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The Psychosis Continuum: Testing a Bifactor Model of Psychosis in a General Population Sample

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Abstract

Although the factor structure of psychosis continues to be debated by taxonomists, recent studies have supported a bifactor model consisting of a general psychosis factor and five uncorrelated symptom-specific factors. While this model has received support in clinical samples, it has not been tested at the general population level. Analysis was conducted on Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions (N= 34,653). Twenty-two psychotic symptoms were used as observed indicators of psychosis. These items were chosen based on their conceptual similarity to the items used by Reininghaus, Priebe and Bentall (2013). Confirmatory factor analysis and confirmatory bifactor modelling were used to test a variety of competing models. The best fitting model consisted of a general psychosis factor that was uncorrelated with five specific factors: positive, negative, disorganisation, mania and depression. These findings suggest that the bifactor model can be extended to general population samples, supporting the continuity between clinical and sub-clinical psychotic experiences. Theoretical and practical implications are discussed.

Introduction

Difficulty in defining the psychosis phenotype has long been recognised as an impediment to both biological and psychological research into severe mental illness. Conventional diagnostic systems such as the DSM [1] and ICD [2] reflect Kraepelin's [3] original division of psychosis into the two main categories of dementia praecox/schizophrenia and the affective psychoses. However, critics of categorical classification have pointed to the poor reliability and disjunctive nature of these diagnoses [4, 5], as for example revealed in the recent DSM-5 field trials [6], the high level of comorbidity between different diagnostic categories such as schizophrenia and bipolar disorder [7], the failure of diagnoses to clearly segregate into non-shared genetic and environmental risks in either family [8] or molecular genetic [9, 10] studies, and poor validity in terms of prediction of outcome or response to treatment [11].

One approach to overcoming these problems has been to attempt to develop empirically-derived classification systems. These efforts have focused on two questions: first, whether there are interpretable structures of covariation between different psychotic symptoms and experiences; second, whether these experiences lie on a continuum with sub-clinical expressions of psychosis, sometimes known as psychotic-like experiences (PLEs). Resolving these issues will potentially open new avenues for aetiological research, facilitate new ways of assessing patients with severe mental illness, and, ultimately, may lead to the identification of new targets for therapeutic intervention.

The structure of psychosis

Research on the first question has yielded several apparently contradictory solutions. On the one hand, the use of factor analytic methods to explore the comorbidity between different

diagnoses has converged on three main spectra of psychiatric disorders: the internalizing spectra (anxiety and mood disorders), the externalizing disorders (behavior and substance disorders) and the psychoses [12-16]. Within this framework, the psychoses appear as one spectrum of disorder, an idea that is consistent with pre-Kraepelinian ideas of unitary psychosis (or 'Einheitspsychose') [17] and with recent research supporting a schizophrenia-bipolar spectrum without a clear separation between the two diagnoses on phenomenological or neuroscientific measures [18]. A major limitation of this approach is that, at the aetiological level, although there appear to be common mechanisms, different diagnoses and symptoms appear to be related to different social and other risk factors [19-22].

On the other hand, factor analyses of psychotic symptoms have most often converged on five separate factors of symptomatology: positive symptoms (hallucinations and delusions), negative symptoms, cognitive disorganization, depression and mania. For example, an exploratory factor analysis (EFA) of the Positive and Negative Syndrome Scale (PANSS) in a sample of recent-onset schizophrenia patients reported a correlated 5 factor solution [23]. More recently, Stefanovics, Elkis, Zhening, Zhang, and Rosenheck [24] compared three different factor models of the PANSS using four samples of diagnosed patients. Using confirmatory factor analysis (CFA) they found that a 5 factor model (negative, positive, disorganized, mania and depression) provided the best fit in each of the samples. More complex solutions have also been proposed, for example by combining symptoms with categories in the hope that this will lead to better predictive validity than the symptom dimensions alone [25]. An obvious limitation of such schemes, however, is that they are too complex for many practical purposes.

Bifactor modelling provides a possible means of resolving the apparent inconsistency between the results of these two approaches while creating an understanding of the structure of psychosis that is not too complex for practical purposes. This approach is comparable to

second order modelling in that both methods acknowledge the multidimensionality of a construct while simultaneously retaining the idea that a single construct is being measured [26]. With second order modelling, the latent trait represents the variance shared by a number of more basic traits (i.e. subdomains). Bifactor modelling differs in that the general and specific factors compete to explain item variance [26]. Put simply, bifactor modelling allows researchers to directly test whether specific dimensions explain a non-redundant amount of variance amongst items that is not accounted for by the general factor [26, 27].

In a preliminary test of the bifactor approach, we analysed data from 309 patients admitted to psychiatric services for acute, first or second episode psychosis and 507 patients with enduring psychosis who were in the care of community mental health teams [27]. In this study, the bifactor model consisting of one general psychosis factor and five symptom dimensions provided a better fit than a unitary psychosis model or the five symptom dimensions alone. However, a major limitation of this analysis was that it was carried out only on patients with diagnoses in the schizophrenia spectrum. We therefore recently replicated this analysis with data from 1168 patients with diagnoses of either schizophrenia spectrum disorder or bipolar disorder, again finding that a bifactor model with one general, transdiagnostic psychosis dimension underlying affective and non-affective psychotic symptoms and five specific dimensions of positive, negative, disorganized, manic, and depressive symptoms provided the best model fit and diagnostic utility for categorical classification [28].

The continuum between psychosis and healthy functioning

The question of whether psychotic symptoms lie on a continuum with sub-clinical psychotic-like experiences (PLEs) in the healthy population has been the subject of considerable debate [29, 30], stimulated by studies of schizotypal traits in healthy individuals [31, 32], and by the

discovery that large numbers of individuals in the population experience PLEs without seeking psychiatric treatment [33]. Whereas the existence of a phenomenological continuum running from eccentricity, through psychotic-like experiences to full-blown psychotic symptoms is difficult to question, some reviewers have concluded that a fully dimensional structural model of psychotic traits and experiences remains unproven [34]. However, there is evidence that those who experience PLEs are at high risk of making the transition to a fully-fledged psychotic disorder [35, 36], especially following exposure to environmental risk factors [37]. Recent evidence that the risk of psychosis is highly polygenic [10, 38], with risk shared across schizophrenia, bipolar disorder and other diagnoses [10] is also consistent with a structural continuum. Although early taxometric research on psychometric measures of PLEs seemed to indicate a taxon of about 10 percent of individuals at elevated risk of psychosis [39], recent rigorous taxometric studies have supported a fully dimensional model [40] .

If PLEs lie on a continuum with psychotic illness, they should have a similar structure to psychotic symptoms in patients. To date, studies which have addressed this issue have mostly used EFA or CFA methods, and have consistently reported structures that correspond to the positive and negative factors revealed in similar studies carried out with patients, but with an additional factor that has been interpreted as indicating cognitive disorganization [41, 42] or social impairment [43, 44], and sometimes with a fourth impulsivity factor [45].

To our knowledge, the validity of the bifactor model in relation to PLEs has only been tested once. In a study with undergraduate students encompassing both schizotypal and affective traits, Preti et al. [46] administered the Schizotypal Traits Questionnaire [47] and the Temperament Evaluation of Memphis, Pisa, Paris and San Diego [48], finding that a bifactor model, with independent sub-domains of positive and negative schizotypal traits and

a further sub-domain of affective traits, was the best fit to the data. However bifactor models have not been tested using community samples.

This study aims to test a large range of competing factor analytic models, including both general and specific dimensions, using data from a large general population sample (the National Epidemiologic Survey on Alcohol and Related Conditions; NESARC). It was hypothesised that models with both general and specific dimensions (bifactor) would provide better fit than correlated (i.e. first order) models and hierarchical (second-order) models.

Method

Sample

Analysis was conducted on the second wave of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) [49]. The NESARC is a longitudinal survey that was designed to be representative of the civilian, noninstitutionalized adult population of the United States, including residents of the District of Columbia, Alaska, and Hawaii [49]. Descriptions of the survey design, and data collection processes are available in greater detail elsewhere [49-52], but will be summarized here. Wave 1 of the NESARC was conducted between 2001 and 2002, while Wave 2 took place between 2004 and 2005. Respondents included those living in private households, boarding or rooming houses, nontransient hotels and motels, shelters, facilities for housing workers, college quarters, group homes and military personnel living off base [49]. One adult was randomly selected from each dwelling. Potential respondents were informed in writing of the nature of the study, the confidentiality procedures that were in place, the intended use for the data and the voluntary nature of their participation [49].

Face-to-face, computer assisted personal interviews were conducted by trained laypersons [49]. In Wave 1, 43,093 adults were interviewed (81% response rate). In Wave 2, 34,653 available respondents (i.e. those who were not deceased, deported, on active military

duty, or mentally or physically impaired throughout the follow-up period) were reinterviewed (86.7% response rate). The cumulative response rate for both waves combined was 70.2%. Blacks, Hispanics and young adults aged 18-24 years were oversampled in both waves of the NESARC. As such, data were weighted to adjust for this oversampling. In order to be representative of the U.S population the data was also adjusted for region, age, sex, race, and ethnicity, based on the 2000 Decennial Census [49]. This study focussed solely on data collected as part of Wave 2.

Measures

The NESARC made use of the Alcohol Use Disorder and Associated Disabilities Interview Schedule – DSM-IV version (AUDADIS-IV) [53]. The AUDADIS-IV is a fully-structured, self-report, diagnostic interview designed to be administered by clinicians or trained laypersons [53]. The AUDADIS-IV assesses both past year and lifetime occurrence of a variety of psychiatric disorders, including substance use disorders, major depression, anxiety disorders, psychosis and personality disorders [52]. The AUDADIS-IV measures of substance use and other psychiatric disorders have high reliability in general population samples [52, 54].

Procedure

The best fitting model tested by Reininghaus, Priebe and Bentall [27] grouped the 30 items of the PANSS into five factors of positive, negative, disorganization, mania and depression. An examination was conducted of the entire AUDADIS-IV and individual items were selected based on their conceptual similarity to the items from the PANSS [55] as used by Reininghaus, Priebe and Bentall [27]. The AUDADIS-IV was deemed suitable for this purpose, as taxometric research supports a dimensional structure to PLEs within this measure [56]. Items were taken primarily from Section 10, ‘Usual Feelings and Actions’, of the AUDADIS-IV. Other items were taken from Section 4a (‘Low Mood’), Section 5 (‘High

Mood'), Section 7 ('Social Situations'), and Section 9 ('General Anxiety'). Overall, 20 individual items were identified under the broad groupings of positive, negative, mania and depression factors (see online supplementary table 1).

The first three questions from sections 4a, 5, 6, 7 and 9 were screener questions used to determine whether respondents should proceed to answer questions about specific symptoms [57]. Items were recoded into binary variables in which responses were coded with a 1 if they endorsed both the screener question and the specific symptom. If respondents did not endorse both, they were coded with a 0. Section 10 ('Usual Feelings and Actions') does not include screener questions, however, each specific symptom item has a follow-up question indicating distress or impaired functionality associated with that symptom ('Did this ever trouble you or cause problems at work or school, or with your family or other people'). To ensure a more stringent selection criteria, data were recoded into binary variables in which respondents endorsed both the symptom and associated distress/impaired functionality with said item (1) or did not (0).

Statistical Analysis

CFA and confirmatory bifactor modelling (CBM) were used to test 20 separate factor models, including both general and specific dimensions, based on previous theory. A unitary factor model was specified in which all 20 items loaded onto one single psychosis factor. For models encompassing 2 specific factors (positive, negative), four permutations were specified; i) a first order correlated traits model, ii) a first order uncorrelated traits model, iii) a bifactor model with orthogonal specific factors, iv) a bifactor model with oblique specific factors. For models encompassing 3 (positive, negative, mania), 4 (positive, negative, mania, disorganisation) and 5 (positive, negative, mania, disorganisation, depression) specific factors, five permutations were specified; i) a first order correlated traits model, ii) a first order uncorrelated traits model, iii) a second order model, iv) a bifactor model with

orthogonal specific factors, v) a bifactor model with oblique specific factors. The model specifications for the alternative models are summarised in table 1. To avoid capitalising on chance, the sample was randomly split in two; the 20 models were fit to the first half of the sample, and the best fitting model cross-validated using the second half of the sample.

<Insert table 1 here>

Models were specified and estimated using Mplus version 6.0 [58], using the robust weighted least squares (WLSMV) estimator based on the polychoric correlation matrix of latent continuous response variables. The WLSMV estimator is the most appropriate statistical treatment of categorical indicators in a CFA context [59, 60]. Goodness of fit for each model was assessed with a range of fit indices including the chi-square, the comparative fit index (CFI) [61], and the Tucker-Lewis Index (TLI) [62]. A non-significant $\chi 2$ and values greater than .90 for the CFI and TLI were considered to reflect acceptable model fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) [63] was reported, where a value less than .05 indicated close fit and values up to .08 indicated reasonable errors of approximation [64]. The Weighted Root Mean Square Residual (WRMR) was designed to be used when modelling categorical data and values less than 1 are indicative of acceptable model fit [65].

Results

The fit statistics of the competing models are reported in table 2. Uncorrelated first order models fit the data extremely poorly. Unitary, correlated first order and hierarchical models provided an acceptable approximation of the data, regardless of whether the models consisted of 2, 3, 4, or 5 specific factors. For these models, both the CFI and TLI values were above the acceptable cut-off point of 0.90.

<Insert table 2 here>

Overall, bifactor models consisting of a general factor and 2, 3, 4 or 5 specific factors provided excellent fit. Models consisting of a general factor and either 4 (positive, negative, disorganisation and mania) or 5 (positive, negative, disorganisation, mania, and depression) correlated specific (i.e. oblique) factors provided almost identical fit, and were the best fitting models overall. Although the 4-factor model was more parsimonious, the five factor model was preferred based on previous literature which has distinguished between negative and depressive psychotic factors [23-25]. This model was cross-validated in the second half of the sample (N= 17,327), and again the model provided excellent fit to the data (χ^2= 417.4; df= 177; CFI = 0.992; TLI = 0.990; RMSEA = 0.009; WRMR = 1.159).

<Insert fig 1 here>

Standardised factor loadings for the best model, fit to the second half of the data, are presented in table 3. Loadings were higher on the general psychosis factor compared with the specific factors for positive, disorganisation, and mania (with the exception of excitement). For the negative symptoms, blunted affect and emotional withdrawal loaded more strongly on the general factor, whereas motor retardation, disturbance of volition and active social withdrawal loaded more strongly on the specific negative factor. While each individual item loaded significantly onto the general factor, not all items loaded onto the specific factors. Grandiosity did not significantly load onto the positive dimension, while poor rapport and passive social withdrawal failed to load onto the negative dimension. Moreover, uncooperativeness did not significantly load onto the mania factor. Items reflecting the

depression dimension had stronger loadings on the specific depression factor compared with loadings on the general psychosis factor.

<Insert table 3 here>

Table 3 also provides the average variance extracted (AVE) for each factor in the best fitting model. The AVE was highest for the depression factor, followed by the disorganisation factor and the general psychosis factor. The AVE was lowest for the mania factor. Correlations between the specific factors are presented in table 4. Correlations were generally high, particularly for the depression and negative factors.

<Insert table 4 here>

Discussion

A better understanding of the latent structure of psychosis may ultimately lead to improvements in the assessment and treatment of those presenting with psychotic symptoms. With this in mind, the present study aimed to test a large range of competing factor analytic models of psychosis, including hierarchical, general and specific dimensions, using data from a large general population sample. Specifically, it was predicted that bifactor models would provide better fit than correlated traits (first order) or (second order) hierarchical models. Results indicated that bifactor models comprised of general and specific dimensions provided superior model fit to unidimensional, correlated traits and hierarchical models, regardless of the number of specific factors included in the model. As such, the main hypothesis was supported.

The best fitting factor structure in the present study consisted of a general psychosis factor and five specific factors of positive, negative, disorganisation, mania and depression.

Similar structures have been identified in previous factor analytic studies utilising clinical samples [27, 28]. Inspection of the AVE of each factor suggested that the specific factors explained a non-redundant amount of variance that was not explained by the general psychosis factor. As such, scores on both general and specific dimensions may be used to inform diagnostic and treatment decisions (see Reininghaus, Priebe and Bentall [25] for suggested guidelines).

It must be noted, however, that the correlation between the depression and negative factors was extremely high, raising the question of whether these factors collapse into a single factor in community samples. This issue may have arose due to the measures used to assess psychosis; the ratings on the PANSS and the OPCRIT system used in previous studies [27, 28] were informed by observation of the patients during the interviews, and hence sampled a broader range of information relevant to negative symptoms compared to the present study. Indeed, it could be argued that a number of items from the present study that were used as proxies for negative symptoms were affective in nature e.g. ('emotional withdrawal' was assessed using the question 'Have you often felt empty inside?'), likely accounting for the high correlation between the negative and depressive factors. These observations suggest that further research using measures specifically designed to assess distinct psychotic dimensions may be required to substantiate this model. However, it could also be argued that other factors that distinguish community and clinical samples will lead to clearer separation of the factors in the latter, for example antipsychotic medication which may produce a loss of hedonic functioning [66]; indeed antipychotics produce negative-type symptoms when taken by healthy volunteers [67].

Overall, the findings of the present study give further credence to the argument that the dementia praecox/affective psychosis differentiation is arbitrary. Indeed, the results of this study suggest that a transdiagnostic psychosis factor underlies the affective and non-

affective symptoms that are reflected in putatively distinct disorders such as schizophrenia and bipolar disorder. While this general psychosis factor appears relatively robust, the precise nature of this factor remains open to interpretation. Plausible interpretations of this factor require further research before they can be substantiated. One possible explanation is that the general psychosis factor reflects elements of aetiology (e.g. genetic vulnerability) that are shared amongst the psychotic disorders. Similar explanations have been put forward in other transdiagnostic studies of psychopathology. For example, recent epidemiological research has suggested that a single psychopathological factor may underlie and account for comorbidity between all psychiatric disorders [68, 69]. It has been speculated that this factor, dubbed *p,* may reflect a genetic predisposition to experience any and all psychiatric disorders, and that specific factors of psychopathology (broad domains of internalizing, externalizing and psychosis) may reflect non-shared environmental factors that ultimately differentiate between what we have traditionally viewed as distinct diagnoses [68, 69]. The findings of the present study could fit within this 'generalist genes/specialist environment' theoretical framework [70]. It is possible that the general psychosis factor reflects shared aetiological agents that put individuals at risk of experiencing any and all psychotic disorders, whereas the specific factors may be experience-dependent and lead to unique expressions of symptoms amongst individuals. The role of genetic influences in the development of psychosis, however, remains a hotly debated issue [10, 11]. In order to substantiate this hypothesis, further research would be required examining the specificity of the associations between genetic and environmental risk factors and the common and specific psychosis factors.

Alternatively, it is possible that the general psychosis factor could be capturing emotional and behavioural outcomes that are common facets of discrete psychotic disorders [46, 70]. In other words, all psychotic disorders are likely to result in psychological distress and impaired functionality (i.e. need for treatment), which may account for the variance

shared amongst these purportedly discrete disorders. This interpretation may be contradicted by the findings of Reininghaus, Priebe and Bentall [27], who found that patients with early onset psychotic disorders scored significantly higher on the general psychosis factor, whereas those with chronic disorders scored significantly higher on the specific factors. One would assume that if the general psychosis factor captures common elements of psychological distress and functional impairment, then patients with chronic psychoses would score higher on this dimension due to their greater need for treatment. Further research examining the association between general and specific dimensions of psychosis and treatment requirements would be required before this interpretation could be substantiated.

Whether a fully dimensional structural model of psychosis can be sustained is still debated [29, 30, 34]. The factor structure of psychotic symptoms in clinical and general population samples serves as a key argument of the continuum hypothesis; if a continuum exists, it is logical to assume that the psychotic symptoms would cluster together in similar ways at both the clinical and sub-clinical levels. Previous studies employing general population samples have identified 2, 3 and 4 factor structures that were analogous to the factors identified in clinical research [41 – 43, 45, 46]. The present study is the first to test a bifactor model in a general population sample. The factor structure identified in this study was broadly similar to that identified in the clinical samples [27, 28]. This suggests that psychotic symptoms tend to cluster together in similar ways at both clinical and subclinical levels. This adds further support to the hypothesis that psychosis reflects an extended phenotype, with clinically relevant psychoses such as schizophrenia representing the extreme upper end of a continuum that occurs naturally within the general population.

Strengths, limitations and future directions

The main strengths of the present study were the large, representative sample and the analytical approach adopted. Indeed, bifactor modelling allowed us not only to test whether a

general dimension underpinned psychosis, but also to directly compare the validity and utility of this general dimension with specific dimensions. The findings of the present study, however, should be considered in light of the following limitations. First, it must be noted that not all of the psychotic symptoms included in previous studies [27, 28] could be mapped onto items in the AUDADIS-IV. As such, a number of psychotic symptoms assessed in previous studies [27, 28] were excluded from the present analysis. Second, the analysis was cross-sectional, therefore it was not possible to assess the stability of this model within individuals over time. Third, replication of this model in diverse samples is required. Finally, these analyses did not control for common method bias, where shared variance among indicators of different dimensions may be attributable to the same measurement procedure rather than the latent variables of interest (see Maul [71] for discussion on the nature of method effects). However theoretically predictable associations between the general psychosis factor and clinical, neurocognitive, and social factors [27] would suggest that it's unlikely that the general factor is due entirely to method effects.

Conclusion

In conclusion the present study aimed to test the validity of a bifactor model of psychosis in a large, representative sample. The results indicated that bifactor models of psychosis provided superior model fit to unidimensional, correlated and second order models. The optimal model consisted of a general psychosis factor independent of five correlated specific factors; positive, negative, mania, depression and disorganisation. These findings are in line with previous studies which have found similar results in clinical samples [27, 28]. Taken together, these results support the idea of a psychosis continuum, as it appears that psychotic symptoms cluster together in similar patterns at both clinical and subclinical levels. The bifactor model of psychosis may be useful in informing clinical diagnoses and treatment plans.

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Supplementary Table 1. Items selected based on conceptual similarity to PANSS items used by Reininghaus et al. [25]

Factor	Item	Concept	Description
Positive	Section 10, Item 40	Delusions	Have you ever felt that you could make things happen just by making a wish or thinking
	Section 10, Item 53	Hallucinations	Have you often thought that objects or shadows are really people or animals, or that noises are actually people's voices
	Section 10, Item 14	Grandiosity	Have you often expected other people to do what you ask without question because of who you are
	Section 10, Item 50	Suspiciousness	Have felt suspicious of people, even if you have known them for a while
	Section 10, Item 38	Unusual thought content	Have you often had the feeling that things that have no special meaning to most people are really meant to give you a message
Negative	Section 10, Item 49	Blunted affect	Have you had trouble expressing your emotions and feelings
	Section 10, Item 33	Emotional withdrawal	Have you often felt empty inside
	Section 10, Item 16	Poor rapport	Have people complained to you that you don't listen to them or care about their feelings
	Section 10, Item 15	Passive social withdrawal	Have other people's problems or feelings failed to interest you
	Section 4, Item 3(A9)	Motor retardation	Moved/talked much more slowly than usual most days for 2+ weeks
	Section 4B, Item A7	Disturbance of volition	Often found it harder to make decisions
	Section 7, Item 3	Active social withdrawal	Had fear/avoidance of social situation due to fear of becoming speechless, having nothing to say or saying something foolish
Depression	Section 9, Item 33	Tension/anxiety	Found it difficult to stop being tense, nervous, or worried
	Section 4A, Item 3(A13)	Guilt	Felt guilty about things wouldn't normally feel guilty about 2+ weeks
	Section 4A, Item 3(A12)	Depression	Felt worthless most of the time for 2+ weeks

Mania	Section 5, Item 1	Excitement	Period of excitement/elation that seemed not normal self
	Section 10, Item 34	Hostility	Have you often had temper outbursts or gotten so angry that you lose control
	Section 10, Item 10	Uncooperativeness	Have you thought that you could ignore certain rules or social conventions when they get in your way
	Section 10, Item 28	Impulsivity	Have you often done things impulsively
Disorganisation	Section 10, Item 51	Conceptual disorganisation	Have people thought you have strange ideas
	Section 10, Item 52	Mannerisms and posturing	Have people thought you act strangely
	Section 10, Item 45	Conceptual disorganisation (2)	Have people thought you are odd, eccentric or strange

Table 1. Model specifications for the alternative models of psychosis

	Unitary Factor	First order, second order* and bifactor** models			
		2 factor	*3 factor*	*4 factor*	*5 factor*
Delusions	PSY	POS	POS	POS	POS
Hallucinations	PSY	POS	POS	POS	POS
Grandiosity	PSY	POS	POS	POS	POS
Suspiciousness	PSY	POS	POS	POS	POS
Unusual thought content	PSY	POS	POS	POS	POS
Blunted affect	PSY	NEG	NEG	NEG	NEG
Emotional withdrawal	PSY	NEG	NEG	NEG	NEG
Poor rapport	PSY	NEG	NEG	NEG	NEG
Passive social withdrawal	PSY	NEG	NEG	NEG	NEG
Motor retardation	PSY	NEG	NEG	NEG	NEG
Disturbance of volition	PSY	NEG	NEG	NEG	NEG
Active social withdrawal	PSY	NEG	NEG	NEG	NEG
Tension/anxiety	PSY	NEG	NEG	NEG	DEPR
Guilt	PSY	NEG	NEG	NEG	DEPR
Depression	PSY	NEG	NEG	NEG	DEPR
Excitement	PSY	POS	MAN	MAN	MAN
Hostility	PSY	POS	MAN	MAN	MAN
Uncooperativeness	PSY	POS	MAN	MAN	MAN
Impulsivity	PSY	POS	MAN	MAN	MAN
Conceptual disorganisation	PSY	NEG	NEG	DIS	DIS
Mannerisms and posturing	PSY	NEG	NEG	DIS	DIS
Conceptual disorganisation (2)	PSY	NEG	NEG	DIS	DIS

*For second order models, specific factors were explained by a higher order psychosis factor
** For bifactor models, each item also had a non-zero loading on a general psychosis factor (PSY) that was uncorrelated with specific factors

Table 2. Fit statistics of the CFA and bifactor models in first half of sample

Factors	Model	χ^2	*df*	CFI	TLI	RMSEA	WRMR
1	unitary	2672.858*	209	0.931	0.924	0.026	3.751
2	correlated	2537.522*	208	0.935	0.928	0.025	3.646
	uncorrelated	14778.662*	209	0.592	0.549	0.063	10.530
	bifactor orthogonal	790.076*	187	0.983	0.979	0.014	1.785
	bifactor oblique	535.156*	186	0.990	0.988	0.010	1.345
3	correlated	2538.428*	206	0.935	0.927	0.026	3.644
	uncorrelated	16091.871*	209	0.556	0.509	0.066	11.284
	bifactor orthogonal	796.691*	187	0.983	0.979	0.014	1.825
	bifactor oblique	520.216*	184	0.991	0.988	0.010	1.326
	second order	2538.431*	206	0.935	0.927	0.026	3.644
4	correlated	2175.656*	203	0.945	0.937	0.024	3.285
	uncorrelated	17243.569*	209	0.523	0.473	0.069	12.116
	bifactor orthogonal	688.078*	187	0.986	0.983	0.012	1.697
	bifactor oblique	358.122*	181	0.995	0.994	0.008	1.053
	second order	2142.621*	205	0.946	0.939	0.023	3.294
5	correlated	1715.270*	199	0.958	0.951	0.021	2.868
	uncorrelated	23397.312*	209	0.351	0.283	0.080	14.479
	bifactor orthogonal	1847.421*	187	0.954	0.943	0.023	2.996
	bifactor oblique	342.373*	177	0.995	0.994	0.007	1.024
	second order	2018.649*	204	0.949	0.942	0.023	3.194

Note. N = 17,327. * indicates statistical significance ($p<0.01$). χ^2 = Chi Square Goodness of Fit Statistic; *df* = Degrees of Freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA Root-Mean-Square Error of Approximation; WRMR= Weighted Root Mean Square Residual. Bifactor orthogonal = correlations between specific factors fixed to zero. Bifactor oblique = correlations between specific factors freely estimated.

Table 3. Standardised factor loadings, internal consistency and average variance extracted (AVE) for the general factor and correlated five specific factors in second half of sample

Item	General	Positive	Negative	Mania	Disorgan-isation	Depression
Delusions	0.721**	0.428**				
Hallucinations	0.710**	0.533**				
Grandiosity	0.731**	-0.040				
Suspiciousness	0.682**	0.473**				
Unusual thought	0.642**	0.504**				
Blunted affect	0.662**		0.303**			
Emotional withdrawal	0.654**		0.587**			
Poor rapport	0.786**		0.019			
Passive social withdrawal	0.836**		-0.013			
Motor retardation	0.193*		0.800**			
Disturbance of volition	0.292**		0.755**			
Active social withdrawal	0.370**		0.485**			
Excitement	0.293**			0.521**		
Hostility	0.674**			0.469**		
Uncooperativeness	0.720**			0.058		
Impulsivity	0.746**			0.301**		
Conceptual disorganisation (1)	0.707**				0.598**	
Mannerisms and posturing	0.693**				0.693**	
Conceptual disorganisation (2)	0.670**				0.531**	
Tension/anxiety	0.318**					0.669**
Guilt	0.276**					0.884**
Depression	0.262**					0.930**
AVE†	0.371	0.189	0.269	0.146	0.373	0.698

Note. N = 17,326; ** p <0.01; * p <0.05; † = average variance extracted.

Table 4. Correlations between specific psychosis factors

	Positive	Negative	Mania	Disorganisation	Depression
Positive		0.810	0.774	0.749	0.650
Negative			0.920	0.511	0.997
Mania				0.489	0.800
Disorganisation					0.408

Note. All correlations significant at $p<0.01$