, 2002).

2.3. Statistical methods

The significance level was set at 5% for all statistical procedures. We used listwise bivariate correlations, paired *t*-tests, and linear regression with forced entry where appropriate. For *t*-tests, the assumptions about normal distributions and variance heterogeneity were checked; for the linear regressions, we examined the proportion of outliers. If more than 5% of the cases had standardized residuals greater than 2, the model seemed to be a poor representation of the data (Field, 2013). The variance inflation factor (VIF) was inspected to assess multicollinearity. If the largest VIF was below 10 and the average VIF was about 1 there was no problem with multicollinearity (Field, 2013). Finally, the assumption of independent error was defined to be met by a Durbin-Watson-Value between 1 and 3 (Field, 2013). If not otherwise noted in the result section, these assumptions were met. Exact *p* values and effect size values will be displayed.

3. Results

3.1. FAS and PCM in patients and their relatives

Before presenting the main results, we explored how closely the ratings of the patients and their relatives matched. The patients of our sample reported higher average FAS ratings than their relatives, $t(90) = -2.38$, $p = 0.02$ (Table 1). Based on listwise bivariate correlations ($n = 83$) the FAS of the patients and their relatives was positively correlated ($r = 0.47$, $p < 0.001$). The level of perceived criticism (PC) assessed with the PCM also correlated positively between patients and their relatives ($r = 0.50$, $p < 0.001$), but the two groups did not differ at all in their assessment of PC, $t(83) = 0.00$, $p = 1.00$, implying a high concordance between patients and their relatives. The listwise correlation between FAS and PCM was significant in patients ($r = 0.50$, $p < 0.001$) and in relatives ($r = 0.37$, $p < 0.001$). Masland and Hooley (2015) suggested that a score above 5 would identify patients at high risk for relapse. For comparison with other studies, in our study, 52.7% of the patients and 44.9% of the relatives reached a PCM score above 5 reflecting a high level of perceived criticism in their families.

3.2. Predictors of EE indices: FAS and PCM

Linear regression analyses were performed in order to examine potential predictors of FAS and PCM scores. First, BDI, SRMI, BRMS, BRMAS, age of onset, number of affective episodes, presence of psychotic symptoms during mood episodes, and type of BD (BD-I versus BD-II) were used as predictors for FAS and PCM in patients and their

relatives. Table 2 shows the bivariate correlation between the clinical variables and the EE measures. The model for the patient-rated FAS was significant, $F(8, 57) = 3.12$, $p = 0.005$. A total of 30.4% of the variance was explained. Looking at the individual predictors, increased SRMI scores and a high number of episodes significantly predicted FAS scores of the patients (Table 3). The model for patient-rated PCM did not reach significance, $F(8, 55) = 1.73$, $p = 0.11$. Furthermore, none of the two models for the relatives was significant (FAS: $F(8, 53) = 1.33$, $p = 0.25$ and PCM: $F(8, 52) = 1.71$, $p = 0.12$), meaning that these clinically relevant variables did not explain variance in EE measures when rated by the relatives when the patients are remitted.

Next, dimensional scores of Cluster A, B, and C personality disorders were used to predict FAS and PCM. To reduce the number of predictors in the analyses we focused on dimensional scores of Clusters instead of individual personality disorders. Table 2 presents the listwise bivariate associations. The regression model for the patient-rated FAS was significant, $F(3, 71) = 5.79$, $p = 0.001$, and explained 20% of variance. Of the three predictors, only Cluster C symptoms made a significant contribution to the model (Table 4). The model for patient-rated PCM was not significant, $F(3, 68) = 0.67$, $p = 0.56$. The regression model for the relative-rated FAS was significant, $F(3, 68) = 4.01$, $p = 0.01$ and explained 15% of variance. Specifically, Cluster A symptoms made a significant prediction to relatives' FAS scores (Table 4). The model for the relatives' PCM was not significant, $F(3, 65) = 0.17$, $p = 0.92$, i.e. personality disorder traits in patients did not predict PC in relatives.

4. Discussion

Expressed emotion has been shown to be a risk factor for relapse in BD (e.g., Johnson et al., 2016), we therefore were interested in examining what kind of patient characteristics would predict EE in a sample of patients with remitted BD and their relatives. Using the FAS and the PCM, we found a) evidence that the two scales share some variance and b) that patients and relatives show some agreement in these measures. In contrast to our expectation, neither clinical variables of BD nor comorbid personality disorder traits predicted the perception of criticism in patients or relatives. When patients used the FAS, self-rated manic symptoms, the number of lifetime episodes and comorbid personality disorder traits were significant predictors. Personality disorder traits also predicted the relative-rated FAS, although a different cluster.

The FAS and PCM shared 25% of the variance for patients and 14% for relatives, suggesting they have conceptual overlap, but may not be assessing identical constructs. Specifically, the FAS measures critical attitudes and critical behavior, and correlates reasonably well with the criticism, hostility, and warmth scores of the CFI, which reflects an observer-based frequency count of observable critical behavior (Chambless and Blake, 2009). In contrast, the PCM estimates only one aspect of EE, namely criticism, but does not tap into other aspects such as emotional overinvolvement or hostility. There is mixed evidence, but PCM scores show only low correlation with the CFI (Chambless and Blake, 2009; Hooley and Parker, 2006). The PCM relies on a single item and might therefore increase the risk of errors of measurement, which reduces the ability of the scale to predict. Furthermore, Chambless and Blake (2009) suggested that the PCM reflects the amount of criticism that is getting through to the patient regardless of the actual behavior. Our results might indicate that the shared variance between PCM and FAS relates to the subjective perception of criticism rather than to actual critical behavior.

We find it noteworthy that the mean levels of PC did not significantly differ between patients and relatives and were positively correlated with each other. The patients' and relatives' FAS were also correlated, however, the patients reported higher FAS scores than their relatives. This is consistent with other studies (Kavanagh et al., 1997) but it is not known what this reflects. For example, this might suggest that patients, who are the targets of the critical comments, are more sensitive to critical attitudes and behavior than their relatives. Another possibility is that it could just be a difference in perception and not reflecting actual behavior. Alternatively, it could be that the relatives are less aware of their criticism and hostility because they might be a reaction to the patient's previous negative remarks or negative non-verbal behavior.

We found some support that illness parameters predicted patient-rated FAS scores. Remitted patients with BD who a) rated themselves having slightly elevated levels of manic symptoms, b) reported more lifetime mood episodes, and c) had more Cluster C personality disorder traits showed elevated FAS scores. A link between manic as well as depressive symptoms and EE has been reported earlier (Kim and Miklowitz, 2004), while others found that EE was unrelated to severity parameters and symptoms of BD (Coville et al., 2008; Simoneau et al., 1998). It is important to note two methodological differences between these three studies and the present study: First, they used observer-rated rather than self-rated instruments to assess mood symptoms. And, while we also included clinician-rated mood symptoms, only the self-rated manic symptoms showed an association to EE. Second, in the above cited studies EE was observer-rated using audiotaped interviews, i.e. the CFI, while we used self-ratings. In our study it could be that manic symptoms that have not reached a threshold to be clinically noticeable have already affected the patients' appraisals of the relatives' overall behavior or the family atmosphere at home. Consistent with this idea, self-rated manic symptoms did not predict the specific one-item measure PCM which focuses only on perceived criticism. Additionally, none of the patient characteristics predicted the relatives' appraisal of the family atmosphere in form of the FAS. The latter would be expected if the manic symptoms were clearly noticeable to others. Two things are relevant in this context: a) previous studies found that the SRMI was more sensitive than observer ratings to detect hypomanic states (e.g. Cooke et al., 1996); b). the early prodromal signs of mania might only be subjectively felt (e.g. more optimistic outlook, more energy, more creativity or flexibility in thinking) but not yet translate in behaviors that can be observed by others and then elicit more critical comments.

We had chosen several indices for the severity of the course of BD such as age of onset, presence of psychotic symptoms or number of lifetime mood episodes. Only the latter was associated with one of the EE measures, the patient-rated FAS. This, first, seems to contradict a previous study, which did not find links between course of BD and EE, but they based their EE ratings on behavioral observations of family interactions (Heikkilä et al., 2002). Furthermore, looking at the FAS items, our data suggests that a higher number of lifetime mood episodes makes patients feel that there is more tension in the family and that they might be a burden for their loved ones. An interesting thought is that the patients' FAS may be more reflective of past experiences, whereas the relatives' FAS may be more reflective of present attitudes and behaviors. When administered between episodes, in a fairly stable and euthymic state, the patients' FAS might reflect more adequately and less biased by current symptoms the relatives' attitudes and behavior than in times when they were symptomatic. If so, one might expect that patients' FAS between episodes may be more predictive of later relapse. This hypothesis, however, remains to be tested.[1]

The specific FAS items might also provide a potential explanation why in patients Cluster C personality disorder traits predicted FAS scores, while in relatives Cluster A traits predicted FAS scores. Patients with Cluster C personality disorder traits describe themselves, for example, as having generally low self-esteem, being more sensitive to criticism, afraid of making mistakes or relying on others (Diedrich and Voderholzer, 2015; Disney, 2013; Huprich, 2012; Weinbrecht et al., 2016). Patients with BD who also have Cluster C traits will therefore be more likely to expect criticism or feel like a burden to their loved ones

[1] We are grateful for an anonymous reviewer to provide us with this interesting idea.

Table 3
Regression analysis using symptoms and severity of BD as predictors of patient rated EE.

Variable	B	SE B	β	t	*p*	95% CI		VIF
						Lower Limit	Upper Limit	
FAS-P								
BDI	0.01	0.29	0.01	0.03	0.98	−0.58	0.60	2.17
BRMS	0.61	0.45	0.20	1.36	0.18	−0.29	1.51	1.84
SRMI	0.41	0.18	0.27	2.26	0.03	0.05	0.77	1.15
BRMAS	0.52	0.68	0.10	0.77	0.45	−0.84	1.87	1.27
Age of Onset	0.32	0.19	0.21	1.70	0.10	−0.06	0.70	1.31
Number of Episodes	0.30	0.11	0.32	2.69	0.01	0.08	0.52	1.14
Psychotic Symptoms	−1.92	4.23	−0.06	−0.46	0.65	−10.40	6.55	1.28
BD-I vs. BD-II	−0.01	0.01	−0.05	−0.43	0.67	−0.03	0.02	1.23

Notes: BD-I, Bipolar Disorder Type I; BD-II, Bipolar Disorder Type II; BDI, Beck Depression Inventory; BRMS, Bech Rafaelsen Melancholia Rating Scale; BRMAS, Bech Rafaelsen Mania Rating Scale; FAS-P, Family Attitude Scale rated by patients; SRMI, Self Rating Mania Inventory.

Table 4
Regression analyses using DSM IV Personality Disorder traits as predictors of patient and relative rated EE.

Variable	B	SE B	β	t	*p*	95% CI		VIF
						Lower Limit	Upper Limit	
FAS-P								
Cluster A	−0.20	0.56	−0.04	−0.35	0.73	−1.30	0.91	1.25
Cluster B	0.47	0.59	0.10	0.80	0.43	−0.70	1.64	1.45
Cluster C	0.72	0.25	0.40	2.90	0.005	0.23	1.22	1.64
FAS-R								
Cluster A	1.03	0.52	0.25	1.97	0.05	−0.01	2.08	1.29
Cluster B	0.93	0.58	0.22	1.60	0.11	−0.23	2.09	1.45
Cluster C	0.01	0.23	0.01	0.04	0.97	−0.45	0.47	1.60

Notes: Cluster A: Number of fulfilled criteria for paranoid, schizoid, and schizotypal personality disorder; Cluster B: Number of fulfilled criteria for narcistic, borderline, histrionic, and antisocial personality disorder; Cluster C: Number of fulfilled criteria for dependent, avoidant, obsessive-compulsive, passive-aggressive, and depressive personality disorder; FAS-P, Family Attitude Scale rated by patients; FAS-R, Family Attitude Scale rated by relatives.

regardless of the frequency and intensity of critical comments of their relatives. This would explain why higher EE is linked to Cluster C traits only when the FAS instead of the PCM is used, because the latter focused solely on perceived expressed criticism and not, for example, on worries of being criticized.

Why do Cluster A traits of the patients specifically predict elevated FAS scores in their relatives? The defining features of Cluster A personality disorders are eccentric and odd thinking styles such as magical ideation, interpersonal problems such as suspiciousness, intimacy avoidance, hostility, indifference to the company of others, motivational deficits, and constricted affect (Rosell et al., 2014; Triebwasser et al., 2013, 2012). They are often discussed as being part of the schizophrenia spectrum (Triebwasser et al., 2013). While the presence of clinically significant psychotic symptoms during mood episodes was not related to any EE measure in our study, these more personality like, stable traits of eccentric, odd thinking or interpersonal deficits seems to affect relatives' perception of the patient and the family interactions in a negative way. Although not looking at personality disorder traits but actual psychotic symptoms, Rosenfarb et al. (1995) results are of interest here. They found a bidirectional relationship between relatives' criticism and unusual thoughts in patients with schizophrenia where the probability for more unusual thoughts was increased when relatives were critical of patients' initial odd thinking. A similar interaction could exist when odd or eccentric behaviors are more often displayed by patients on a trait level such as Cluster A traits.

This is one of the few studies in which hostility and criticism, two key elements of EE, were rated by the affected individuals themselves, as well as, by their relatives, instead by clinicians. In addition, we assessed criticism as the patients and their relatives *perceive* it with the PCM having empirical evidence to be a valid predictor of relapse similar to the more time consuming interviews or observations of actual family interactions (Hooley and Teasdale, 1989). However, relying solely on self-reports is a limitation of the study, because EE was not additionally rated by experts based on actual observations (Hooley and Parker, 2006; Kavanagh et al., 2008). Also, emotional overinvolvement, which is a key variable of EE, was not assessed in this study. Another limitation is that we cannot be sure that the participating relative was the key person responsible for the highest criticism and hostility in the family, nor did we have much information about the relatives themselves. Some studies suggest that the kind of relation between the relative and patient, as well as psychiatric symptoms, personality traits, distress, or attributional style of the relatives might play a crucial role (Hooley, 2007). Given the limited sample size, we were, however, not able to look at correlations and differences between different subgroups of relatives. One needs also to acknowledge that the sample size can negatively affect the robustness of regression analyses, and the multiple analyses can inflate Type 1 errors. Finally, although we examined potential predictors of hostility and criticism, our cross-sectional design does naturally not allow to determine any direction of the relationships between the variables.

Our aim was to explore potential predictors of key elements of EE in a sample of patients with BD and their relatives. Based on our results, we conclude that on the one hand our study fits to prior research that did not generally find much evidence for an association between patient characteristics and hostility and criticism; on the other hand, we found that the self-perceived family interactions might inform us about problems which might be more closely related to stable personality factors of the patients than their Axis I psychiatric disorder. The latter might be a topic that might deserve more attention clinically and in research.

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