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Dimensions of psychotic experiences among women in the general population

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Abstract

Full-information factor analysis of ordinal data was employed to determine the factorial structure of the responses of 31,822 adult Swedish women to the 20 "positive" psychotic experience items of the Community Assessment of Psychic Experiences (CAPE) questionnaire. Five separable but correlated trait dimensions were found, reflecting Paranoia, Grandiosity, Magical Thinking, Delusions, and Hallucinations. High scores on any dimension were associated with a higher probability of questionnaire-assessed lifetime major depressive episodes or generalized anxiety disorder, though Grandiosity was so only to a very small degree. Our results closely match previous findings among adolescents and young women, and demonstrate that psychotic experiences cannot be considered a single trait. *Copyright © 2013 John Wiley & Sons, Ltd.*

Introduction

The focus of psychosis-risk research has increasingly shifted to clinically significant sub-psychotic traits and symptoms, as newer questionnaires (e.g. Y-PARQ by Ord *et al.*, 2004) measure subclinical psychotic experiences (PEs) at the more severe or acute end of the spectrum, largely motivated by the clinical high-risk paradigm. These experiences are essentially the same as the symptoms of psychotic disorders, though they may be less intense or accompanied by less conviction. There has also been a new wave in theoretical development, and subsequent data analyses suggest that PEs form a continuum from normal variation in behaviour to full psychosis (Johns *et al.*, 2002; Shevlin *et al.*, 2007; van Os *et al.*, 2000), though there have been assertions to the contrary (Lenzenweger and Korfine, 1992). Such conceptualizations focus on the issue of whether there is a single latent dimension or a single latent class explaining the PEs.

However, there is a long history of finding the related concepts of psychosis-proneness or schizotypy to be multidimensional (Bentall *et al.*, 1989). Traits resembling the features of psychotic disorders have long been of interest as possible predictors of psychosis, and specific questionnaires of postulated psychosis-proneness or schizotypy have been carefully constructed since the 1970s, with the Wisconsin scales (Chapman *et al.*, 1976) having been the most widely employed. Constructed according to the best practices of classical psychometrics, they consist of items chosen, among other criteria, for their similar and comparatively high response rates to the individual items. The greatest discriminatory power (i.e. precision of measurement) is thus achieved in the average range of the supposed psychosis-proneness dimensions, though the phenomena of interest tend to be in the upper extreme. Nevertheless, though the severity of item content has been lower than in more recent PE questionnaires, the research in the dimensionality of

schizotypy and psychosis-proneness is likely to be informative to the PE concept.

The primary method for analysing dimensionality in psychosis-proneness and schizotypy research has been common factor analysis (CFA; e.g. Bentall *et al.*, 1989). However, traditional CFA is ill-suited for combining items of highly variable severity, as items may aggregate by endorsement rate (i.e. items with a high response rate forming a factor), rather than by underlying trait (Ferguson, 1941). These problems can fortunately be overcome by modern latent-trait psychometric methods. Rather than being treated as equally difficult, the items are modelled with intercept parameters in addition to factor loadings. When using large samples, latent factors thus allow a new level of precision for questionnaire measurement.

In order to examine the validity of the implicit one-dimensional assumption of the psychosis continuum, the present study examines whether separable latent dimensions of positive PEs can be identified in a general population sample with the Community Assessment of Psychic Experiences (CAPE; Konings *et al.*, 2006; Stefanis *et al.*, 2002), an instrument explicitly designed to probe clinically relevant PEs. If these PEs turn out to be multi-faceted and consist of partially independent sub-dimensions, it may be necessary to assess these subscales separately, as their usefulness in screening for actual psychosis liability may differ and be poorer as an aggregate. For convergent validation of psychopathological significance, identified PE dimensions are contrasted with self-reports of lifetime depression and generalized anxiety gathered on the same questionnaire.

Method

Instruments

The primary data were self-reports of PEs assessed with the 20 "positive" CAPE items (Stefanis *et al.*, 2002; questionnaire available at http://www.cape42.homestead.com/index.html) included in a larger questionnaire on women's health. The items were translated from English into Swedish and back-translated to verify correspondence with the original scale. Two independent professional translators did the back-translation and the consensus version was tested in a pilot study with 50 subjects. The positive symptoms of the CAPE questionnaire are a modified version of the Peters *et al.* Delusions Inventory (PDI; Peters *et al.*, 1999), which is based on the ninth edition of the Present State Examination (PSE; Wing *et al.*, 1974). Most of these items are prefaced with "Do you ever feel/hear/see/think …" e.g. "Do you ever hear voices talking to each other when you are alone?", the exceptions being "Do you believe in the power of witchcraft, voodoo or the occult?" and "Have your thoughts ever been so vivid that you were worried other people would hear them?": the time span assessed is thus an indeterminate one including the present or the entire lifetime. The CAPE scale has four symptom frequency levels for each item: "almost always," "often," "sometimes," and "never." The degree of distress associated with the experience was not included in the current study.

Some mental disorders were also addressed on the same questionnaire. Participants responded to a series of questions closely corresponding to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria for a major depressive episode (MDE) and generalized anxiety disorder (GAD). Due to the questionnaire response format, not all criteria were included, and MDE required both the Mood and Anhedonia symptoms to be reported rather than either of them.

Participants

The participants were Swedish women aged 41–61 (mean 51.4 years), who took part in 2003/2004 in the follow-up phase of the Scandinavian Women's Lifestyle and Health Cohort (Ekman *et al.*, 2006; questionnaires and study information available at http://ki.se/ki/jsp/polopoly.jsp?d=20051&l=en) 47,859 women were invited to complete a web-based questionnaire, and non-responders received a paper questionnaire. The overall response rate in the follow-up phase was 72%, with 34,415 returned questionnaires. At least partial responses to the CAPE items were available for 31,950 individuals, for a section-specific response rate of 67% of the original sample. Of these, 128 response sets (0.4%) with more than two CAPE items empty were considered unreliable and were removed, leaving 31,822 response sets.

The recruitment methods of the initial study have previously been described in detail (Kumle *et al.*, 2002). Briefly, 96,000 women from the Uppsala region were randomly selected from Central Population Registry and were invited in 1991/1992 to complete a questionnaire on health, contraception, and health-related behaviours; the total response rate in the initial study was 51.3%. The study protocol has been approved by the Ethical Committee at Karolinska Institutet and the Swedish Data Inspection Board.

Analysis

Response frequencies for the CAPE positive items are reported in Table 1. Endorsement of a particular item at

Table 1. Response frequencies of CAPE-42 "positive" items

Item	Never	Sometimes	Often	Almost always
Double meaning	56.74 %	41.05 %	1.93 %	0.28 %
Messages from television	86.83 %	12.65 %	0.35 %	0.17 %
False appearance	31.09 %	63.28 %	5.42 %	0.20 %
Being persecuted	95.66 %	3.99 %	0.25 %	0.10 %
Conspiracy	91.94 %	7.61 %	0.35 %	0.10 %
Being important	70.64 %	24.68 %	3.92 %	0.77 %
Being special	60.44 %	34.53 %	4.16 %	0.87 %
Telepathy	47.18 %	45.89 %	5.78 %	1.15 %
Influenced by devices	94.87 %	4.57 %	0.45 %	0.11 %
Voodoo	78.44 %	18.20 %	2.13 %	1.23 %
Odd looks	84.80 %	13.91 %	1.01 %	0.28 %
Thought withdrawal	93.56 %	5.95 %	0.43 %	0.06 %
Thought insertion	94.15 %	5.45 %	0.29 %	0.11 %
Thought broadcasting	95.36 %	4.35 %	0.25 %	0.04 %
Thought echo	94.18 %	5.47 %	0.30 %	0.05 %
External control	95.22 %	4.19 %	0.42 %	0.18 %
Verbal hallucinations	97.70 %	2.15 %	0.12 %	0.03 %
Voices conversing	99.45 %	0.48 %	0.05 %	0.02 %
Capgras syndrome	98.64 %	1.26 %	0.07 %	0.03 %
Visual hallucinations	95.80 %	3.74 %	0.35 %	0.12 %

any level varied from 0.5% for Voices Conversing and 1.4% for Capgras to over 50% for False Appearances and Telepathy. Responses to the more severe items were strongly correlated: only 17% of the respondents endorsed, at any level, any of the seven items with overall endorsement rates under 5%.

Full-information factor analyses of the original ordinal responses to the 20 CAPE items were carried out with the Mplus program version 6.11 (Muthén and Muthén, 2011). The model was computed separately for 1–7 dimensions with the Robust Maximum Likelihood algorithm. This algorithm uses all the available raw data rather than polychoric correlation matrices, and ignores missing responses instead of replacing them or deleting cases. For each item, three threshold parameters were estimated (corresponding to the steps between the four response alternatives) in addition to one loading parameter per factor. Adaptive Monte Carlo integration was used with 2187 integration points, iterating the Expectation-Maximation phase until the change in slope estimates was less than the default limit of 0.005. For each number of dimensions the analysis was run 20 times, with the best-fitting result retained, and the resulting factors were rotated with the OBLIMIN method. Models were compared using the Bayes Information Criterion (BIC).

MDE and GAD items were used to classify participants into four diagnostic groups based on lifetime presence of each syndrome. In addition, participants were classified as high-scorers on each factor separately if they were in the highest 5%.

Results

BIC scores for factorial models improved with increasing dimensions, despite the increasing number of parameters, though improvements were marginal beyond the four-dimensional solution. The found factorial structures in up to five dimensions were readily interpretable, and are reported in Table 2, with the six-factor model included for completeness. In the single-dimensional model, which accounted for 44.4% of the variance, all items had a loading over 0.50. In the two-dimensional model, the second dimension loaded almost exclusively on the two "Grandiosity" items. In three dimensions, a further "Magical Thinking" factor was separated from the main factor. In the four-dimensional solution, the main PE dimension split into "Paranoia" and "Delusions & Hallucinations." In five dimensions "Delusions" and "Hallucinations" were separated from each other, with 62.8 % of the variance explained.

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Table 2. OBLIMIN-rotated factor loadings of robust maximum likelihood (MLR) solutions, with factor correlations

	1-factor	2-factor		3-factor			4-factor				5-factor					6-factor					
Item	F1	F1	F2	F1	F2	F3	F1	F2	F3	F4	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5	F6
OBLIMIN-rotated factor loadings of robust maximum likelihood (MLR) solutions																					
Double meaning	**0.56**	**0.69**	−0.09	**0.73**	−0.01	−0.08	**0.85**	−0.02	0.03	−0.10	**0.74**	−0.03	0.05	0.12	−0.16	**0.77**	−0.01	0.08	0.04	−0.14	0.09
Messages from television	**0.51**	**0.43**	0.15	**0.49**	0.21	−0.13	**0.41**	0.23	0.05	−0.03	**0.37**	0.17	0.11	0.07	−0.07	0.27	0.16	0.04	0.06	−0.03	**0.39**
False appearance	**0.64**	**0.56**	0.16	**0.56**	0.20	0.01	**0.53**	0.24	0.07	0.01	**0.51**	0.20	0.16	0.13	−0.21	**0.44**	0.14	0.17	0.05	−0.05	0.28
Being persecuted	**0.72**	**0.83**	−0.14	**0.85**	−0.03	−0.09	**0.66**	−0.02	0.00	0.21	**0.73**	0.01	−0.02	−0.04	0.25	**0.70**	0.05	−0.04	0.02	0.24	−0.07
Conspiracy	**0.68**	**0.80**	−0.13	**0.84**	−0.01	−0.14	**0.74**	0.00	−0.03	0.10	**0.79**	0.03	−0.04	−0.02	0.13	**0.76**	0.03	−0.04	−0.01	0.16	−0.02
Being important	**0.51**	−0.02	**0.78**	−0.01	**0.89**	−0.05	−0.04	**0.87**	−0.05	0.05	−0.04	**0.91**	−0.07	0.02	0.01	−0.04	**0.87**	−0.08	−0.02	0.05	0.06
Being special	**0.58**	0.06	**0.80**	0.04	**0.70**	0.14	0.07	**0.72**	0.14	−0.02	0.07	**0.71**	0.14	−0.04	0.02	0.07	**0.77**	0.11	0.04	−0.07	−0.08
Telepathy	**0.59**	0.35	0.35	0.01	0.17	**0.72**	0.06	0.15	**0.72**	0.02	0.02	0.11	**0.75**	0.06	−0.06	0.00	0.11	**0.74**	0.06	−0.03	0.08
Influenced by devices	**0.63**	**0.46**	0.26	0.29	0.18	0.33	0.03	0.17	0.26	**0.37**	−0.01	0.13	0.32	**0.39**	−0.02	−0.05	0.10	0.33	0.23	0.13	0.29
Voodoo	**0.53**	**0.36**	0.24	−0.03	−0.02	**0.82**	0.06	−0.03	**0.79**	0.02	0.03	−0.06	**0.83**	−0.04	0.04	0.04	−0.05	**0.81**	−0.02	0.04	−0.05
Odd looks	**0.53**	**0.66**	−0.14	**0.64**	−0.10	0.01	**0.50**	−0.09	0.06	0.16	**0.48**	−0.10	0.08	0.17	0.02	**0.50**	−0.07	0.07	0.27	−0.08	−0.10
Thought withdrawal	**0.71**	**0.74**	−0.02	**0.74**	0.08	−0.07	0.12	0.07	−0.19	**0.77**	0.09	0.01	−0.10	**0.83**	−0.05	0.08	0.00	−0.10	**0.64**	0.11	0.25
Thought insertion	**0.75**	**0.74**	0.02	**0.68**	0.06	0.08	0.00	0.04	−0.09	**0.86**	−0.03	−0.02	0.01	**0.83**	0.05	−0.02	−0.02	−0.01	**0.72**	0.12	0.13
Thought broadcasting	**0.73**	**0.71**	0.05	**0.64**	0.07	0.10	0.08	0.05	−0.02	**0.70**	0.06	0.03	0.05	**0.62**	0.11	0.06	0.04	0.03	**0.76**	−0.04	−0.07
Thought echo	**0.74**	**0.71**	0.06	**0.63**	0.07	0.13	0.02	0.05	−0.02	**0.78**	0.01	0.02	0.06	**0.67**	0.13	0.01	0.04	0.03	**0.81**	−0.01	−0.09
External control	**0.77**	**0.65**	0.19	**0.50**	0.13	0.29	0.04	0.11	0.17	**0.62**	0.04	0.10	0.21	**0.45**	0.20	0.05	0.12	0.19	**0.50**	0.14	−0.09
Verbal hallucinations	**0.77**	**0.76**	0.03	**0.59**	−0.06	0.31	0.04	−0.07	0.15	**0.73**	0.09	0.01	0.08	0.14	**0.72**	0.08	−0.01	0.08	0.09	**0.77**	0.00
Voices conversing	**0.86**	**0.83**	0.04	**0.67**	−0.07	0.32	−0.01	−0.06	0.11	**0.86**	0.07	0.06	0.01	0.09	**0.87**	0.05	0.04	0.00	0.05	**0.91**	0.01
Capgras syndrome	**0.72**	**0.64**	0.12	**0.49**	0.06	0.28	0.00	0.03	0.15	**0.65**	0.03	0.07	0.15	0.32	**0.38**	0.03	0.07	0.13	0.34	**0.36**	−0.05
Visual hallucinations	**0.66**	**0.49**	0.26	0.17	0.03	**0.63**	−0.04	0.02	**0.52**	**0.36**	−0.02	0.04	**0.50**	0.02	**0.40**	−0.02	0.04	**0.49**	0.01	**0.42**	−0.04
Factor correlations of OBLIMIN-rotated factors																					
			F1	F2		F1	F2	F3		F1	F2	F3	F4		F1	F2	F3	F4	F5		F1	F2	F3	F4	F5
		F1	1		F1	1			F1	1				F1	1					F1	1				
		F2	0.48	1	F2	0.41	1		F2	0.35	1			F2	0.33	1				F2	0.32	1			
					F3	0.52	0.35	1	F3	0.31	0.33	1		F3	0.34	0.39	1			F3	0.32	0.41	1		
									F4	0.66	0.40	0.49	1	F4	0.61	0.42	0.43	1		F4	0.57	0.42	0.44	1	

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Table 3. Factor score means (*M* values) and standard deviations (SD values) by lifetime diagnosis group

	MDE	GAD	Both MDE and GAD	No MDE or GAD
	M (SD)	*M* (SD)	*M* (SD)	*M* (SD)
1. Paranoia	0.49 (1.17)	0.72 (1.18)	0.94 (1.24)	0.00 (1.00)
2. Grandiosity	0.08 (0.99)	0.25 (1.04)	0.14 (0.97)	0.00 (1.00)
3. Magical thinking	0.24 (1.08)	0.34 (1.15)	0.39 (1.08)	0.00 (1.00)
4. Delusions	0.40 (1.15)	0.70 (1.31)	0.86 (1.34)	0.00 (1.00)
5. Hallucinations	0.38 (1.23)	0.56 (1.31)	0.75 (1.46)	0.00 (1.00)
N (%)	6343 (19.9%)	375 (1.2%)	929 (2.9%)	24175 (76.0%)

Each diagnostic group's scores on the five factors were standardized using the means and standard– deviations of the group without MDE or GAD, and are reported in Table 3. The *p*-values for the differences between the reference group and each disorder group in a two-way Dunnett's *t*-test were all below 0.0001.

The odds ratios for the top 5% high-scorers having either disorder were 4.1 [95% confidence interval (CI) 3.7–4.6] for Paranoia, 1.2 (95% CI 1.1–1.3) for Grandiosity, 2.0 (95% CI 1.8–2.2) for Magical Thinking, 2.8 (95% CI 2.5–3.1) for Delusions, and 2.4 (95% CI 2.1–2.6) for Hallucinations.

Discussion

We found the PEs corresponding to positive psychotic symptoms to be readily interpretable as five independent dimensions. Earlier studies of the dimensionality of schizotypy or psychosis-proneness have consistently found a three- or four-dimensional structure (e.g. Claridge *et al.*, 1996) when an even larger variety of symptoms or traits are included. In these models, the positive and negative symptoms are separable from a third dimension, defined as disorganization, paranoia, or depression, depending on scale content, and sometimes a fourth, such as impulsive non-conformity. The previously found number of factors might be an artefact of the analysis method and an arbitrary selection of the number of factors. A similar finding of multifactorial subdivision and an associated argument regarding artefactual findings has been forwarded within the literature of schizophrenia symptoms, where a subdivision of the positive symptom dimension into as many as 11 subdimensions may provide a better fit to the data (Stuart *et al.*, 1999). Note that the CAPE lacks items addressing disorganization; these symptoms are usually found to be most closely associated with, but separable from, the other positive symptoms (Reynolds *et al.*, 2000).

Our results were somewhat similar to those of Brenner *et al.* (2007), who used the full CAPE-42 and found that unidimensionality could not be confirmed for the original positive and negative symptom scales in a general population sample. They tested exploratory Maximum Likelihood solutions and obtained marginally improved fit indices with a five-factor solution, which essentially subdivided the positive scale into three factors referred to as "Positive-bizarre", "Social Delusions", and "Popular Psychic Beliefs". Our study further subdivided their Positive-bizarre factor into Hallucinations and Delusions, and their Social Delusions factor into Paranoia and Grandiosity. The focus on positive symptoms and the large number of respondents is likely to account for the greater detail in the present results.

Other studies have analysed specifically the positive items of the CAPE. Barragan *et al.* (2011) reported a four-dimensional principal component structure of the positive items in a community sample of 777 adolescents. Unfortunately they did not report their criteria for choosing four components, but the structure was very close to our four-dimensional model. The differences were that their Hallucinatory Experiences included what we labelled Magical Thinking, and they found a component consisting of the items Messages from the television and Influenced by Devices. Note that their analysis treated the frequency categories as a linear scale, did not allow for correlated factors, and did not take measurement error into account, which explains some of the discrepancy. A study of 875 adolescents (Yung *et al.*, 2009) employed linear factor analysis of the frequency categories, with oblique rotation, and the four-dimensional model was selected based on a Monte-Carlo simulation. Their model was very similar to ours, but combined our two Grandiosity items in Magical Thinking, had the Capgras item loading most strongly on Paranoia, and associated the Visual Hallucinations item

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primarily with Hallucinations. Another study using exactly the same methods as Yung *et al.* (2009) in a school and student sample with 1777 respondents (Armando *et al.*, 2010) presented a model almost identical to our five-dimensional solution, but it lacked Magical Thinking – of which two items were left out of the analyses, based on the previous results – and Messages from the television was associated with the Delusions dimension.

The methodologically strongest and also largest previous studies of the positive items of the CAPE, however, are those by Wigman *et al.* (2011, 2012). Using fit indices to determine the optimal number of dimensions, they found a five-dimensional structure in a general population sample of 7652 adolescents, and verified it in a confirmatory analysis of 2230 adolescents' responses. This model, which was further tested at three time points among 283 young female twin pairs, showed a comparative fit index (CFI) of 0.96, 0.96, and 0.99 over the three measurements at six-month intervals, indicating an excellent fit. Their model differed from ours in grouping Messages from the television with Delusions, and the Capgras and Visual Hallucinations items with Delusions and Hallucinations, respectively. The latter discrepancies are largely accounted for by the strong cross loadings in our data on these items; Wigman *et al.* (2011, 2012) do not report cross loadings in their explorative model, but their factor correlations are 0.80 and 0.87 in the relevant dimension pairs. All previous studies have investigated adolescents and young adults, while our study sample consisted of middle-aged women. Therefore, the consistency of the factor structure of CAPE is very encouraging.

Lifetime presence of MDE and GAD was measured in order to partially assess the clinical significance of the identified dimensions. The GAD lifetime prevalence was similar to that observed in large epidemiological surveys using structured interviews (Lee *et al.*, 2009), but the MDE lifetime prevalence was somewhat small for women of this age group (Bromet *et al.*, 2011). This may be explained by the fact that both depressive mood and anhedonia were required in the diagnostic algorithm. Participants with MDE or GAD had higher scores on the five dimensions, and the top scorers on each dimension had a higher probability of having had one of the syndromes. These associations were not, however, equal across dimensions. In particular, scores on the Grandiosity dimension were only slightly increased among the disorder groups, and those reporting the two primary Grandiosity experiences had only a very slightly increased risk for the assessed mental disorders. These findings parallel those of Yung *et al.* (2009), who found depression scores among community adolescents to be least associated with their factor corresponding to our Grandiosity and Magical Thinking.

Our study does not support the notion of a single continuum from mild positive PEs to positive psychotic symptoms. Specifically, the present results raise doubts about the usefulness of using PE questionnaires as single summary measures. For instance, the Grandiosity factor in the present study, reflecting two items that could be separated from the others in all multidimensional models, appeared to probe primarily non-pathological experiences, as 46.8% of the respondents endorsed at least one of them to some degree, and strong endorsement was only negligibly associated with self-reported MDE or GAD – perhaps reflecting only general response tendency. In addition, the highly varying endorsement rates of the items, reflecting varying psychopathological severity of the content, show that simply summing item scores will lose much relevant information, and increase the relative contribution of measurement noise.

Impact of sample characteristics and questionnaire presentation

Though drawn from the general population, the sample of the present study was unusual, in consisting only of women over the age of 41. The very low endorsement rates of some items are likely to reflect not only the severity of the probed symptoms, but the age of the sample; self-reported psychotic-like experiences decline markedly between ages 20 and 40 (Rössler *et al.*, 2007). It is unclear whether this reflects true variation, or understanding of the items increasing with age and therefore less false positives. To our knowledge, gender effects on the structure of psychosis-proneness have not been reported, and our results can tentatively be generalized to men.

As the current sample was drawn from the general population, it is likely to contain also people with schizophrenia and other psychotic disorders, for which the sum prevalence among women of this age group are about 3% (Perälä *et al.*, 2007). For the items with the lowest endorsement rates, these individuals may have a significant impact on the factor structure. However, as inclusion required responding to two lengthy questionnaires, individuals with psychotic disorders are likely to be under-represented. Further studies are needed to assess whether the factor structure is affected by the exclusion of groups with current or previous psychotic illness.

Finally, the questionnaire has been constructed with the items in approximately increasing order of *a priori* severity, but the respondent's understanding of what

domain is being probed may also improve as they go along. Specifically, as the probed experiences are infrequent, understanding their general severity level is likely to lead to less false positives in the later parts of the questionnaire. Therefore, item ordering effects may be confounding the item difficulty estimates. The current factor analyses, however, by modelling item difficulty, minimize the effect of item ordering on the factor structure.

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Declaration of interest statement

The authors have no competing interests.

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