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Response to psychotic experiences: Impact of personality traits on perceived levels of distress

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ABSTRACT

Background: This study examined the influence of personality traits on (subclinical) positive symptom distress in patients with a psychotic disorder, their unaffected siblings and healthy controls.
Methods: Data were obtained from the Genetic Risk and Outcome of Psychosis study (GROUP), a Dutch longitudinal multicenter cohort study. Data from 140 patients, 216 unaffected siblings and 102 healthy controls was available for baseline levels of Five Factor Model personality traits and frequency and distress due to psychotic experiences three years later, assessed with the Community Assessment of Psychic Experience questionnaire. Main effects of all five personality traits on symptom distress were investigated as well as moderating effects of Neuroticism, Extraversion and Openness on positive symptom frequency and positive symptom distress. Age, gender, symptom frequency and IQ were controlled for.
Results: In both patients and siblings, the observed main effects of Neuroticism and Openness on (subclinical) positive symptom distress three years later either lost significance or had a very small effect size when controlling for covariates, mainly due to the correction for the effect of positive symptoms on personality traits at baseline. In both groups, levels of Openness at baseline moderated the association between positive symptom frequency and positive symptom distress three years later, in the direction that higher levels of Openness were associated with weaker associations between positive symptom frequency and - distress, even when covariates were controlled for.
Discussion: The level of Openness to Experiences influences the perceived distress from (subclinical) positive symptoms in both patients and siblings.

1. Introduction

Distress in various forms has been acknowledged to play a crucial role in the onset and maintenance of psychosis (e.g., McCutcheon et al., 2020; Rapado-Castro et al., 2015). Distress related to (vulnerability to) psychosis may originate from various sources (Griffiths et al., 2019). One of these sources is distress arising from hallucinations and delusions. The treatment of positive symptoms of psychotic disorders and subclinical positive symptoms in help-seeking individuals at risk for psychosis aims at diminishing symptom distress and/or improving coping capabilities to alleviate suffering and improve prognosis (Rekhi et al., 2019; Wilson et al., 2020; Hutton and Taylor, 2014). Effective

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treatment strategies may vary largely. For example, suppression of positive symptoms by use of medication may be combined with exposure therapy to possible stress inducing contexts. Ideally, the choice of therapy is based on a joint effort of care seeker and caregiver. However, specific tools on making the best choice of individually tailored treatment are largely lacking today. More knowledge on the experience of (subclinical) positive symptom distress and specifically its variations based on individually contributing and moderating variables may facilitate further development of treatment.

Positive symptom distress is not only related to symptom content or severity, but also to the mental processes that accompany the presence of positive symptoms. With regard to delusions, both worrying about delusion content and meta-worrying about uncontrollability of worries tend to increase levels of distress in individuals with psychotic disorders (Startup et al., 2007). Regarding hallucinations, core beliefs (Birchwood et al., 2004), appraisal (Mawson et al., 2010; Tsang et al., 2021) and levels of self-esteem and self-compassion (Norman et al., 2020) have been shown to influence the level of distress derived from hallucinations in individuals with psychotic disorders. Additionally, in college students, perceived distress from subclinical positive symptoms was increased by self-stigma (Denenny et al., 2015).

Recently, three personality traits of the Five Factor Model (FFM) (Costa and McCrae, 1992b) were found to moderate the relation between frequency of subclinical delusional ideations and related distress in the general population. Lower Neuroticism, higher Extraversion and higher Openness played a buffering role in the experience of distress (Kuranova et al., 2020). These findings may align the findings described in the first paragraph, since personality, as an overarching construct, is associated with specific core beliefs, such as appraisal (Otani et al., 2018; Gallagher, 1990) and habitual cognitive processes are part of some personality traits descriptions (Costa and McCrae, 1992b). Neuroticism is often described as trait worrying. Openness reflects an open attitude open to new experiences. Extraversion is described as the tendency to be warm and outgoing and is related to higher self-esteem in general (Swickert et al., 2004; Vaughan-Johnston et al., 2021) and lower self-stigma in psychotic illness (Szcześniak et al., 2021).

Severity of symptom levels as well as levels of FFM personality traits tend to vary according to genetic load of psychosis liability (Stefanis et al., 2002; van Os et al., 2009; Janssens et al., 2016; Ohi et al., 2016; Boyette et al., 2013). Psychotic symptoms occur on a continuum of subclinical and clinical phenomenology (Johns and van Os, 2001; van Os and Reininghaus, 2016). Differentiation between subclinical and clinical symptoms is based on the severity and persistence of symptoms, the co-occurrence of impairment and levels of related distress (Lawrie et al., 2010; Stanghellini et al., 2012; Murphy et al., 2018). Siblings of individuals with psychosis showed higher persistence of (subclinical) psychotic symptoms compared to controls, but the level of co-occurring impairment was found to be comparable to controls (Janssens et al., 2016). It might be, that levels of symptom related distress vary over groups as well, with in-between levels for siblings compared to patients and controls. The current study includes patients, their unaffected siblings and healthy controls, spanning over a continuum of psychosis liability and testing identical hypotheses in these groups, thereby expanding on the study by Kuranova et al. on the impact of personality on symptom distress in the general population (Kuranova et al., 2020).

Mean levels of FFM personality traits vary with age, gender and general intelligence (Hoekstra et al., 1996; Costa and McCrae, 1992a; Anglim et al., 2022). Although personality in psychotic disorders is fairly stable over time (Boyette et al., 2015; Fagerberg et al., 2022), moderate correlations between personality traits and symptom dimensions exist (Scholte-Stalenhoef et al., 2023) and particularly affective and negative symptom fluctuation may impact momentary personality expression in individuals with psychotic disorders (Boyette et al., 2015). Since Kuranova et al. controlled for age and gender, but not for symptoms and IQ (Kuranova et al., 2020), the possibility that the moderating effects of Openness, Neuroticism and Extraversion on positive symptom distress were influenced by IQ or subclinical symptoms is not ruled out. Therefore, the current study aims to additionally control for symptoms - subclinical or clinical - and IQ at the time of assessment of the personality levels. Another difference between Kuranova et al. (Kuranova et al., 2020) and the current study is that we assessed personality three years before measurement of symptom distress, allowing for testing the relationship between personality and symptom distress over time. Lastly, while the large population sample was examined on distress related to bizarre experiences, delusional ideations and perceptional anomalies separately, for our smaller sample we chose to examine distress related to the positive symptom domain as a whole.

To increase our understanding of the impact of personality on (subclinical) positive symptom distress, the first aim of our study was to investigate whether personality traits, measured at baseline and controlled for age, gender, IQ and symptom frequencies, predict reported distress derived from (subclinical) delusions or (subclinical) hallucinations three years later in patients, siblings and controls. All five personality traits of the FFM were explored. Based on earlier findings (Dinzeo and Docherty, 2007; Scholte-Stalenhoef et al., 2023), we hypothesized that Neuroticism would predict higher, and Extraversion would predict lower levels of positive symptom distress.

The second aim was to investigate whether Neuroticism, Extraversion or Openness measured at baseline would moderate the relationship between reported frequency of (subclinical) delusions or (subclinical) hallucinations and reported positive symptom distress three years later in patients, siblings and controls. Based on findings in the general population (Kuranova et al., 2020), we hypothesized that Neuroticism, Extraversion and Openness would moderate the relation between positive symptom frequency and positive symptom distress, so that lower level of Neuroticism and higher level of Extraversion and higher level of Openness would be associated with weaker relations between positive symptom frequency and positive symptom distress when controlling for age and gender. We aimed to explore whether this relation would hold when additionally controlling for symptoms and IQ.

2. Methods

2.1. Study design

Data pertained to a subsample of the Genetic Risk and Outcome of Psychosis (GROUP) study, a large Dutch longitudinal multicenter cohort study of vulnerability and resilience factors for variation in the expression and course of non-affective psychotic disorders. See Korver et al. (Korver et al., 2012) for detailed information on the GROUP study design and a previous paper on the same sample (Boyette et al., 2013) describing medication use and PANSS symptom severity. The study protocol was approved by the ethical review board of the University Medical Center Utrecht (04/003-O) and subsequently by the ethical review boards of each participating academic centers. The current sample consisted of patients, siblings and controls of two of the four GROUP regions (Amsterdam and Utrecht), who participated in a personality assessment at the second assessment which took place three years after inclusion and was used as baseline measurement in the current study. In addition, we included data on the perceived distress from (subclinical) positive symptoms from the third assessment, three years later, as outcome. Original study inclusion criteria for patients were (1) age 16 years or older, (2) fluent in Dutch and (3) meeting DSM-IV criteria (Frances and American Psychiatric Association. Task Force on, 2000) for a non-affective psychotic disorder. The included siblings of patients had no lifetime experience of a psychotic disorder at study inclusion and the group of healthy controls had no lifetime experience of a psychotic disorder nor a first-degree family member with a lifetime psychotic disorder.

Frequency and distress due to psychotic experiences were assessed with the Community Assessment of Psychic Experience questionnaire (CAPE; www.cape42.homestead.com). The CAPE has good internal

validity and reliability and is significantly associated with equivalent dimensions of interview-based measures for the presence of both subclinical and clinical psychotic symptoms (Konings et al., 2006). The three dimensions of the CAPE are positive, negative and depressive symptoms, all consisting of both a symptom frequency and distress subscale, rated on a scale from 0 ('absent') to 3 ('almost always'). Subscales of symptom frequencies of positive, negative and depressive symptoms and subscale of positive symptom distress were calculated if at least 70 % of the subscale items of the specific subscale were available. Subscale scores were calculated as the average item score.

The correlation between the CAPE frequency and distress subscales is expected to be robust when both are assessed concurrently, as is the case in the CAPE measurement at each time point. In this study, the CAPE measures were employed with dual objectives: first, to control for potential momentary effects of symptom fluctuations on personality traits; and second, to serve as an outcome measure for positive symptom distress. For this purpose, symptom frequencies measured at baseline, coinciding with personality assessment, were utilized to adjust personality traits for symptoms. The outcome of positive symptom distress was assessed at three years of follow-up, aiming to achieve predictive value over time. Regarding the potential moderating effects of personality traits, the three-year time interval was positioned between baseline personality traits and the subsequent measurement of positive symptom frequency and distress.

Five-Factor Model (FFM) personality traits: Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness were assessed with the NEO-Five Factor Inventory (NEO-FFI) (Hoekstra et al., 1996; Costa and McCrae, 1992a). Each personality domain contains twelve items, which are scored by the participant on a Likert scale from 1 to 5. The NEO-FFI shows satisfactory to excellent construct validity and moderate to good reliability in general population samples (Hoekstra et al., 1996; Costa and McCrae, 1992a). The factor structure and reliability of the FFM in patients with psychiatric conditions, including schizophrenia, were found to be similar to a normative sample (Bagby et al., 1999).

DSM diagnoses regarding psychotic disorders were based on the Comprehensive Assessment of Symptoms and History (CASH) (Andreasen et al., 1992). The CASH is a widely used interview, designed for research on symptoms and diagnosis of schizophrenia spectrum and affective spectrum conditions.

2.2. Statistical analysis

SPSS 25 was used for all analyses. To determine if separate analyses were warranted for patients, siblings and controls, between-group differences were tested with personality trait*status interaction variables included in the regression analysis and distress due to psychotic experiences as dependent variable. As a significant interaction was observed between Neuroticism and group status, we continued analyses in separate groups. The skewness of the outcome, i.e. the CAPE subscale of positive symptom distress was assessed. For controls ($n = 102$, missing: $n = 37$) a positive skewness of 2.07 (0.24) was observed, indicating a departure from a normal distribution. The rejection of normality was confirmed with Kolmogorov-Smirnov: D (102) = 0.43, $p < 0.001$. Similarly, in the siblings group ($n = 216$, missing: $n = 64$) a positive skewness of 1.6 (0.17) was observed, and normality was rejected (Kolmogorov-Smirnov: D (216) = 0.35 (0.7), p < 0.001). In the patients group ($n = 140$, missing: $n = 77$) the distribution of positive symptom distress showed no skewness: 0.25 (0.21), but normality was rejected (Kolmogorov-Smirnov: D (140) = 0.12 (0.95), p < 0.001). Due to the non-parametric and mostly skewed distribution of the positive symptom distress, it was decided to treat the distress as a dichotomous variable. The average item score of the CAPE positive symptom distress subscale was transformed into categorical outcome variables of either any distress (1) or no distress at all (0), following the approach used in previous literature (Kuranova et al., 2020; Pignon et al., 2022). Consequently, in the patients group ($n = 140$), 19.3 % was classified as having no distress, in the siblings group ($n = 216$) 60.6 % and in the control group ($n = 102$) 72.5 %. In the first analysis, the main effects of all five FFM personality traits at baseline were investigated as predictors of positive symptom distress at three years follow-up. To this end, stepwise logistic regression analyses were conducted separately for patients, siblings and controls and controlling for covariates of age, gender and symptom frequencies at baseline. In a first step, all personality traits and the covariates gender and age were entered. In a second step, subclinical baseline symptom dimension frequencies and IQ were added, if their zero-order correlations with personality traits at baseline were significant at $p < 0.05$. In a second analysis, interaction effects of the personality traits: Neuroticism, Extraversion, Openness measured at baseline on the relation between positive symptom frequency and on positive symptom distress, both measured three years later, were tested. Personality traits, their interaction terms with frequencies of symptoms, and covariates age and gender were entered in a first step. In a second step, IQ and baseline frequency symptoms were added if their zero-order correlations with personality at baseline were significant p < 0.05. We tested for multicollinearity using tolerance values of independent variables according to linear regression (Pallant, 2020) and since these were all above 0.01 it was inferred that multicollinearity was not a problem.

3. Results

3.1. Sample characteristics

Our sample consisted of $n = 140$ patients, $n = 216$ unaffected siblings and $n = 102$ healthy controls. Data of Sociodemographic characteristics are presented in Table 5 in the Supplementary data. CAPE positive symptom frequency and distress at follow up and baseline personality scores are presented in Tables 1a and 1b. Spearman correlations between personality domains and baseline CAPE symptom frequencies and IQ, respectively are included in the Supplementary data, Table 6. Dropout analysis was performed, comparing participants with available positive symptom distress data at follow-up with participants of whom these follow-up data were lacking. This revealed no significant differences in mean age, gender distribution, diagnosis distribution or mean IQ between dropouts and completers in patients. Also, dropouts and completers in controls did no differ significantly on any of these variables. Dropouts in siblings were younger ($t = -2.45$, $p = 0.02$), had a lower mean IQ ($t = -2.35$, p = 0.02) and were more often male compared to completers (Pearson chi square, continuity correction: 4.97, $p = 0.03$).

3.2. Main effects of personality traits on positive symptom distress

In patients, a first step of logistic regression, including the five personality traits at baseline as independent variables, gender and age as covariates, and positive symptom distress after three years as dependent variable, resulted in a fitting model: $\chi 2$ (7, $N = 135$) = 39.75, $p < 0.001$. Only two of the independent variables made a unique statistically significant contribution to the model: Neuroticism (B = 0.17, S.E. = 0.05, p < 0.001) and Openness (B = 0.15, S.E. = 0.06, $p < 0.01$), meaning that higher levels of these traits predicted higher positive symptom distress three years later. Based on significance of zero-order correlations (see Supplementary data), additional covariates (positive, negative and depressive symptom frequencies and IQ) were added to the model in a second step. The resulting model was statistically significant, $\chi 2$ (11, N = 135) = 61.79, $p < 0.001$, but personality traits of Neuroticism and Openness lost significance. Gender and positive symptom frequency contributed uniquely and statistically significant to the model, the latter with a very large effect size. See Table 2.

In siblings, a first step using all personality traits, gender and age as independent variables and positive symptom distress as dependent variable, resulted in a statistically significant model, with $\chi 2$ (7, $N =$

Table 1a
Mean personality scores of participants.

	Patients n = 140	Siblings *n* = 216	Controls *n* = 102	ANOVA for mean differences between groups	Post-hoc Bonferroni mean difference patients-controls	Post-hoc Bonferroni mean difference patients - siblings	Post-hoc Bonferroni mean difference siblings-controls
Neuroticism at baseline[a]	M = 35.54 SD = 8.73 Min = 15 Max = 54	M = 28.99 SD = 8.85 Min = 13 Max = 54	M = 26.80 SD = 7.42 Min = 12 Max = 52	F (2, 455) = 37.58, $p < 0.001$	p < 0.001	p < 0.001	p = 0.02
Extraversion at baseline[a]	M = 37.09 SD = 7.28 Min = 19 Max = 57	M = 42.25 SD = 6.85 Min = 21 Max = 57	M = 43.54 SD = 5.98 Min = 28, Max = 58	F (2, 455) = 33.94, p < 0.001	p < 0.001	p < 0.001	p = 0.04
Openness at baseline[a]	M = 38.14 SD = 5.96 Min = 23 Max = 58	M = 38.31 SD = 5.82 Min = 23 Max = 55	M = 39.29 SD = 5.73 Min = 23 Max = 53	F (2, 455) = 1.32, $p = 0.27$	$p = 0.24$	$p = 0.54$	$p = 0.49$
Agreeableness at baseline[a]	M = 42.88 SD = 5.05 Min = 27 Max = 55	M = 45.13 SD = 5.38 Min = 31 Max = 60	M = 45.49 SD = 5.00 Min = 26 Max = 56	F (2, 455) = 10.26, $p < 0.001$	p < 0.001	p < 0.001	$p = 0.52$
Conscientiousness at baseline[a]	M = 41.00 SD = 6.87 Min = 21 Max = 58	M = 44.69 SD = 6.15 Min = 24 Max = 60	M = 44.86 SD = 6.23 Min = 24 Max = 58	F (2, 455) = 16.70, p < 0.001	p < 0.001	p < 0.001	$p = 1.00$

[a] For personality, total domain scores are used.

Table 1b
Mean symptom frequency and distress scores of participants.

	Patients *n* = 140	Siblings n = 216	Controls n = 102	Kruskal Wallis for mean differences between groups	Post-hoc Bonferroni mean difference patients-controls	Post-hoc Bonferroni mean difference patients - siblings	Post-hoc Bonferroni mean difference siblings-controls
CAPE positive symptom frequency at follow up[a]	M = 0.46 SD = 0.43 Min = 0.00 Max = 2.10	M = 0.09 SD = 0.14 Min = 0.00 Max = 0.95	M = 0.08 SD = 0.12 Min = 0.00, Max = 0.80	$\chi2$ (2, $N = 458$) = 116.5, $p < 0.001$	p < 0.001	p < 0.001	p = 1.00
CAPE positive symptom distress at follow up[a]	M = 0.95 SD = 0.67 Min = 0.00 Max = 2.86	M = 0.36 SD = 0.54 Min = 0.00 Max = 2.75	M = 0.20 SD = 0.38 Min = 0.00 Max = 2.00	$\chi2$ (2, N = 458) = 109.385, p < 0.001	p < 0.001	p < 0.001	$p = 0.10$

[a] For CAPE positive symptom frequency and CAPE positive symptom distress average item scores of subscales are used.

Table 2
Main effects of personality traits at baseline on positive symptom distress three years later, controlled for age, gender, symptoms and IQ in patients.

Independent variables, measured at baseline	B	S. E.	Wald	df	p	Exp (B) [95 % C.I. for Exp (B)]
Gender	3.04*	1.47	4.29	1	0.04	20.88 [1.18–370.05]
Age	0.02	0.05	0.20	1	0.65	1.02 [0.93–1.12]
Neuroticism	0.06	0.06	1.04	1	0.31	1.06 [0.94–1.19]
Extraversion	0.00	0.07	0.00	1	0.99	1.00 [0.87–1.15]
Openness to experience	0.11	0.07	2.27	1	0.13	1.11 [0.97–1.28]
Agreeableness	−0.03	0.08	0.21	1	0.65	0.97 [0.84–1.12]
Conscientiousness	0.02	0.07	0.05	1	0.82	1.02 [0.89–1.16]
Positive symptom frequency	4.82*	1.80	7.17	1	<0.01	123.70 [3.64–4206.92]
Negative symptom frequency	−0.28	1.02	0.08	1	0.78	0.76 [0.10–5.54]
Depressive symptom frequency	1.81	1.57	1.33	1	0.25	6.12 [0.28–133.340]
Estimated IQ	0.02	0.02	0.78	1	0.38	1.02 [0.98–1.07]
Constant	−11.86	5.69	4.35	1	0.04	0.00

* Significant at $p < 0.05$.

206) = 47.45, $p < 0.001$. Only Neuroticism provided a statistically significant contribution to the model (B = 0.10, S.E. = 0.03, $p < 0.001$). When additional covariates (positive, negative and depressive symptom frequencies and IQ) were added to the model in a second step, a statistically significant model resulted: $\chi2$ (11, N = 206) = 74.34, p < 0.001. Neuroticism and IQ both uniquely contributed to the model in a statistically significant way, but with a very small effect size. Positive symptom frequency contributed uniquely and statistically significant to the model with a very large effect size. See Supplementary data, Table 7 for complete logistic regression model for main effects of personality traits on positive symptom distress three years later.

In controls, in a first step using personality traits, age and gender as independent variables, a statistically significant model was found, with $\chi2$ (7, $N = 96$) = 14.91, $p = 0.04$. No variable added uniquely statistically significantly to the model.

3.3. Moderator effects of Neuroticism, Extraversion and Openness between personality traits and positive symptom frequency on positive symptom distress

In patients, no interaction effects were found for Neuroticism nor Extraversion. For Openness to Experience, a first step resulted in a significant model, with $\chi 2$ (5, $N = 135$) = 87.70, $p < 0.001$. The interaction term of Openness with positive symptom frequency on positive symptom distress contributed significantly to the model (B = −1.15, S.E. = 0.51, $p = 0.02$). In a second step, adding covariates (positive symptom frequency at baseline and IQ), the total model was significant: $\chi 2$ (7, N = 135) = 92.22, p < 0.001 and again the interaction term for Openness with positive symptom frequency on positive symptom distress significantly uniquely contributed to the model. See Table 3.

In siblings, no interaction effects for Neuroticism nor Extraversion were found. The model for Openness was significant $\chi 2$ (5, $N = 206$) = 122.49, p < 0.001, when controlling for age and gender in a first step. The interaction term for Openness with positive symptom frequency on positive symptom distress was statistically significantly contributing to the model (B = -1.91, S. E. = 0.71, $p < 0.01$). In a second step, controlling for the additional covariates (positive symptom frequency at baseline and IQ), again a significant model was found: $\chi 2$ (9, N = 206) = 126.90, p < 0.001, with the interaction term of Openness significantly contributing to the model. See Table 4.

In controls, the interaction terms for Neuroticism, Extraversion and Openness with positive symptom frequency on positive symptom distress were not statistically significant.

To examine the nature of the moderation of Openness in patients and siblings, the strength of the association between positive symptom frequency and the dichotomized distress value was calculated separately for participants with 'high' vs 'low' levels of Openness. 'High' Openness levels were defined as values exceeding one standard deviation above the mean, while 'low' Openness levels were defined as values falling below one standard deviation below the mean. In patients who scored low in Openness ($n = 21$), this association had a strength of Spearman rho = 0.78 (p < 0.01); in patients higher in Openness ($n = 20$) this strength was: rho = 0.48 ($p < 0.05$). For siblings, strengths of associations were rho = 0.86 (p < 0.01) in the group lower in Openness ($n = 40$) and rho = 0.51 (p < 0.05) in the group high in Openness ($n = 36$). Thus, moderation of Openness is inferred to be in the direction of higher levels of Openness buffering the associations between positive symptom frequency and positive symptom distress. This buffering effect is also illustrated in Fig. 1 with 3 separate lines for patient groups with low (i.e. lower than 1 SD below the mean), and high (i.e. higher than 1 SD above the mean) levels of Openness to Experience, respectively. Positive symptom distress is in the figure visualized as the mean average item score of the positive symptoms domain in the CAPE, other than the dichotomized value used in the analyses.

Visualization of the moderating role for Openness to Experience in patients. Mean frequency of symptoms on the x-axis: relative to the patient group as a whole. Mean positive symptom distress on the y-axis: mean distress ranging from value 0, corresponding to answers classifying the felt response to positive symptoms as 'not distressed', to 1: 'a bit distressed', 2: 'quite distressed' and 3: 'very distressed'. Level of Openness to Experience: high level > + 1 SD above the mean, low level < −1 SD below the mean level of Openness.

4. Discussion

The experience of positive symptom distress plays a crucial role in psychotic disorder and in transition to psychosis in those at elevated risk to developing psychotic disorder. More knowledge on variations in positive symptom distress based on contributing and moderating variables is needed for developing tailored interventions. The current study investigated the association between personality traits and the level of (subclinical) positive symptom distress across the psychosis vulnerability spectrum. This study also examined whether baseline personality traits moderated the association between the frequency of (subclinical) positive symptoms and the level of related distress.

Our hypothesis based on previous literature (Dinzeo and Docherty, 2007; Scholte-Stalenhoef et al., 2023) that Neuroticism would predict higher, and Extraversion would predict lower levels of positive symptom distress was only partly confirmed. Higher levels of Neuroticism at baseline predicted higher positive symptom distress three years later, in both patients and siblings, when controlling for age and gender. This was consistent with our anticipation that greater tendency to worrying would predict higher levels of symptom distress. Nevertheless, when further adjusting for symptoms and IQ, this Neuroticism effect reached significance for siblings exclusively- albeit with a notably small effect size. Analysis of effect sizes (see Table 2 for patients and Table 7 in the Supplementary data for siblings) revealed that positive and depressive symptom correction played a pivotal role in attenuating this Neuroticism effect.

In contrast to our initial hypothesis, the present study did not provide evidence supporting any impact of Extraversion – whether controlled or uncontrolled for symptoms – on positive symptom distress. Higher levels of Openness predicted higher positive symptom distress in patients, but again, accounting for symptoms and IQ led to loss of significance, mostly explained by the substantial effect of positive symptom frequency, which largely exceeded the effect size of Openness (see Table 2 for patients and Supplementary data for siblings).

Altogether, main effects of personality on symptom distress were quite limited. When controlling for potential covariates, these were restricted to a positive effect of Neuroticism on distress in siblings uniquely. Despite its limited magnitude, we speculate that siblings' involvement and concern with family members may explain the impact of this trait on the perceived symptom distress in this group. Siblings may follow a relatively threatening interpretation of their psychotic experiences, possibly related to fear of transition to psychotic disorder– a phenomenon distinct from controls, who may display less involvement and patients, already transmitted.

Particularly noteworthy were our results regarding the interaction effects of personality on the relationship between positive symptom frequency and the associated distress. Clearly, referring to Tables 3 and

Table 3
Interaction for Openness to Experience with positive symptom frequency on positive symptom distress in patients.

Independent variables	B	S. E.	Wald	df	p	Exp (B) [95 % C.I. for Exp (B)]
Gender	3.71*	1.79	4.31	1	0.04	40.81 [1/23–1355.06]
Age	0.04	0.05	0.64	1	0.43	1.04 [0.95–1.14]
Estimated IQ	0.04	0.03	1.84	1	0.18	1.05 [0.98–1.11]
Positive symptom frequency BL	3.09	2.11	2.15	1	0.14	21.99 [0.35–1366.510]
Openness	0.13	0.09	1.88	1	0.17	1.14 [0.95–1.36]
Positive symptom frequency FU	71.86*	29.05	6.12	1	0.01	1.621E+31 [3,033,794.76–8.661E+55]
Openness × positive symptom frequency FU	−1.28*	0.64	4.00	1	<0.05	0.28 [0.08–0.97]
Constant	−16.60*	6.26	7.03	1	<0.01	0.00

BL = baseline, FU = three-year follow-up.
* Significant at $p < 0.05$.

Table 4
Interaction between Openness to Experience and positive symptom frequency on positive symptom distress in siblings.

Independent variables	B	S. E.	Wald	df	p	Exp (B) [95 % C.I. for Exp (B)]
Gender	−0.18	0.46	0.16	1	0.69	0.83 [0.34–2.03]
Age	−0.01	0.03	0.17	1	0.68	0.99 [0.94–1.04]
Estimated IQ	−0.02	0.01	2.61	1	0.11	0.98 [0.95–1.01]
Positive symptom frequency BL	1.10	2.11	0.27	1	0.60	3.02 [0.05–188.16]
Openness	0.12	0.07	3.14	1	0.08	1.12 [0.99–1.27]
Positive symptom frequency FU	90.27*	31.16		1	<0.01	1.591E + 39 [5.199E+12–4.870E+65]
Openness × positive symptom frequency FU	−1.66*	0.73	5.15	1	0.02	0.19 [0.05–0.80]
Constant	−3.90	3.00	1.69	1	0.19	0.02

BL = baseline, FU = three-year follow-up.
* Significant at $p < 0.05$.

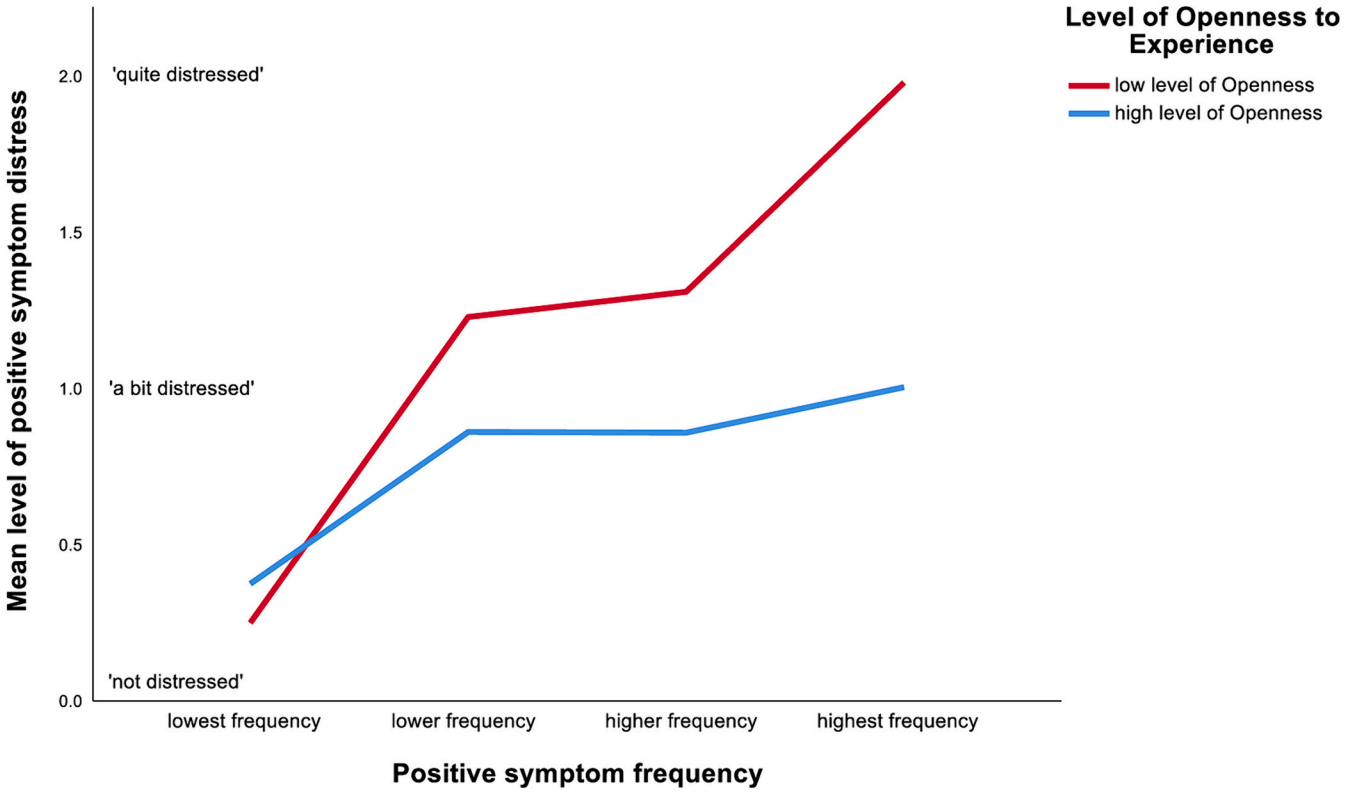

Fig. 1. Positive symptom distress in patients.

4, the positive symptom frequency at follow-up (i.e. the 'dose' of positive symptoms) is the strongest predictor positive symptom distress at the same time point (i.e. the 'response') of all covariates in patients and siblings. Our hypothesis posited that Neuroticism, Extraversion and Openness, without correction for symptoms, would moderate this 'dose-response' relationship in a similar vein as described in a previous population study (Kuranova et al., 2020), with Neuroticism leading to a stronger distress response relative to the frequency of positive symptoms and Extraversion and Openness leading to a weaker response relative to this frequency. Furthermore, we extended our investigation to encompass moderator effects of personality traits that were adjusted for symptoms and IQ.

Openness to Experience emerged as a significant moderator of the association between positive symptom frequency and symptom distress in both the patients and siblings of our sample. In both groups, higher levels of Openness were associated with a weaker distress response relative to the frequency of positive symptoms, as depicted in Fig. 1. This effect remained significant when controlling for age and gender, and even when additionally controlling for symptoms and IQ. Although this moderating effect of Openness aligns with findings of the mentioned population study (Kuranova et al., 2020), the absence of any moderating effect of Openness in the control group of the current study was unexpected. Furthermore, contrary to our anticipations, Neuroticism nor Extraversion played a moderating role, not even in the uncontrolled conditions.

The described differences in results between the general population study and the current study may be attributed to the greater statistical power inherent in the general population sample as compared to the control sample employed in the present study. Moreover, differences in distribution of positive symptom distress across the samples may account for the observed differences. Notably, only a minority of our control sample endorsed any distress over the total of positive symptoms. In the general population study, moderating effects of personality traits were restricted to the subset of delusional ideations in which more than half of the participants reported secondary distress. Similarly, the higher proportion of participants experiencing any positive symptom distress in the siblings group compared to the control group may elucidate why a moderating effect of Openness was observed in our sibling group but not in our control group. It is noteworthy that mean levels of distress in controls and siblings were however comparably low,

as indicated in Table 1b.

The moderating effect of Openness may be explained by certain qualities reflected in this trait. Openness is a broad FFM personality trait, of which the composing facets correlate to a lesser degree to each other than is seen in other personality traits (McCrae and Sutin, 2009). Openness may be disentangled into two components: intellect, reflecting ingenuity, quickness, interest in ideas on one hand; and a reflecting sense of aesthetics and imagination on the other hand (DeYoung et al., 2007). Since IQ was controlled for, this element of intellect is less likely to be responsible for the found effect, but curiosity to new experiences and the appreciation of unusual ideas may be explanative. Cognitive flexibility and self-efficacious appraisals are some of the various concepts that have been related to Openness (Bucher and Samuel, 2022). Additionally, Openness to Experience has been related to activities of the default network of the brain, which is related to activities such as spontaneous thinking, daydreaming, and introspection (Marstrand-Joergensen et al., 2021). These activities may reflect an open and receptive attitude towards inner experiences that may add to acceptance of positive symptoms and thereby lessen distress from these symptoms.

The moderating influence of higher Openness in patients and siblings is exerted in a distress diminishing way. At the same time, the direct effect higher Openness tends towards greater distress – this is based on the uncorrected main effect in patients as described in paragraph 3.2 and the uniquely contributing effect of Openness in the interaction analysis in siblings in Table 4. The opposite direction of these two tendencies of Openness might appear counterintuitive. However, when we consider that the main effect of Openness is on the overall levels of distress, and that its moderating effect operates upon the dose-response relation between symptom frequency and symptom distress, this seeming contradiction can be clarified by regarding Openness as a predisposition to embrace experiences, rather than trying to suppress them. Openness as a trait may elevate the awareness of distress, congruent with the higher scores of symptom distress associated with higher levels of Openness as a main effect. Simultaneously, Openness may mitigate the dose-response relation between the frequency of positive symptoms and the associated distress due to acceptance as explained in the previous paragraph.

Although we did not posit a hypothesis on gender but introduced it as a covariate to our analyses, a noteworthy finding was that gender contributed in patients to the explained variance of distress levels, with female gender being positively associated with levels of symptom distress. This may be related to findings of higher distress in female patients compared to male patients in reaction to voice hearers in previous studies (Hayward et al., 2016; Toh et al., 2020; Schlier et al., 2021). Future research on gender in psychosis may address differences in distress levels, while including personality assessment.

While the current study expands our understanding of the role of personality in the association between psychotic symptoms and symptoms distress, there are several limitations that should be addressed. The CAPE measures the habitual frequency of (subclinical) psychotic experiences and the general degree to which these experiences generate any distress. It therefore does not inform about momentary fluctuations in distress. Although widely used, the CAPE as a measure of psychotic experiences (Jaya et al., 2021), may be less suitable for clinical populations. Self-report bias may influence outcomes, in contrast to using a semi-structured interview such as the PANSS (Positive and Negative Symptoms Scale) (Kay et al., 1987), detecting symptoms also in cases of low insight in psychosis. Next, relatively low levels of positive symptom frequency and positive symptom distress in the current study may represent a selection bias of individuals who may be more willing to give informed consent and allow remeasurements at follow-up. Lower levels of symptom frequency and symptom distress may have attenuated our findings. Dichotomization of positive symptom distress is a common solution to handling a skewed distribution (Kuranova et al., 2020; Pignon et al., 2022), but it may have led to loss of relevant variation. The observed models may be overfitted. Of note, inferences on causality of effects of personality traits on positive symptom distress, either as a main effect or as a moderating effect, cannot be drawn from the current study, although, the assessment of personality three years before the assessment of distress is a strength of our study. Importantly, receipt of treatment may influence symptom distress, but medication use, psychotherapy or other forms of treatment or support were not involved in our analyses.

To further advance our understanding, future research may explore specific facets of Openness as measured by NEO-PI-R (Costa and McCrae, 1992a) in relation to positive symptom distress. Investigating distress reactions to the occurrence of positive symptoms at time points with Experience Sample Methods (Csikszentmihalyi and Larson, 1992) may provide additional insight into momentary fluctuations in distress and the underlying mechanisms. Additionally, intervention studies, targeting Openness, could shed light on the clinical applicability of the current findings. For example, the general receptive and cognitive flexible attitude related to Openness to Experience as a personality trait shows similarities with cognitive defusion, acceptance and reappraisal, components that are promoted in Acceptance and Commitment Therapy (ACT) (Shawyer et al., 2017; Moran et al., 2021). ACT has been shown to be effective in psychosis in terms of lower hospitalization (Bach and Hayes, 2002) and exploring the potential links between Openness as a personality trait and ACT may provide valuable insights into whether ACT can influence personality traits and enhance Openness.

In summary: the main finding of the current study was that Openness to Experience as a moderator played a buffering role in the relationship between positive symptom frequency and positive symptom distress in patients and siblings. This aligns with findings of a previous population study (Kuranova et al., 2020) and expands on these findings by revealing that the moderating effect of Openness remained when controlling for symptoms and IQ, additionally to age and gender. A moderating effect of Openness was not found in controls, probably due to symptom distress being largely absent in our control group. Contrary to the findings of the mentioned population study, we did not find any relevant effects of Neuroticism or Extraversion on symptom distress. This difference in findings may be partly explained by symptom correction, but also differences variance may have contributed. Although the current study does not allow conclusions on causality or explaining mechanisms, our findings support the hypothesis that a receptive, open and flexible attitude towards internal and external experiences that comes along with Openness to Experience, may contribute to more acceptance of the occurrence of positive symptoms, thereby mitigating the related distress.

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CRediT authorship contribution statement

Anne Neeltje Scholte-Stalenhoef: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft. **Lindy-Lou Boyette:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization, Formal analysis. **Marieke Begemann:** Writing – review & editing. **Frederike Schirmbeck:** Writing – review & editing, Visualization, Methodology, Formal analysis, Conceptualization. **Ilanit Hasson-Ohayon:** Methodology, Conceptualization, Supervision, Writing – review & editing. **Wiepke Cahn:** Writing – review & editing. **Lieuwe de Haan:** Writing – review & editing. **Gerdina Hendrika Maria Pijnenborg:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Declaration of Generative AI and AI-assisted technologies in the writing process

Statement: During the revision of this work the first author used ChatGPT to improve readability and language. After using this service, the first author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

Declaration of competing interest

All authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

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