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Common Taxonomy of Traits and Symptoms: Linking Schizophrenia Symptoms, Schizotypy, and Normal Personality

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The associations among normal personality and many mental disorders are well established, but it remains unclear whether and how symptoms of schizophrenia and schizotypal traits align with the personality taxonomy. This study examined the joint factor structure of normal personality, schizotypy, and schizophrenia symptoms in people with psychotic disorders (*n* = 288) and never-psychotic adults (*n* = 257) in the Suffolk County Mental Health Project. First, we evaluated the structure of schizotypal (positive schizotypy, negative schizotypy, and mistrust) and normal traits. In both the psychotic-disorder and never-psychotic groups, the best-fitting model had 5 factors: neuroticism, extraversion, conscientiousness, agreeableness, and psychoticism. The schizotypy traits were placed on different dimensions: negative schizotypy went on (low) extraversion, whereas positive schizotypy and mistrust went on psychoticism. Next, we added symptoms to the model. Numerous alternatives were compared, and the 5-factor model remained best-fitting. Reality distortion (hallucinations and delusions) and disorganization symptoms were placed on psychoticism, and negative symptoms were placed on extraversion. Models that separated symptom dimensions from trait dimensions did not fit well, arguing that taxonomies of symptoms and traits are aligned. This is the first study to show that symptoms of psychosis, schizotypy, and normal personality reflect the same underlying dimensions. Specifically, (low) extraversion, negative schizotypy, and negative symptoms form one spectrum, whereas psychoticism, positive schizotypy, and positive and disorganized symptoms form another. This framework helps to understand the heterogeneity of psychosis and comorbidity patterns found in psychotic disorders. It also underscores the importance of traits to understanding these disorders.

Key words: psychoticism/mistrust/detachment/positive symptoms/negative symptoms

Introduction

Trait-based paradigms, which have treated psychopathology as fully dimensional, have been useful in understanding psychopathology, particularly internalizing and externalizing disorders.[1–3] The Hierarchical Taxonomy of Psychopathology (HiTOP) seeks to improve on traditional diagnostic systems, such as the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) and *International Classification of Diseases (ICD)*, and conceptualize psychopathology dimensionally.[4] A major dimension within HiTOP is the psychotic spectrum, which ranges from normal personality to schizotypal traits to frank psychosis. Schizotypy also reflects a liability for the development of schizophrenia.[5–8] The dimensional conceptualization is supported by evidence that psychotic disorders form a continuum with schizotypal traits,[9–15] and schizotypal traits fit well in the personality taxonomy alongside normal traits.[16,17] An alternative view of schizotypy is that it is quasi-dimensional, and previous work has not definitely resolved this issue.[9,13] Some research has demonstrated that psychosis exists on a continuum with normal perceptual experiences whether examined with latent variable mixture models[18] or taxometric methods.[19,20] This study aims to identify where schizotypy fits within other spectra of psychopathology regardless of whether the underlying construct is dimensional or categorical. Previous research strongly supports that other psychopathology spectra included in HiTOP parallel dimensions of normal personality and extend into maladaptive extremes[2,3,21–23] (although some recent research suggests that normal personality characteristics are separate from personality disorders on a genetic level[24]). Recent theorists have noted that personality pathology is often neglected in schizophrenia research,[25] and unlike other spectra, the psychotic spectrum has not been comprehensively studied vis-à-vis the taxonomy of normal personality.

This mapping is especially complicated because psychotic symptoms are multidimensional, with structural studies finding at least 2 factors of positive and negative symptoms.[26–28] The positive symptom factor includes reality distortion (delusions and hallucinations) and disorganization (bizarre behavior and formal thought disorder), and the negative symptom factor includes inexpressivity (flat affect and alogia) and avolition (avolition and asociality).[29–32]

Maladaptive personality traits relevant to psychosis typically are labeled schizotypy and are also multidimensional. This domain includes an array of perspectives including risk factors,[5,6,33–36] prodromal signs and symptoms,[37–41] maladaptive traits,[42–45] and personality disorders.[10,46,47] Across perspectives, schizotypy includes at least 2 dimensions, positive (anomalous perceptions and beliefs) and negative (anhedonia and social withdrawal).[48,49] These dimensions also have been labeled psychoticism and detachment.[4,36] Some studies observed additional factors,[50–54] among which the placement of mistrust—sometimes termed suspiciousness or paranoia—has been inconsistent. Models have grouped mistrust with positive schizotypy,[51,55,56] negative schizotypy,[52,57] antagonism/disagreeableness,[58,59] or found a separate factor,[53,60–62] including large multinational studies.[63]

Multiple models have been proposed to organize personality, and the most studied includes 5 traits: neuroticism, extraversion, conscientiousness, agreeableness, and openness.[64] Some theorists have hypothesized a link between maladaptive openness and psychoticism/positive schizotypy,[65] but observed correlations are weak and often nonsignificant.[66–69] Openness is largely unrelated to other forms of psychopathology,[23] and neuroticism, extraversion, conscientiousness, and agreeableness have emerged as the normal personality characteristics relevant to mental disorders. Schizotypy does not fit fully into this taxonomy. Detachment typically maps onto low extraversion[53,70,71] or forms a distinct dimension.[51,55] In contrast, psychoticism/positive schizotypy has been consistently found to form a dimension distinct from normal personality.[66–68,72–75]

It is less clear how schizophrenia relates to normal personality because few investigations assessed both relatively rare psychotic disorders and normal personality. A meta-analysis of this small literature found that people with schizophrenia have lower extraversion, conscientiousness, and agreeableness, but higher neuroticism compared with healthy controls.[76] Limited evidence suggests that schizophrenia correlates with psychoticism more strongly than with other traits.[77] This overall profile likely masks rather different trait correlates of schizophrenia symptoms. Negative symptoms have been consistently linked to low extraversion[78–81] and negative schizotypy.[82] Personality correlates of positive symptoms are uncertain,[83] except for a strong link of reality distortion to psychoticism/positive schizotypy.[82] Personality links of disorganization are largely unknown.

It remains unclear whether schizophrenia symptoms and schizotypy traits fit within the taxonomy of the normal model or form additional dimensions. This study sought to address this issue by performing the first-factor analysis of all relevant dimensions. First, we examined the joint structure of schizotypy and normal personality traits in psychotic-disorders and never-psychotic samples. We tested alternative models that reflect organizations suggested in the literature. Next, in the psychotic-disorders sample, we added symptoms of schizophrenia, again comparing all organizations suggested in the literature. These analyses were designed to determine whether schizophrenia symptoms, schizotypy, and normal personality fall along the same major spectra, and help to understand heterogeneity within psychotic disorders from the perspective of traits.

Methods

Participants

Data came from the Suffolk County Mental Health Project, a longitudinal epidemiologic study of first-admission patients with psychosis.[84–86] The psychotic-disorders group was recruited from 12 psychiatric inpatient units of Suffolk County, NY, between 1989 and 1995. Inclusion criteria were first admission within 6 months, psychosis, ages 15–60, intelligence quotient >70, proficiency with English, resident of Suffolk County, and no apparent medical etiology for psychotic symptoms. Patients were followed over 2 decades, and 288 completed the personality assessment at the 20-year time point. The never-psychotic group (N = 257) was recruited using random digit dialing to zip codes where the psychotic disorder group resided (for sampling procedure see Velthorst et al[87]). The study was approved annually by the institutional review boards of Stony Brook University and participating hospitals. All participants provided written informed consent. See table 1 for the demographic characteristics of the samples. Socioeconomic status was measured with the Hollingshead Index of Socioeconomic Status.[88]

Four participants in the never-psychotic group were excluded due to excessive missing data. Demographic information was available for 373 participants in the psychotic-disorders group at 20-year wave, 85 of whom did not provide information necessary for present analyses and were excluded. These participants did not significantly differ from the 288 included participants on age, gender, race/ethnicity, employment status, or socioeconomic status. However, the included group was more likely to have a diagnosis of schizoaffective and bipolar disorders, and less likely to have a diagnosis of drug abuse or other miscellaneous disorder. A plurality of both groups carried a diagnosis of schizophrenia. Among participants for whom some data were available, all data were missing completely at random. In all analyses, missing data were excluded pairwise.

Measures

Normal Personality traits were measured with the Conscientious, Extraversion, Agreeableness, and

Table 1. Demographic Characteristics and Psychometric Properties

	Psychotic disorders (n = 288)			Never-psychotic (n = 257)			χ^2 or t (df)	Cohen's d
Age: M (SD)	48.41 (9.17)			50.39 (8.94)			2.56 (255)*	0.21
Sex: n (% female)	130 (43.8)			114 (44.4)			0.03(1)	—
Ethnicity (% Hispanic)	39 (13.1)			21 (8.2)			3.40 (1)	—
Race: n (%)							8.96 (4)	—
White	232 (78.1)			224 (87.5)			—	—
African American	35 (11.8)			16 (6.3)			—	—
Asian	6 (2.0)			2 (0.8)			—	—
Multiracial	9 (3.0)			6 (2.3)			—	—
Other	15 (5.1)			8 (3.1)			—	—
Employed: n (%)	108 (36.7)			186 (74.4)			77.18 (1)*	
Past year GAF: M (SD)	46.56 (17.34)			72.75 (12.20)			20.06 (254)*	1.81
Marital status: n (%)							111.96 (4)*	
Never married	132 (44.9)			19 (7.6)				
Married	90 (30.6)			176 (70.1)				
Divorced	49 (16.7)			37 (14.7)				
Separated	15 (5.1)			11 (4.4)				
Widowed	8 (2.7)			8 (3.2)				
Medication: n (%)								
Antipsychotic	159 (54.6)			4 (1.6)			182.17 (1)*	—
Antidepressant	114 (38.4)			27 (10.6)			57.62 (1) *	—
Mood stabilizer	80 (26.9)			2 (0.8)			75.66 (1) *	—
Diagnosis: n (%)								
Schizophrenia/schizoaffective	137 (46.1)			—			—	—
Bipolar disorder	79 (26.6)			—			—	—
Major depression	36 (12.1)			—			—	—
Substance use disorder	17 (5.7)			—			—	—
Other diagnoses	28 (9.4)			—			—	—
Socioeconomic status								
Large bus owner, major prof, exec	11 (3.7)			NA			—	—
Manager, med bus owner, lesser prof	42 (14.3)			NA			—	—
Admin, small bus owner, minor prof	51 (17.3)			NA			—	—
Clerical, sales technician	55 (18.7)							
Skilled manual	46 (15.6)			NA			—	—
Machine operator, semi-skilled	43 (14.3)			NA			—	—
Unskilled	19 (14.6)			NA			—	—
Not working	27 (9.2)			NA			—	—
Big Five Inventory	M	SD	α	M	SD	α		
Neuroticism	22.77	6.98	.80	18.22	6.58	.84	7.696 (529)*	0.67
Extraversion	24.62	6.43	.76	27.78	6.28	.81	–5.688 (523)*	0.50
Agreeableness	36.48	5.87	.75	38.66	5.08	.76	–4.555 (532)*	0.40
Conscientiousness	33.61	6.77	.78	37.56	5.56	.78	–7.207 (515)*	0.64
Schedule for Nonadaptive and Adaptive Personality								
Mistrust	6.33	5.10	.89	2.71	3.41	.89	9.366 (512)*	0.83
Detachment	6.54	4.24	.83	3.85	3.61	.84	7.748 (519)*	0.68
Eccentric perceptions	2.97	3.37	.85	1.36	1.69	.63	6.821 (523)*	0.60
Scale for the Assessment of Positive/Negative Symptoms								
Inexpressivity	7.52	9.54	.90	0.94	2.80	.83	10.561 (491)*	0.94
Avolition	13.29	9.67	.87	2.90	3.82	.69	16.125 (547)*	1.41
Reality distortion	4.10	7.31	.84	NA				
Disorganized	4.53	6.43	.77	NA				

Note: GAF, global assessment of functioning.
*$P < .05$.

Neuroticism scales of the Big Five Inventory (BFI).[89] The BFI is a 44-item instrument in which participants indicate how much they agree with statements on a scale from 1 *(Disagree Strongly)* to 5 *(Agree Strongly)*. The BFI is the most commonly used measure of general personality, has high correlations with other measures of big 5 personalities in both psychotic and general population samples, and represents the 5 dimensions well in factor analyses.[73,90] Cronbach's alphas for all scales were >.70 in both samples (table 1).

Schizotypy was measured with the Eccentric Perceptions, Detachment, and Mistrust scales of the Schedule for Nonadaptive and Adaptive Personality (SNAP).[91] The SNAP is a 375-item *true*/false questionnaire. The SNAP is widely used in general population samples and has impressive evidence of reliability and validity.[91] Specifically, the Eccentric Perceptions scale measures odd or unusual beliefs, cognitions, and perceptual experiences and is strongly correlated with measures of psychoticism in general population samples including the Magical Ideation Scale, Perceptual Aberration Scale, Schizotypal Traits Scale-Magical Ideation Subscale, and a schizotypal personality questionnaire (SPQ)-derived unusual beliefs and experience scale (*rs* = .69–.73)[92] and interview ratings of schizotypal personality disorder.[91] The Detachment scale measures interpersonal and emotional distance and shows excellent convergence with and the Revised Social Anhedonia Scale (r = .77) and a SPQ-derived social anhedonia measure (r = .75) in a general population sample[92] and interview measures of schizoid, schizotypal, and avoidant personality disorders.[93] The Mistrust scale measures suspiciousness, alienation, and feelings of injustice. It is highly correlated with interview ratings of both schizotypal and paranoid personality disorder[94] and other measures of mistrust including the Schizotypy Traits Scale-Paranoia Subscale (r = .80) and SPQ-Suspiciousness (r = .73) in a general population sample.[92]

Psychosis Symptoms were measured with the Scale for the Assessment of Positive Symptoms (SAPS)[27] and the Scale for the Assessment of Negative Symptoms (SANS).[95] The SAPS consists of 31 items covering 4 symptom domains and global ratings. The SANS consists of 19 items assessing 5 domains and global ratings. For both scales, symptoms are rated on a scale from 0 (*None)* to 5 *(Severe)*. Previous factor analyses examined the SAPS and SANS symptom ratings and concluded that 4 dimensions are most informative: Reality Distortion, Disorganization, Inexpressivity, and Apathy/Avolition,[29] consistent with numerous previous studies.[30–32,96,97] The inter-rater reliability of these ratings was high for inexpressivity (intraclass correlation coefficient [ICC] = 0.79), Apathy/Avolition (ICC = 0.94), Reality Distortion (ICC = 0.95), and Disorganization (ICC = 0.85).[29]

Data Analyses

We used confirmatory factor analysis (CFA) to test models of traits and symptoms. We compared these models using Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC), of which BIC was primary as recommended (lower scores represent better fit).[98,99] Root Mean Squared Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardized Root Mean Squared Residual (SRMR) were used to evaluate absolute model fit. Following conventional criteria, RMSEA and SRMR values < .10 were considered acceptable and < .05 were excellent. CFI and TLI values > .90 were acceptable and > .95 were excellent.[100–102] All models were fit with Mplus, version 7.31[103] using maximum likelihood estimation with robust standard errors estimation, a maximum likelihood estimator with standard errors that are robust to violations of the normality assumption.

Given the measures available, modeling of latent factors required creation of parcels from each scale.[104] The individual items in the scales could not be used because it would have required estimating too many parameters in relation to sample size. We created 2 random parcels for each scale (ie, odd items comprising parcel 1, even items comprising parcel 2). We tested the unidimensionality assumption of parceling by conducting an exploratory factor analysis for each scale, and comparing the eigenvalues of the 1- through 4-factor solutions using a scree plot (see supplementary tables S1A and S1B). In the never-psychotic group, the slope of the scree plots suggested a unidimensional solution for all BFI and SNAP scales, with the potential exception of Conscientiousness. In the psychotic-disorders group, the slope of the scree plots for all scales suggested a single factor in each. We concluded that the random parceling approach was appropriate, given evidence for the unidimensionality in 6 of the 7 scales across both samples. Although there was evidence for multidimensionality for one scale, this finding did not replicate across samples and is inconsistent with the scale having been developed to measure a unidimensional construct.[89]

The first goal was to determine where schizotypy traits (ie, Detachment, Mistrust, and Eccentric Perceptions) fit within the personality taxonomy. We estimated a series of models that tested hypothesized arrangements of these traits separately in both samples. After the best-fitting model was identified, we examined measurement invariance between groups. First, a configural model was tested in which the pattern of the factor loadings matrix (free or fixed to 0) is constrained to equality between groups, but the magnitude of factor loadings and intercepts were allowed to vary between groups. Second, a metric model was tested in which the pattern and magnitude of factor loadings were constrained to be equal between groups, but the intercepts were allowed to vary.

Finally, a scalar invariance model was tested in which the pattern and magnitude of factor loadings and intercepts were constrained to be equal between groups.[105] Given the well-known limitations of chi-square difference testing for measurement invariance,[106] we used change in CFI (ΔCFI),[107] McDonald's Noncentrality Index (Mc),[108] and lower BIC[109,110] to compare model fit. As recommended, we used 0.010 and 0.020 as the cutoffs for ΔCFI and Mc, respectively.[106]

The second goal was to test the joint factor structure of personality, schizotypy, and schizophrenia symptoms. We retained the best-fitting model from the personality and schizotypy analyses for the psychotic-disorders sample and added the SAPS and SANS parcels (the never-psychotic group was excluded because, by definition, they did not have sufficient variability in SAPS and SANS ratings). For all analyses, parcels from a given scale were assigned to factor together. Correlations between pairs of parcels can be inflated due to common source, and we modeled that by correlating the corresponding error terms in all analyses including measurement invariance.

Results

Descriptive Statistics

Compared with the never-psychotic group, the psychotic-disorders group was moderately elevated on Neuroticism, and low on Extraversion, Agreeableness, and Conscientiousness (table 1). The Eccentric Perceptions and Detachment scales were moderately elevated, and the mistrust scale was highly elevated.

Structure of Personality and Schizotypy

Next, we examined associations among personality and schizotypy variables in both the psychotic-disorder and never-psychotic samples (supplementary table S2A). We compared 5 models representing different arrangements of schizotypy and normal traits (table 2). The model that showed the best fit on BIC consisted of psychoticism (Eccentric Perceptions and Mistrust), extraversion (Extraversion and low Detachment), neuroticism, conscientiousness, and agreeableness factors. This model had the lowest BIC in both samples and fit well according to the RMSEA, CFI, TLI, and SRMR. The AIC showed the best fit for Model 3, which placed Mistrust on both the Psychoticism and Agreeableness factors, but only in the never-psychotic sample. Overall, Model 1 fit best on AIC in psychotic-disorders sample, fit best on the primary index (BIC) in both samples, and is the most parsimonious (figure 1).

Measurement Invariance

As can be seen in supplementary table S3, the configural model fit the data well. The metric invariance model fit the data as well as the configural model according to ΔCFI and better according to BIC, but worse according to Mc. Because 2 of the 3 indicators suggest metric invariance, the factor structure is deemed to be invariant. Finally, the scalar invariance model fit as well as the metric model according to all 3 indices. This suggests that the indicators measure the same constructs, measure them equally well between groups, and differences in scores represent meaningful differences in trait severity, consistent with the literature on elevations of personality traits in psychosis.

Structure of Personality, Schizotypy, and Schizophrenia Symptoms

We then investigated the alignment of psychosis symptoms and personality traits (supplementary table S2B). We compared 5 competing models, all of which retained the structure from previous analyses and added symptoms in several arrangements (table 3). The model that fit best on BIC had only 5 dimensions, placing Reality Distortion and Disorganization on the Psychoticism factor, and Inexpressivity and Avolition on the (low)Extraversion/Detachment factor. Absolute indices indicated adequate fit. Additional factors for negative symptoms worsened model fit, suggesting that negative symptoms belong on the same dimension as extraversion and detachment. The AIC favored Model 3, in which Reality Distortion and Disorganized scales formed a separate, sixth factor. However, this positive symptoms factor correlated very highly with psychoticism factor (r = .78), suggesting little distinction between the 2 dimensions. Because the 5-factor model had the lowest BIC, was most parsimonious, and psychoticism and positive symptoms were so strongly correlated, we determined the 5-factor model fit the data best (figure 2).

Discussion

These findings contribute to our understanding of the taxonomy of symptoms and traits associated with psychosis in several ways. First, we observed that psychoticism/positive schizotypy forms a dimension distinct from normal personality, whereas detachment/negative schizotypy is inseparable from (low) extraversion. Mistrust joined psychoticism rather than aligning with normal personality dimensions or defining a separate factor. This factor structure was invariant between groups. Second, schizophrenia symptoms fit into this structure fully and did not require additional dimensions. Positive symptoms and psychoticism formed one spectrum, whereas negative symptoms and detachment formed another. Overall, these results suggest that normal personality, schizotypy, and psychotic disorder symptoms are intertwined, and research on psychosis should consider traits as well as symptoms.

Table 2. Fit Statistics for Models of Personality and Schizotypy

Model	Para	BIC	AIC	χ^2 (df)	RMSEA (90% CI)	CFI	TLI	SRMR
Never-psychotic group								
1) Mistrust on psychoticism	**55**	**14 443.91**	**14 284.71**	**124.973 (64)**	**0.061 (0.045–0.077)**	**0.959**	**0.942**	**0.046**
2) Detachment on psychoticism	54	14 485.60	14 293.95	164.972 (65)	0.077 (0.063–0.092)	0.933	0.901	0.071
3) Mistrust on agreeableness	56	14 444.11	14 245.36	120.468 (63)	0.060 (0.043–0.076)	0.962	0.945	0.045
4) Mistrust on neuroticism	56	14 449.55	14 250.80	125.942 (63)	0.062 (0.046–0.078)	0.958	0.939	0.046
5) Mistrust separate factor	58	14 456.69	14 250.84	122.070 (61)	0.062 (0.046–0.078)	0.959	0.939	0.043
Psychotic-disorders droup								
1) Mistrust on psychoticism	**55**	**17 803.74**	**17 602.27**	**213.726 (64)**	**0.090 (0.077–0.104)**	**0.919**	**0.885**	**0.055**
2) Detachment on psychoticism	55	17 850.10	17 652.30	265.008 (65)	0.103 (0.091 -0.116)	0.892	0.849	0.071
3) Mistrust on agreeableness	56	17 815.68	17 610.55	221.116 (63)	0.093 (0.080–0.107)	0.915	0.877	0.057
4) Mistrust on neuroticism	56	17 813.08	17 607.95	217.777 (63)	0.092 (0.079–0.106)	0.917	0.879	0.055
5) Mistrust separate factor	58	17 816.44	17 603.99	210.923 (61)	0.092 (0.079–0.106)	0.919	0.879	0.055

Note: Para = number of parameters, in all models, BFI Neuroticism loads on Neuroticism, BFI-Extraversion loads on Extraversion, BFI-Conscientiousness Loads on Conscientiousness, BFI- Agreeableness Loads on Agreeableness, and SNAP Eccentric Perceptions loads on Psychoticism. 1) Mistrust on Psychoticism: SNAP Mistrust loads Psychoticism, SNAP Detachment loads on Extraversion; 2) Detachment on Psychoticism: SNAP Mistrust loads Psychoticism, SNAP Detachment crossloads on Extraversion and Psychoticism; 3) Mistrust on Agreeableness: SNAP Mistrust crossloads on Psychoticism and Agreeableness, SNAP Detachment loads on Extraversion.; 4) Mistrust on Neuroticism: SNAP Mistrusts crossloads on Psychoticism and Neuroticism, Detachment loads on Extraversion; 5) Mistrust Separate Factor: SNAP Mistrust forms separate sixth factor, Detachment loads on Extraversion. Best-fitting model is in bold. BIC, Bayesian Information Criterion; AIC, Akaike Information Criterion; RMSEA, Root Mean Squared Error of Approximation; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; BFI, Big Five Inventory; SNAP, Schedule for Nonadaptive and Adaptive Personality.

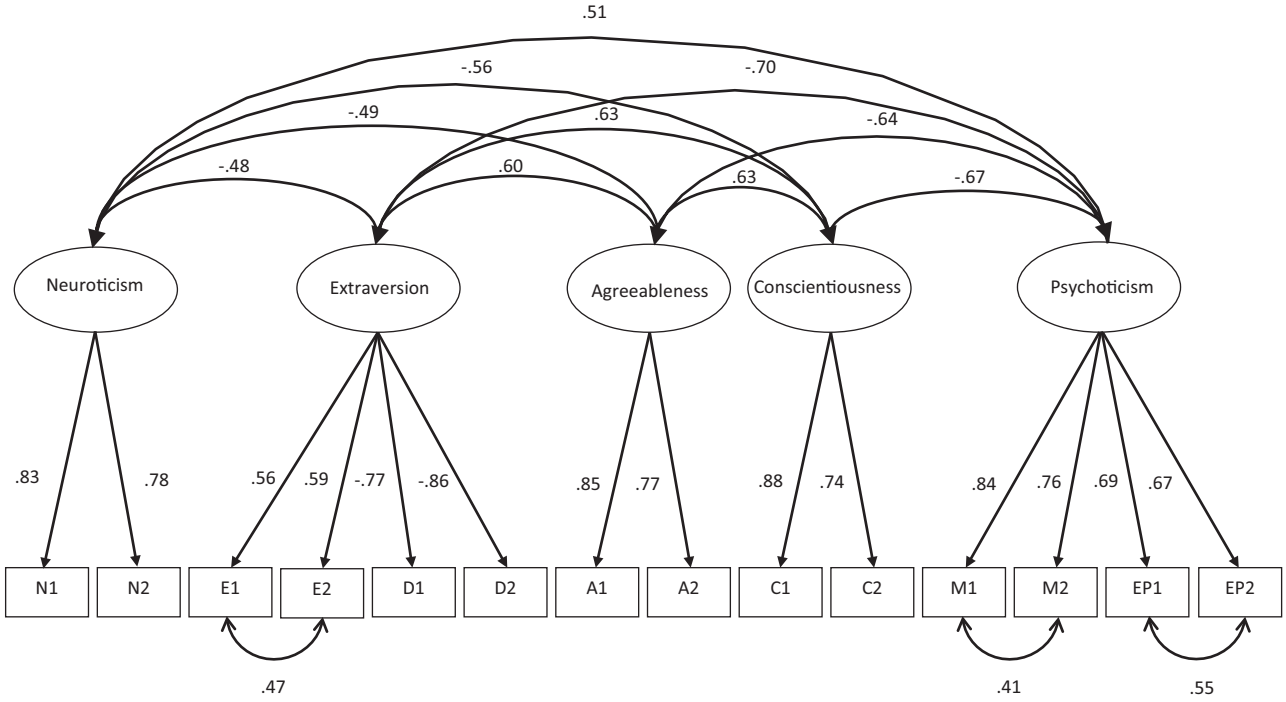

Fig. 1. Joint confirmatory factor analysis of normal personality and schizotypy in the psychotic-disorders group. *Note*: N = Big Five Inventory (BFI) Neuroticism, E = BFI Extraversion, A = BFI Agreeableness, C = BFI Conscientiousness, D = Schedule for Nonadaptive and Adaptive Personality (SNAP) Detachment Subscale, M = SNAP Mistrust Subscale, EP = SNAP Eccentric Perceptions, numbers on straight lines represent standardized factor loadings, numbers on curved lines represent correlation coefficients between latent variables and residuals for manifest variables.

Table 3. Fit Statistics for Models of Personality, Schizotypy, and Psychosis Symptoms

Model	Para	BIC	AIC	χ^2 (df)	RMSEA (90% CI)	CFI	TLI	SRMR
1) 5-Factor	**83**	**29 248.96**	**28 942.38**	**499.435 (192)**	**0.073 (0.066–0.081)**	**0.907**	**0.888**	**0.079**
2) SANS on psychoticism	86	29 266.08	28 948.42	501.192 (189)	0.075 (0.067–0.083)	0.905	0.884	0.078
3) 6-Factor positive	88	29 250.89	28 925.84	478.805 (187)	0.072 (0.064–0.081	0.912	0.891	0.073
4) 6-Factor negative	87	29 274.24	28 952.89	502.395 (188)	0.075 (0.067–0.083)	0.905	0.883	0.097
5) 7-Factor	93	29 278.37	28 934.86	479.155 (182)	0.074 (0.066–0.082)	0.910	0.886	0.089

Note: In all models, BFI Neuroticism loads on Neuroticism, BFI-Extraversion and SNAP Detachment load on Extraversion, BFI-Conscientiousness loads on Conscientiousness, BFI-Agreeableness loads on Agreeableness, and SNAP Eccentric Perceptions and SNAP Mistrust load on Psychoticism. 1) 5-Factor: SAPS Reality Distortion and SAPS Disorganized load on Psychoticism, SANS Inexpressivity and SANS Avolition load on Extraversion. 2) SANS on Psychoticism: SANS Avolition and Inexpressivity crossload on Psychoticism and Extraversion. SAPS Reality Distortion and Disorganized load on Psychoticism; 3) 6-Factor Positive: SANS Avolition and Inexpressivity load on Extraversion, SAPS Reality Distortion and Disorganized form separate sixth factor; 4) 6-Factor Negative: SAPS Reality Distortion and Disorganized load on Psychoticism, SANS Avolition and Inexpressivity form separate sixth factor; 5) 7-Factor: SAPS Reality Distortion and Disorganized for separate sixth factor, SANS Avolition and Inexpressivity form separate seventh factor. The best-fitting model is in bold. BIC, Bayesian Information Criterion; AIC, Akaike Information Criterion; RMSEA, Root Mean Squared Error of Approximation; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; BFI, Big Five Inventory; SNAP, Schedule for Nonadaptive and Adaptive Personality.

Our finding that psychoticism/positive schizotypy and positive symptoms form a coherent spectrum is consistent with previous research documenting links between them.[111] It is further reinforced by prospective evidence that psychoticism predicts first onset of psychosis in general population[34,112] and prodromal samples.[113,114] Psychosis and psychoticism are influenced by some of the same genetic vulnerabilities[115–117] and environmental factors, such as cannabis exposure, stress or trauma, and urbanicity.[12,118] They also exhibit similar brain abnormalities and cognitive and social-cognitive deficits.[119–121] Although the 5-factor model fit the data best according to BIC, the difference

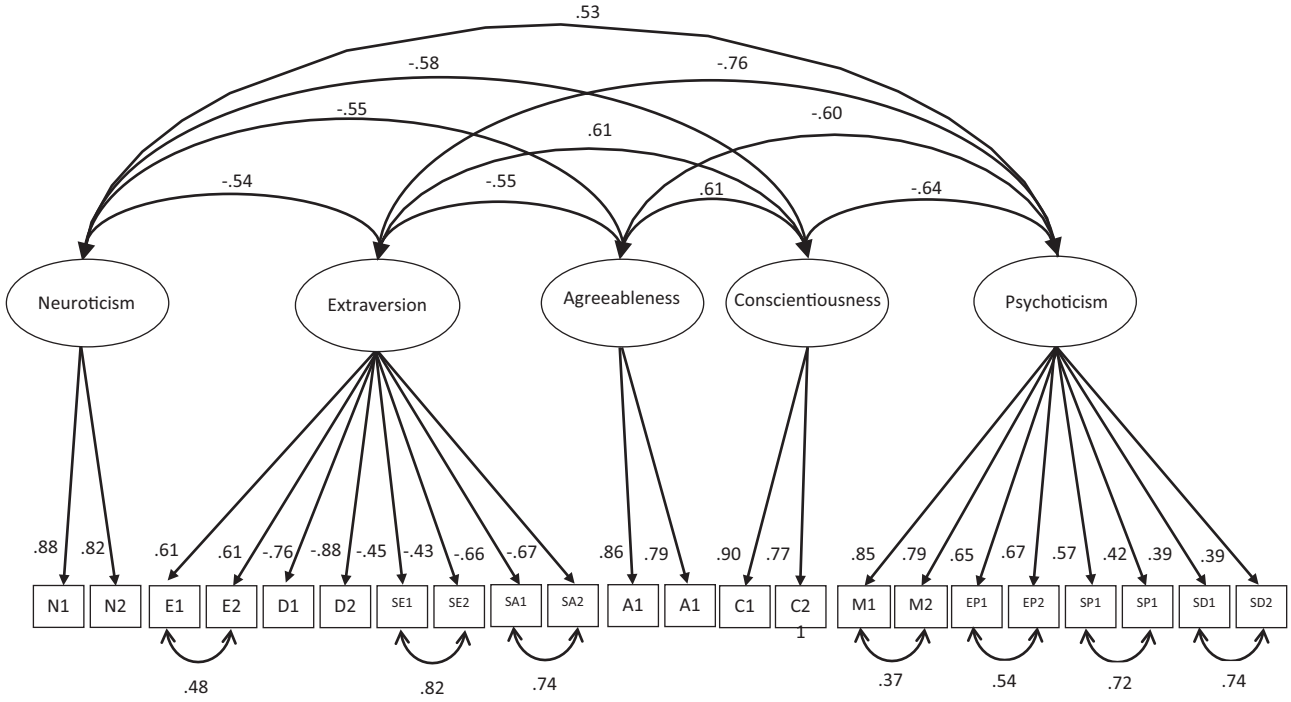

Fig. 2. Joint confirmatory factor analysis of normal personality, schizotypy, and psychotic symptoms in the psychotic-disorders group. *Note*: N = Big Five Inventory (BFI) Neuroticism, E = BFI Extraversion, A = BFI Agreeableness, C = BFI Conscientiousness, D = Schedule for Nonadaptive and Adaptive Personality (SNAP) Detachment Subscale, M = SNAP Mistrust Subscale, EP = SNAP Eccentric Perceptions, SA = Scale for the Assessment of Negative Symptoms (SANS) Avolition factor, SE = SANS, Inexpressivity factor, SP = Scale for the Assessment of Positive Symptoms (SAPS), Reality Distortion factor, SD = SAPS, Disorganized factor, numbers on straight lines represent standardized factor loadings, numbers on curved lines represent correlation coefficients between latent variables and between residuals for manifest variables.

between model fit was small and may not represent a substantial difference in fit. Thus, an alternative explanation may be that positive symptoms of psychosis represent a separate factor from psychoticism. However, this model is less parsimonious, and the positive symptom factor is very strongly correlated with psychoticism (r = .78), suggesting a lack of a meaningful distinction.

Our observation that a single spectrum spans from (low) extraversion to detachment/negative schizotypy to negative symptoms is consistent with several lines of evidence. Previous research documented a strong link between detachment and (low)extraversion.[44,53,70–72,122] Detachment is highly correlated with negative symptoms,[37,123–126] predicts the first onset of psychosis,[5,112,127–129] shares a genetic liability with schizophrenia,[130,131] and is associated with similar social-cognitive deficits,[132] deficits in reward processing,[133–135] neurofunctional abnormalities,[136,137] and cognitive deficits among others.[138,139] In contrast, some evidence from previous research suggests that some aspects of negative schizotypy and negative symptoms in schizophrenia are categorical.[32,140–142] One potential explanation is that low extraversion, negative schizotypy, and negative symptoms are underpinned by a dimension of risk from which dimensional traits and categorical entities emerge.

This study also sheds light on the relations between mistrust and other traits. Our analyses placed mistrust to the psychoticism factor, suggesting it is more closely related to psychoticism than to other traits. Previous work on the placement of mistrust has produced inconsistent results.[2,51–53,58,59,143–145] This finding is consistent with the traditional view of paranoia and persecutory delusions as positive symptoms and with substantial evidence indicating that paranoia is on a continuum with subclinical suspicious thoughts and pathological mistrust in personality disorders.[51,143,146,147] A case could also be made that Mistrust belongs on both psychoticism and agreeableness in the never-psychotic group. The model in which mistrust crossloaded on psychoticism and agreeableness fit well than the model with mistrust only on psychoticism according to AIC, and the differences in BIC were small. However, the mistrust on psychoticism model clearly fit better in the psychotic-disorders group, and the measurement invariance analyses suggest the factor structure is statistically equivalent between groups.

This study is the first to investigate the joint taxonomy of symptoms and traits related to psychosis, but it had several limitations. Although measured with well-validated instruments, only one measure of each construct was included. This necessitated the construction of parcels for CFA. There is a lack of consensus in the literature about whether the parceling approach is appropriate for CFA.[104,148,149] Some research suggests that item parceling

may lead to incorrect decisions regarding the number of factors, distort relations among factors when items cross-load on multiple factors, artificially inflate fit statistics, and may be especially problematic when testing measurement invariance.[149] Future research could avoid this issue by including multiple measures of each construct.

Another limitation is that this study cannot comment on relations between openness and psychosis. This question was outside the scope of the present investigation. Prior research established that openness is largely unrelated to psychopathology,[23,66,68] and we chose not to assess it. Moreover, cases had onset of psychosis more than 2 decades ago. Many continued to experience symptoms, but it is possible that symptom-trait associations might be different early in the illness course, and the joint taxonomy should be investigated in recent-onset samples. Work with the Positive and Negative Symptom Scale suggests a five-factor structure including positive, negative, disorganized, emotional distress, and excitement/agitation. We chose to focus on schizophrenia symptoms because mood symptoms (i.e., emotional distress and excitement/agitation) are already characterized in dimensional taxonomies and have been assigned to the internalizing spectrum.[4] The current study also lacked a cross-validation sample, which could add certainty to the stability of the results.

The current research used the eccentric perceptions, mistrust, and detachment scales of the SNAP as measures of schizotypy. There is somewhat limited evidence from previous research about the validity of SNAP scores as measures of schizotypy, particularly in samples of people with schizophrenia. Although several studies have found that SNAP scores are associated schizotypy measures, the majority are non-peer reviewed publications in the form of assessment manuals and unpublished dissertations.[43,91–93] Thus, the current results may not generalize to other measures of schizotypy. At the same time, the finding of the CFAs and the significant zero-order correlations among SNAP, BFI, and SAPS/SANS scores provide some evidence of the validity of SNAP scores in people with psychosis. Finally, we could not consider symptom-trait associations in the never-psychotic group because it lacked variance in positive symptoms by design.

Conclusions

These results clarify the common structure of personality, schizotypy, and schizophrenia symptoms. We found that these disorders harbor 2 fundamental spectra: psychoticism dimension defined by mistrust, positive schizotypy, and positive symptoms and detachment dimension spanning (low)extraversion, negative schizotypy, and negative symptoms. The resulting 2-spectra model helps to conceptualize heterogeneity within psychotic disorders and interpret their comorbidities. Also, neuroticism has long been established as the core of internalizing disorders, whereas (low)conscientiousness and (low)agreeableness underpin externalizing disorders. These findings highlight that traits are important in psychotic disorder as well and even brief personality assessments would substantially benefit researchers and clinicians.

Supplementary Material

Supplementary data are available at *Schizophrenia Bulletin* online.

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