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ASSOCIATIONS BETWEEN FIVE-FACTOR MODEL PERSONALITY TRAITS AND PSYCHOTIC EXPERIENCES IN PATIENTS WITH PSYCHOTIC DISORDERS, THEIR SIBLINGS AND CONTROLS

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ABSTRACT

Background

Earlier studies indicated that personality characteristics contribute to symptomatic outcome in patients with psychotic disorders. The aim of the present study was to further explore this connection by examining the relationship between Five-Factor Model (FFM) personality traits and a dimensional liability for psychosis.

Methods

FFM traits according to the NEO-FFI and levels of subclinical psychotic symptoms according to the CAPE were assessed in 217 patients with psychotic disorders, 281 of their siblings and 176 healthy controls. Psychotic symptoms according to the PANSS were assessed in the patient group.

Results

Patients differed from siblings and controls on four of the five FFM traits, all but Openness. Siblings reported higher levels of Neuroticism than controls, but lower levels than patients. Particularly lower Agreeableness, and to a lesser degree, higher Neuroticism and lower Extraversion were associated with more severe symptoms in patients. Furthermore, higher Neuroticism and higher Openness were associated with higher levels of subclinical psychotic experiences in all three groups. Associations were strongest in patients.

Conclusion

Our findings suggest that levels of Neuroticism increase with the level of familial risk for psychosis. Levels of Openness may reflect levels of impairment that distinguish clinical from subclinical symptomatology.

1. INTRODUCTION

Recent reviews of literature concerning normal personality traits and schizophrenia suggest that the relationships between the Five-Factor Model (FFM) personality traits (Digman, 1990; McCrae, 1992) and clinical phenomena in patients with schizophrenia and related disorders are more complex and reciprocal than previously conceptualized (Dinzeo and Docherty, 2007; Andersen and Bienvenu, 2011). The five personality traits of the FFM are Neuroticism: the vulnerability to emotional instability and self-consciousness, Extraversion: the tendency to be warm and outgoing, Openness: the cognitive disposition to creativity and aesthetics, Agreeableness: the tendency to be sympathetic, trusting and altruistic and Conscientiousness: the tendency towards dutifulness and competence. These five traits are believed to represent the most basic dimensions of personality (Costa and McCrae, 1992).

There are several reasons *why* the study of FFM personality traits is relevant to schizophrenia research. First, FFM traits may contribute to the vulnerability to develop the disorder. Premorbid high levels of Neuroticism, and other traits that reflect a vulnerability to worry and be distressed, were found to be a risk factor for the development of schizophrenia (van Os and Jones, 2001; Goodwin et al., 2003; Lonnqvist et al., 2009; Krabbendam et al., 2002), while a high level of Extraversion reduces the risk (van Os and Jones, 2001). The former finding is consistent with the vulnerabily-stress model of schizophrenia. This model states that dispositional vulnerability factors are associated with high sensitivity to environmental stressors that increases an individual's liability for the onset or exacerbation of psychotic symptoms (Nuechterlein et al., 1994). The latter finding (elements that reduce the risk) might be explained by the 'stress buffering' hypothesis, which states that social support makes people less vulnerable to stress (Cohen and Wills, 1985). After onset of illness, patients with schizophrenia and related disorders continue to present higher levels of Neuroticism and lower levels of Extraversion than healthy controls (Berenbaum and Fujita, 1994; Reno, 2004; Herran et al., 2006; Kentros et al., 1997), regardless of fluctuations in positive symptoms (Kentros et al., 1997). Additionally, some studies reported lower levels of Conscientiousness in patients with schizophrenia (Kentros et al., 1997; Gurrera et al., 2000), whereas others found differences in all five FFM personality traits (Camisa et al., 2005; Beauchamp et al., 2006).

The second reason of interest is that FFM personality traits may influence the course of illness. Earlier studies found low levels of Extraversion (Jonsson and Nyman,

1991) and both high levels of Neuroticism and low levels of Agreeableness (Gleeson et al., 2005) to be associated with a higher risk of psychotic relapse in patients with schizophrenia and related disorders.

The third reason is that there is some evidence that FFM personality traits are associated with specific symptoms, although findings are inconsistent. One study reported associations between positive symptoms and both Neuroticism and Agreeableness (Lysaker et al., 2003). Neuroticism has also been associated with emotional distress-related symptoms (Huber et al., 2012). Negative symptoms were found to be inversely associated with Extraversion (Kentros et al., 1997; Herran et al., 2006); one study also found inverse associations with Openness and Agreeableness (Kentros et al., 1997). In a prospective study of psychotic symptoms in patients with schizophrenia, high levels of Neuroticism and low levels of Extraversion were found to be associated with more emotional disstress at one year follow-up; and low levels of Agreeableness were associated with more positive symptoms one year later (Lysaker and Taylor, 2007). However, other studies found no associations between FFM personality traits and symptoms of psychosis (Gurrera et al., 2000; Beauchamp et al., 2011).

To date, little is known about possible differences in normal personality traits between individuals with an increased familial risk for psychosis (first-degree relatives of patients with psychotic disorders) compared to healthy control subjects. One study found that first-degree relatives reported higher levels of Neuroticism compared to healthy controls (Maier et al., 1994); however these findings were not replicated in another study (Laurent et al., 2003).

To our knowledge, there have been no prior studies that explore associations between subclinical psychotic symptoms and FFM personality traits in patients with psychotic disorders, their first-degree relatives as well as healthy control subjects. By including first-degree relatives of patients with psychotic disorders and by expanding the focus to *subclinical* psychotic symptoms, more can be learned about potential associations between personality traits and a dimensional liability for psychosis. Findings could contribute to a better understanding of how personality and symptomatic outcome in patients with psychotic disorders might be related.

Subsequently, the research questions in the current study are: (1) Do patients and their siblings report different levels of FFM traits compared to healthy control subjects? (2) Which FFM traits best predict current psychotic symptoms in patients with psychotic disorders? (3) Are FFM traits associated with subclinical psychotic symptoms in patients, siblings and controls? (4) If so, are these associations different for the three groups?

2. METHODS

2.1 Participants and procedures

GROUP (Genetic Risk and Outcome of Psychosis) is an ongoing Dutch longitudinal multicenter cohort study that was designed to study vulnerability and resilience factors for variation in expression and course of non-affective psychotic disorders. Details of the GROUP study have been described elsewhere (Korver et al., 2012). A subsample of the patients, siblings and healthy control subjects participated in the current study on personality traits (Amsterdam and Utrecht regions). Data from the second measurement (database 3.2, data collected between 2008 and 2011) was used for analyses. Eligible patients fulfilled the following criteria: (1) age between 18 and 50 (extremes included), (2) meeting DSM-IV criteria (American Psychiatric Association, 2000) for a non-affective psychotic disorder; schizophrenia, schizophreniform disorder, schizoaffective disorder, delusional disorder or psychotic disorder NOS, (3) maximum duration of illness of 10 years, (4) fluent in Dutch, (5) participating in NEO-FFI assessment. Siblings were between 18 and 50 years of age and had no life time diagnosis of psychosis. Healthy control subjects were between 18 and 50 years of age and had no lifetime diagnosis of psychosis and no first-degree family member with a life time diagnosis of psychosis.

2.2 Instruments

DSM diagnoses were based on the Comprehensive Assessment of Symptoms and History (CASH) (Andreasen et al., 1992). The CASH is a widely-used semi-structured interview designed for research of the major psychoses.

The Community Assessment of Psychic Experiences (CAPE; www.cape42.homestead.com) was used to rate self-reports of psychotic experiences in the preceding three years. The CAPE measures frequency as well as distress associated with subclinical positive, negative and depressive symptoms. In the present study we included frequency of subclinical positive and negative symptoms to analyses. We recoded the original 1-4 scale into a scale of 0-3 (zero indicating that psychotic experiences were absent). Studies using the CAPE in general population samples have shown good psychometric properties in terms of reliability and validity (Konings et al., 2006;Hanssen et al., 2006).

Current psychotic symptoms in patients with psychotic disorders were assessed with the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987). The PANSS is a widely used interview to assess the symptoms of schizophrenia. The five factor model

by Van der Gaag et al. (van der Gaag et al., 2006a) was used for analyses. This model has good validity compared to earlier models (van der Gaag et al., 2006b). (Incidentally, the similar name of the Five-Factor Model of personality is coincidental).

The Dutch version of the NEO-FFI (Costa and McCrae, 1992) was used to rate self-reports of the FFM personality traits. The NEO-FFI has demonstrated satisfactory to excellent construct validity and moderate to good internal reliability in general population samples, with slightly lower Chronbach alpha's for Openness and Agreeableness (Hoekstra et al., 1996; Costa and McCrae, 1992). Scores of patients with schizophrenia and related disorder were found to be comparable to clinician's estimation on most FFM traits, although patients with poor insight seem to overestimate their level of Extraversion (Bell et al., 2007).

2.3 Data analyses

SPSS 18 was used for all analyses. Cases were excluded if they missed ≥ 30% of the NEO-FFI (N = 5). Also, some patients were excluded because diagnoses did not fulfill criteria for a non-affective psychotic disorder (N = 7). Normality of the NEO-FFI, CAPE and PANSS scales was checked visually (histograms and boxplots) and confirmed by Shapiro-Wilk tests. Possible differences in gender and age between patients, siblings and controls were assessed with Chi-square tests and one-way analysis of variance (ANOVA). A one-way between groups multivariate analysis of variance (MANOVA) was performed to investigate differences in levels of FFM traits between patients, siblings and controls. Tukey HSD posthoc comparisons were performed to determine pair wise group differences. Standard regression analyses were performed to investigate whether FFM traits predicted the levels of psychotic symptoms in patients. Then similar regression analyses were conducted to investigate whether the FFM traits predicted the levels of subclinical psychotic experiences in all three groups separately. Subsequently, in order to examine the group differences in relations between FFM traits and subclinical positive symptoms while taking intra-family correlations into account, a mixed model regression analysis was performed. Family ID was entered as a random factor and a compound symmetry covariance matrix was conducted. First, main effects of the FFM traits, gender and group status on subclinical positive symptoms according to the CAPE were examined. Then interaction effects between the FFM traits and gender and between the FFM traits and group status were tested. The same procedure was repeated for CAPE subclinical negative symptoms.

3. RESULTS

3.1 Normality

All FFM traits were normally distributed. The PANSS and CAPE scales showed positive skew in their distribution: most scores were clustered at the low values.

3.2 Sample characteristics

The total sample (N = 674) consisted of 217 patients with psychotic disorders (32.2%), 281 siblings of patients with psychotic disorders (41.7%) and 176 healthy control subjects (26.1%). There were significant group differences in gender; the patient group consisted of 82.5% males, compared to 41.7% in the relatives and 53.9% in the controls (χ^2 = 84.88, $p < 0.001$). No significant differences between the groups were found on age. Socio-demographic and clinical characteristics of the participating patients (including PANSS scores) are provided in Table 1. Scores (means, median, range) for the three groups on CAPE and the NEO-FFI scales are provided in Table 2.

3.3 Group differences in FFM traits

A MANOVA was performed in order to determine group differences in FFM traits between patients, siblings and controls. Preliminary assumption testing showed a violation of the equality of variance for Neuroticism, resulting in our choice for a more conservative level of alpha of 0.025. No other violations were found. There was a statistically significant difference between the groups on the combined FFM personality traits (F = 13.33, $p < 0.001$; Pillai's Trace = 0.18). When the results for the FFM personality traits were considered separately, four FFM personality traits reached statistical significance: Neuroticism (F = 58.49, $p < 0.001$); Extraversion (F = 53.84, $p < 0.001$); Agreeableness (F = 14.51, $p < 0.001$) and Conscientiousness (F = 21.81, $p < 0.001$). Patients reported statistically significant higher levels of Neuroticism and lower levels of Extraversion, Agreeableness and Conscientiousness than siblings and controls ($p <$ 0.001 for all tests). There were no differences in levels of Openness reported by patients compared to siblings and controls. Siblings reported higher levels of Neuroticism than controls (p = 0.018). Lower levels of Extraversion (p = 0.040) failed to reach statistical significance because of our more conservative measure of alpha.

In addition, because of the unequal distribution of males between groups, we performed two-way between-group analyses of variance to explore whether differences in the FFM traits between the groups were influenced by gender. There

Table 1. Socio-demographic and clinical characteristics in patients (*N* = 217)

Characteristics	
Age (M, SD)	30.5 (7.6)
Gender (% male)	82.5
Decent (% Caucasian)	79.7
DSM diagnosis (%)	
Schizophrenia	73.7
Schizophreniform disorder	1.8
Schizoaffective disorder	12.4
Delusional disorder	0.9
Psychotic disorder NOS	11.1
Age of onset first psychosis (M, SD)	22.8 (7.1)
Psychotic episodes in the previous 3 yrs (%)	
0	73.3
1	17.5
2-5	4.1
Unknown	5.1
Status antipsychotics (%)	
Currently using	77.8
Not currently using	8.8
Unknown	13.3
PANSS scale scores (M, SD)	
Positive symptoms	11.36 (5.33)
Negative symptoms	12.73 (5.95)
Disorganization	15.17 (5.49)
Excitement	10.73 (3.30)
Emotional distress	13.01 (4.64)

were no statistically significant interaction effects between group status and gender for Neuroticism, Extraversion, Agreeableness and Conscientiousness.

3.4 FFM traits and psychotic symptoms in patients

Spearman's rho correlations between the FFM traits and PANSS symptoms are shown in Table 3. Regression analyses (see Table 4) revealed that the FFM traits explained between 7.5% (disorganization) and 26.8% (emotional distress) of the variance in PANSS psychotic symptoms in the patient group. Agreeableness provided unique contribution to all PANSS symptoms (inverse relations). Additionally, Neuroticism provided unique contribution to emotional distress symptoms and Extraversion to negative symptoms (inverse relation); there was a trend for Openness (inverse relation).

Table 2. CAPE* and NEO-FFI[2] means, standard deviations, medians and ranges (*N* patients=217, *N* siblings=281, *N* controls=176)

	Scale	*Group*	*Mean*	*SD*	*Median*	*Range*
CAPE	Positive, frequency	Patients	10.15	9.59	8	0-54
		Siblings	2.34	2.99	2	0-20
		Controls	1.73	2.18	1	0-9
	Negative, frequency	Patients	13.02	7.84	12	0-38
		Siblings	7.06	6.20	6	0-34
		Controls	5.41	4.25	5	0-21
	Depressive, frequency	Patients	6.72	4.25	6	0-20
		Siblings	4.24	3.19	4	0-16
		Controls	3.26	2.64	3	0-15
	Positive, distress	Patients	23.20	13.31	21	0-60
		Siblings	10.78	12.01	9	0-60
		Controls	7.36	9.81	0	0-40
	Negative, distress	Patients	17.77	8.43	17.5	0-42
		Siblings	12.00	9.03	11.5	0-42
		Controls	8.94	6.73	8	0-15
	Depressive, distress	Patients	11.12	5.37	11	0-24
		Siblings	7.85	5.06	8	0-23
		Controls	6.77	4.64	8	0-20
NEO-FFI	N	Patients	35.00	8.55	35	12-55
		Siblings	28.81	8.36	27	13-54
		Controls	26.68	7.12	26	12-52
	E	Patients	37.50	7.08	38	19-57
		Siblings	42.42	6.69	43	21-57
		Controls	43.97	5.91	45	27-58
	O	Patients	38.10	6.17	38	22-58
		Siblings	38.37	5.72	39	23-55
		Controls	38.98	6.00	39.5	23-56
	A	Patients	42.85	5.24	43	27-57
		Siblings	44.83	5.47	45	30-60
		Controls	45.63	5.34	46	26-59
	C	Patients	41.35	6.74	41	21-60
		Siblings	44.65	6.23	45	24-60
		Controls	44.96	5.85	45	24-58

* CAPE symptoms scores were recoded from the original 1-4 scale into to 0-3 scale (higher scores indicating more symptoms).

[2] N: Neuroticism, E: Extraversion, O: Openness, A: Agreeableness, C: Conscientiousness

Table 3. Spearman rho correlations between the NEO-FFI[2] and PANSS in patients (*N* =200)

PANSS \ *NEO-FFI*	*N*	*E*	*O*	*A*	*C*
Positive symptoms	0.22*	-0.21*	0.03	-0.30**	-0.16*
Negative symptoms	0.28**	-0.37**	-0.21*	-0.27**	-0.24*
Disorganization	0.14	-0.08	-0.05	-0.28**	-0.16*
Excitement	0.24*	-0.26**	0.01	-0.36**	-0.25**
Emotional distress	0.51**	-0.34**	0.04	-0.32**	-0.35**

[2] N: Neuroticism, E: Extraversion, O: Openness, A: Agreeableness, C: Conscientiousness.
** $p < 0.001$, * $p < 0.05$

3.5 FFM traits and subclinical positive symptoms in all groups

Spearman's rho correlations between the FFM traits and subclinical symptoms according to the CAPE in patients, siblings and controls are shown in **Appendix 1**. Regression analyses (see **Table 4**) revealed that the FFM traits explained between 16.8% (controls) and 25.0% (siblings) of the variance in CAPE subclinical positive symptoms. Neuroticism and Openness provided unique contribution to CAPE subclinical positive symptoms in all three groups. Additionally, Agreeableness provided unique contribution to CAPE subclinical positive symptoms in controls and -on a trend level- in siblings (inverse relations).

In order to investigate possible group differences in relations between FFM traits and CAPE subclinical positive symptoms, while taking intra-family correlations into account, mixed model regression analyses was conducted. Mixed model regression analyses revealed that Neuroticism ($F = 45.48$, $p < 0.001$), Openness ($F = 25.18$, $p < 0.001$) and group status ($F = 70.64$, $p < 0.001$) were significant predictors of subclinical positive symptoms according to the CAPE; there was a trend for (male) gender ($F = 3.46$, $p = 0.063$). A statistically significant interaction effect for Neuroticism and group status was found: higher levels of Neuroticism in patients, compared to siblings ($B = 0.012$, $SE\ B = 0.003$, $t = 4.10$, $p < 0.001$) and controls ($B = 0.016$, $SE\ B = 0.004$, $t = 4.40$, $p < 0.001$) were associated with higher subclinical positive symptoms. No interaction was found comparing siblings to controls. Also, a statistically significant interaction effect for Openness and group status was found: higher levels of Openness in patients, compared to siblings ($B = 0.011$, $SE\ B = 0.004$, $t = 2.75$, $p = 0.011$) and controls

Table 4. Standard multiple regression analyses: FFM personality traits[2] as predictors of (subclinical) psychotic symptoms in patients (N = 200), siblings (N = 274) and controls (N = 168)

	Group	R^2 (%)	F	unique contributors	beta
PANSS					
Positive	Patients	9.4	4.02*	A	-0.24*
Negative	Patients	14.0	6.39**	E, A, (trend O)	-0.17*; -0.15*; (-0.12[1])
Disorganization	Patients	7.5	3.16*	A	-0.29**
Excitement	Patients	16.1	7.54**	A	-0.36**
Emotional distress	Patients	26.8	14.28**	N, A	0.37**; -0.17*
CAPE					
Positive, frequency	Patients	17.0	8.23**	N, O	0.35**; 0.23*
	Siblings	25.0	17.85**	N, O, (trend A)	0.41**; 0.23**; (-0.11[1])
	Controls	16.8	6.56**	O, A, N	0.27**; -0.21*; 0.20*
Negative, frequency	Patients	29.1	16.56**	N, C, O, (trend E, A)	0.29**; -0.24*; 0.12*; (-0.14[1]; -0.11[1])
	Siblings	45.1	44.06**	N, E, O	0.45**; -0.25**; 0.10*
	Controls	47.2	22.74**	N, O, C, A	0.44**; 0.22*; -0.17*; -0.14*

[2] N: Neuroticism, E: Extraversion, O: Openness, A: Agreeableness, C: Conscientiousness (NEO-FFI).
** $p < 0.001$, * $p < 0.05$, [1] $p < 0.10$

(B = 0.013, $SE\ B$ = 0.005, t = 2.75, p = 0.006) were associated with higher subclinical positive symptoms. No interaction was found comparing siblings to controls. Also, no interactions were found between the FFM traits and gender.

FFM traits and subclinical negative symptoms in all groups

The same procedure was followed for CAPE subclinical negative symptoms replacing CAPE subclinical positive symptoms. Regression analyses (see Table 4) revealed that the FFM traits explained between 29.1% (patients) and 47.2% (controls) of the variance in CAPE subclinical negative symptoms. Neuroticism and Openness provided unique contribution to CAPE subclinical negative symptoms in all three groups. Additionally, Conscientiousness provided unique contribution to CAPE subclinical negative symptoms

in patients and controls (inverse relations). Extraversion provided unique contribution in siblings and -on a trend level- in patients (inverse relations). Agreeableness provided unique contribution in controls and -on a trend level- in patients (inverse relations).

Mixed model analysis, accounting for intra-family correlations, revealed that Neuroticism ($F = 80.99$, $p < 0.001$), Extraversion ($F = 20.15$, $p < 0.001$), patient status ($F = 17.66$, $p < 0.001$), Openness ($F = 15.15$, $p < 0.001$) and Conscientiousness ($F = 9.56$, $p = 0.02$) were significant predictors of subclinical negative symptoms according to the CAPE. No interactions were found between the FFM traits and group status, or between the FFM traits and gender.

4. DISCUSSION

The findings of the present study show that patients with psychotic disorders differ from both siblings and controls on four of the five FFM traits. The associations were in the expected directions as found in most previous studies: patients reported higher Neuroticism, lower Extraversion, lower Agreeableness and lower Conscientiousness (Dinzeo and Docherty, 2007). Furthermore, siblings reported (slightly) higher levels of Neuroticism than controls, which is consistent with the findings of one earlier study (Maier et al., 1994). In addition, we found lower levels of Extraversion in siblings compared to controls, but this finding failed to reach statistical significance due to our use of a more conservative value of alpha.

We found several associations between FFM traits and (subclinical) psychotic symptoms. In the patient group, Agreeableness was inversely related to positive, negative, disorganization, excitement and emotional distress symptoms. Additionally, Extraversion was (inversely) related to negative symptoms and Neuroticism to emotional distress symptoms. These findings are in line with most findings of earlier studies (Lysaker et al., 2003; Huber et al., 2012). Regarding subclinical symptoms, higher Neuroticism and higher Openness were associated with more psychotic experiences in patients with psychotic disorders, as well as in their siblings and in controls. The effects were strongest in patients. By contrast, levels of Openness were not associated with positive symptoms in patients; an inverse association with negative symptoms was found on a trend level.

Our findings suggest that levels of Neuroticism increase with the level of familial risk for psychosis. This lends support to the theory that Neuroticism might qualify as a dispositional vulnerability factor for psychosis, as described in the vulnerability-stress

model of schizophrenia (Nuechterlein et al., 1994). Studies in the general population have strongly linked Neuroticism with emotional reactivity to stress (Bolger and Schilling, 1991; Gunthert et al., 1999; Mroczek and Almeida, 2004; Suls and Martin, 2005; Jacobs et al., 2011). High emotional reactivity to stress has been identified as a possible vulnerability marker for psychotic disorders, as the level of emotional reactivity to daily life stressors of first-degree relatives of patients with psychotic disorders has shown to be intermediate of the levels of patients and controls (Myin-Germeys et al., 2001). Furthermore, in patients with psychotic disorders, higher emotional reactivity to stress was found to exist prior to an increase in psychotic symptoms (Docherty et al., 2009) and very high emotional reactivity to stress was found to be associated with an increased risk for psychotic relapse (Dinzeo et al., 2004; Docherty et al., 2009; Myin-Germeys and van, 2007). The constructs of stress reactivity and Neuroticism show considerable overlap, since high Neuroticism identifies individuals who are prone to negative emotionality and emotional distress. However, according to Costa and McCrea (1992), the construct of Neuroticism also explicitly includes unrealistic fears and ideas and maladaptive coping responses, i.e. cognitive and behavioral components. Indeed, studies of FFM personality traits and coping in patients with psychotic disorders found high Neuroticism to be associated with more avoidant coping strategies (Lysaker et al., 2003; Lysaker and Taylor, 2007). Better understanding of how Neuroticism and psychotic symptoms might be related would not only need to be attained by more research on the biological mechanisms of stress-regulation, but also by investigating psychological mechanisms, such as the effects of the use of specific coping styles over time.

In response to criticism regarding the informative value of Neuroticism as a vulnerability marker for psychopathology (see for instance Ormel et al., 2004), progress is being made in specifying what constitutes Neuroticism, in terms of biological and psychological mechanisms (Ormel et al., 2013) and measurable person-context interactions (Jacobs et al., 2011).

However, our present findings suggest that not only high Neuroticism might be unfavorably related to outcome in patients with psychotic disorders, but also lower Extraversion and particularly lower Agreeableness. These FFM traits might -perhaps in part- represent structural tendencies in behavior, cognition and affect in patients that may elicit higher levels of stress, facilitate social isolation and reduce opportunities for disconfirmation of psychotic interpretation, which may increase their vulnerability for psychotic symptom exacerbation. Gleeson et al. (2005) describe several hypotheses

how this may be the case specifically for low Agreeableness. For instance, patients with psychotic disorders who possess lower levels of Agreeableness may more easily come into conflict with others due to more antagonistic behavior, which may subsequently increase their stress levels, reduce their opportunities for social support and confirm paranoid thinking.

In regard to subclinical symptoms, the FFM traits may –perhaps in part- reflect schizotypical symptoms. In the present study, we found Openness to be related to subclinical-, but not clinical psychotic symptoms, except on a trend level inversely with negative symptoms. Particularly social-interpersonal schizotypical symptoms (i.e. 'negative schizotypy') have been found to be elevated amongst relatives of schizophrenia patients compared to healthy controls (Tarbox and Pogue-Geile, 2011). Negative schizotypy has been found to be associated with domains and facets of Neuroticism (+), Extraversion (-), Openness (-) and Agreeableness (-), while 'positive schizotypy' (cognitive-perceptual symptoms) has been found to be associated with domains and facets of Neuroticism (+), Openness (+) and Agreeableness (-) (Ross et al., 2002). Regarding DSM diagnosis, Camisa et al. (2005) found higher levels of Openness in individuals with a cluster A personality disorder compared to both schizophrenia patients and controls. However, several authors have remarked that associations between Openness and positive schizotypy are generally found in nonclinical samples, but not in samples consisting of individuals with a DSM diagnosis of schizotypical personality disorder (Camisa et al., 2005; Dinzeo and Docherty, 2007; Ross et al., 2002). As speculated by Ross et al. (2002), perhaps higher levels of Openness reflect a willingness to entertain unusual ideas, rather than a proneness to psychosis. An alternative explanation, suggested by Dinzeo and Dochterty (2007), states that individuals with greater levels of functional impairment caused by psychotic illness may be less capable of developing (or expressing) this trait. For instance, in a subgroup of more severely impaired patients, levels of Openness may be suppressed by negative symptoms.

This brings us to the limitations of the present study. First, we assessed personality traits after onset of a psychotic disorder; therefore we cannot rule out that the personality scores are influenced by the course or severity of illness. Second, this was a cross-sectional study and therefore we cannot give evidence of causality. For instance, current positive symptoms, such as paranoia, might make patients more antagonistic in contact, instead of antagonistic tendencies making them more susceptible to

Appendix 1. Spearman rho correlations between the NEO-FFI[2] and CAPE (*N* patients=208, *N* siblings=274, *N* controls=168)

NEO-FFI / *CAPE*	*Group*	*N*	*E*	*O*	*A*	*C*
Positive, frequency	Patients	0.44**	-0.22*	0.18*	-0.21*	-0.24*
	Siblings	0.42**	-0.25**	0.18*	-0.33**	-0.24*
	Controls	0.24*	-0.10	0.21*	-0.21*	-0.08
Negative, frequency	Patients	0.52**	-0.37**	0.03	-0.08	-0.45**
	Siblings	0.60**	-0.54**	0.13*	-0.29**	-0.36**
	Controls	0.52**	-0.40**	0.17*	-0.22*	-0.36**
Additional exploratory analyses:						
Depressive, frequency	Patients	0.66**	-0.39**	0.10	-0.15*	-0.45**
	Siblings	0.66**	-0.45**	0.21**	-0.28**	-0.32**
	Controls	0.60**	-0.33**	0.20*	-0.03	-0.29*
Positive, distress	Patients	0.35**	-0.20*	-0.14	0.01	-0.21*
	Siblings	0.43**	-0.18*	-0.07	-0.13	-0.03
	Controls	0.22*	-0.16	0.15	-0.04	-0.06
Negative, distress	Patients	0.44**	-0.13	-0.04	-0.02	-0.26**
	Siblings	0.56**	-0.39**	0.14*	-0.11	-0.19*
	Controls	0.27*	-0.20*	0.09	0.10	-0.14
Depressive, distress	Patients	0.48**	-0.21*	-0.03	0.02	-0.26**
	Siblings	0.55**	-0.32**	0.17*	-0.15*	-0.18*
	Controls	0.37**	-0.20*	0.15	0.16	-0.22*

[2] N: Neuroticism, E: Extraversion, O: Openness, A: Agreeableness, C: Conscientiousness.
** $p < 0.001$, * $p < 0.05$

positive symptoms. And the presence of positive symptoms might make patients more distressed, instead of a tendency towards emotional instability making them more susceptible to positive symptoms. On the other hand, previous research has indicated that some personality differences predate onset of illness (van Os and Jones, 2001; Goodwin et al., 2003; Lonnqvist et al., 2009; Krabbendam et al., 2002) and that FFM traits are stable regardless of the fluctuations of positive symptoms (Kentros et al., 1997).

Our results support the findings of earlier studies that indicated that personality traits contribute to symptomatic outcome in patients with psychotic disorders. However, we emphasize that found effects were small to moderate; indicating a

modest contribution to symptom expression. Also, the potential influence of illness characteristics, particularly negative symptoms, on FFM levels is yet unclear and would need more detailed examiniation.

Thereupon, further research could be directed at testing the validity of specific pathways between FFM traits, cognitive and affective processing, social behavior and fluctuations of symptoms in patients with psychotic disorders. Use of the NEO-PI-R (Costa and McCrea, 1992), would give more detailed information, as this version also assesses lower level facet scores of the FFM. Finally, further research could be directed at possible clinical implications. For instance, clinicians might offer stress management training or anxiety reducing medication for patients who are more vulnerable to stress (Docherty et al., 2009) and cognitive behavior therapy for patients who are more likely to employ cognitive biases that facilitate social isolation or interpersonal conflict. In time, assessment of normal personality traits might help to select personalized interventions for patients at risk for an unfavorable course.

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