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The cross-national structure of mental disorders: results from the World Mental Health Surveys

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Abstract

Background. The patterns of comorbidity among mental disorders have led researchers to model the underlying structure of psychopathology. While studies have suggested a structure including internalizing and externalizing disorders, less is known with regard to the cross-national stability of this model. Moreover, little data are available on the placement of eating disorders, bipolar disorder and psychotic experiences (PEs) in this structure.

Methods. We evaluated the structure of mental disorders with data from the World Health Organization Composite International Diagnostic Interview, including 15 lifetime mental disorders and six PEs. Respondents ($n = 5478–15\,499$) were included from 10 high-, middle- and lower middle-income countries across the world aged 18 years or older. Confirmatory factor analyses (CFAs) were used to evaluate and compare the fit of different factor structures to the lifetime disorder data. Measurement invariance was evaluated with multigroup CFA (MG-CFA).

Results. A second-order model with internalizing and externalizing factors and fear and distress subfactors best described the structure of common mental disorders. MG-CFA showed that this model was stable across countries. Of the uncommon disorders, bipolar disorder and eating disorder were best grouped with the internalizing factor, and PEs with a separate factor.

Conclusions. These results indicate that cross-national patterns of lifetime common mental-disorder comorbidity can be explained with a second-order underlying structure that is stable across countries and can be extended to also cover less common mental disorders.

Introduction

Comorbidity among mental disorders is common (e.g. Kessler *et al.* 1994; Bijl *et al.* 1998; Teesson *et al.* 2009; Hasin & Kilcoyne, 2012) and has been hypothesized to reflect the latent general structure of psychopathology (Sher & Trull, 1996; Mineka *et al.* 1998; Widiger & Clark,

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2000; Carragher *et al.* 2015). Much scientific work has focused on gaining a better understanding of this 'meta structure' of mental disorders (e.g. Mineka *et al.* 1998; Krueger & Markon, 2006; Carragher *et al.* 2015; Eaton *et al.* 2015; Kotov *et al.* 2017) and has shown that the structure of common mental disorders can be explained by two broad underlying domains: *internalizing* and *externalizing* (Krueger *et al.* 1998; Krueger, 1999; Krueger & Markon, 2006). Depressive disorders and anxiety disorders load on the internalizing factor and conduct disorder (CD), substance-related disorders and antisocial problems load on the externalizing factor.

The existence of separate, but correlated, internalizing, and externalizing domains has been confirmed repeatedly in empirical studies. However, the structure is likely to be more complex and multiple underlying subdomains are likely to exist. For instance, the internalizing domain has been consistently shown to have at least two lower order subfactors that explain the more specific clustering of, respectively, 'fear' (panic disorder, agoraphobia, specific phobia, social phobia, and obsessive–compulsive disorder) and 'distress' disorders [major depressive episode (MDE), dysthymia, generalized anxiety disorder (GAD), and post-traumatic stress disorder (PTSD) e.g. Krueger *et al.* 1998; Krueger, 1999; Vollebergh *et al.* 2001; Watson, 2005; Krueger & Markon, 2006; Slade & Watson, 2006; Eaton *et al.* 2013*a*; Kotov *et al.* 2017]. For externalizing disorders, subfactors have been found that explain additional clustering of disorders that are either characterized by 'norm-violations' (CD, substance-use disorders) or by 'oppositional behavior' [oppositional-defiant disorder (ODD), attention-deficit hyperactivity disorder (ADHD); Farmer *et al.* 2009]. It has also been suggested that there may be aggression-related and substance-related subfactors (Krueger *et al.* 2007). Overall, the findings on the subfactor structure of the externalizing domain have so far been less consistent than for the internalizing domain (e.g. Krueger *et al.* 2005; Markon & Krueger, 2005; Vrieze *et al.* 2012).

Despite ongoing discussions about the best lower order structure, the higher order, two-factor model has been found to be very robust and is considered to reflect the natural structure of common mental disorders (Krueger, 1999; Watson, 2005; Krueger & Markon, 2006; Kotov *et al.* 2011*a*, *b*; Carragher *et al.* 2015; Kotov *et al.* 2017). Various studies have supported this idea. For instance, variations on the internalizing and externalizing domains have been found to be linked to variations on distinct genetic risk factors (Kendler *et al.* 2011; Lahey *et al.* 2017). In addition, the internalizing and externalizing domains have been shown to account for a large part of comorbidity patterns that are observed over a patients' lifetime: the association of disorders with subsequent onset was found to be stronger within each domain than between domains (Kessler *et al.* 2011*a*, *b*, *c*). However, disorders from each of the separate domains have also been shown to predict each other over time (Lahey *et al.* 2017). Structural studies that investigated psychopathology together with personality disorders have shown that the joint latent structure can be described with a finite number of dimensions, including internalizing and externalizing dimensions (Markon, 2010; Røysamb *et al.* 2010; Kendler *et al.* 2011; Kotov *et al.* 2011*a*, *b*; South & Jarnecke, 2017). The two-factor structure has been shown to be structurally invariant across ethnic groups in the US (Eaton *et al.* 2013*b*), gender (Hicks *et al.* 2007; Kramer *et al.* 2007; Eaton *et al.* 2012) and over time (e.g. Vollebergh *et al.* 2001; Eaton *et al.* 2011).

Despite the many insights that have been gained from the above described research, important research questions still remain unsatisfactorily answered. The current study aims to address the following of these questions: (1) how stable is the cross-national structure of common mental disorders and (2) where do uncommon mental disorders fit into the structure?

The first question deals with what has been referred to as 'structural validity'. Establishing the structural validity of the model of mental disorders is very important as this stability across countries determines to what extent factors and (mean) factor scores can be validly compared across countries when conducting mental health research. Therefore, more insight must be gained into cross-national measurement invariance of the latent structure of common mental disorders. Currently, there is little available research on this. Although the same general latent structure has been replicated in different countries (e.g. Australia: Slade & Watson, 2006; the Netherlands: Vollebergh *et al.* 2001; Norway: Røysamb *et al.* 2010), most of this work is from Western countries. Krueger *et al.* (2003) conducted the only cross-national study of the latent structure of mental disorders with data from the WHO Collaborative Study of Psychological Problems in General Health Care, which were collected in 15 countries around the world (Brazil, Chile, China, France, Germany, Greece, India, Italy, Japan, the Netherlands, New Zealand, Nigeria, Turkey, the UK, and the US). They showed that two factors (internalizing *v.* alcohol problems) described the structure best in the cross-national and most of the country datasets. Formal evaluations of measurement invariance showed that the model had *configural invariance* and *metric invariance* (invariant factor loadings across countries) across countries, indicating that the factor-loading configuration was invariant but that factor means and residual variances could vary across countries. Unfortunately, this study included only one externalizing disorder ('hazardous use of alcohol'), prohibiting a thorough investigation of the structural stability of the full externalizing domain. In the current cross-national study, the stability of a model based on a broader range of disorders could be investigated.

The optimal placement of many less common mental disorders into the two-factor model has remained unclear, partly due to the limited availability of datasets that include these less common disorders. Fortunately, more recent, large epidemiological datasets have enabled researchers to extend the original two-factor model by including additional disorders. These studies have shown that psychotic experiences (PEs) have been found to load on a separate factor ('thought disorders' or 'psychosis'; Markon, 2010; Kotov *et al.* 2011*a*, *b*; Keyes *et al.* 2013; Wright *et al.* 2013; Kotov *et al.* 2017). Bipolar disorders have been found to load on this 'thought disorders' factor as well (Kotov *et al.* 2011*a*, *b*), but others have found a 'bipolar/mania' subfactor of the internalizing domain (Forbush & Watson, 2013; Kotov *et al.* 2015) or have found bipolar disorder to cross-load on the fear and distress subfactors (Eaton *et al.* 2013*a*), making it unclear whether bipolar disorder belongs with the internalizing disorders, the thought disorders or both (Kotov *et al.* 2017). Eating disorders have been found to group with the internalizing disorders, more specifically, as a subfactor of the internalizing domain (Forbush *et al.* 2010; Forbush & Watson, 2013). Taken together, research on uncommon disorder placement has been comparatively scarce and the results rather inconsistent. This could reflect the multifactorial nature of the studied uncommon disorders, but could also be explained by methodological differences (e.g. the kind and number of included symptoms/disorders) which brings us to a more nuanced notion of common and uncommon disorders: some of the common disorders have rather low prevalence (e.g. panic disorder) while some of the uncommon disorders are in

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fact more prevalent (e.g. eating disorder). This has a lot to do with methodological differences in their grouping but also in exclusion of subthreshold variants of a disorder (e.g. PEs *v.* schizophrenia). Although not perfect, we will use the term uncommon disorders in the present study to describe eating disorders, bipolar disorder and PEs. Both from an etiological and clinical perspective, it would be very useful to find out much more about the placement of these disorders into the latent structure, as this could provide very interesting clues about the nature and the extent of overlap between vulnerabilities for common and uncommon, but very severe, disorders (Kotov *et al.* 2017). To gain a more systematic and complete insight into this, more research is needed using samples, in which all common but also (several) uncommon disorders were systematically assessed. Such datasets were available for the current study.

Given the above described need for further research, the current study aimed to investigate (1) the latent structure of common mental disorders and its measurement invariance across countries, and (2) the placement of uncommon disorders into the latent structure. Data came from the World Mental Health (WMH) Surveys, which were conducted in several countries around the world and included a comprehensive assessment of both common internalizing and externalizing disorders [e.g. ADHD, CD, ODD, and intermittent explosive disorder (IED), substance abuse and dependence] and less common disorders. More specifically, a range of models, based on the previous literature was tested to evaluate the optimal placement of (1) eating disorders, (2) bipolar disorder and (3) PEs in the model.

Methods

WMH Surveys

Data came from the WMH Surveys. The WHO Composite International Diagnostic Interview (CIDI) version 3.0 was administered in 29 WMH surveys across the world (Table 1). Most surveys used stratified multistage clustered area probability household sampling with no substitution for non-participants. Data collection took place between 2001 and 2012, and response rates ranged from 45.9 to 97.2%, with an average of 69.5%. Classification of country income categories was based on the World Bank criteria at the time of each survey (The World Bank, 2009). All WMH surveys were conducted face-to-face by lay interviewers who had received standardized training. Standardized translation, back-translation, harmonization and quality control procedures were applied in all of the participating survey sites (Pennell *et al.* 2008). Informed consent was obtained according to protocols endorsed by local Institutional Review Boards.

The CIDI was divided into two parts, with part I assessing core mental disorders and part II additional disorders and correlates. Part I was completed by all subjects and part II was administered to all subjects meeting criteria for any of the part I disorders and a probability subsample of the other subjects. To adjust for differential sampling, all responses in the part II subsample were weighted by the inverse of their probability of selection into the part II sample.

Mental disorders

Analyses were conducted with lifetime CIDI/DSM-IV diagnoses (present/absent), without hierarchy rules. The following common mental disorders were included: MDE, dysthymia, panic disorder, agoraphobia, social phobia, specific phobia, GAD, PTSD, ADHD, ODD, alcohol abuse, drug abuse, CD, and IED. The prevalence rates of these disorders in the different countries have been described previously (see Supplementary 1 for disorder-specific references). Alcohol and drug abuse were combined into a single substance-abuse variable (with or without substance dependence). Bipolar-i, bipolar-ii, and subthreshold bipolar disorder were assessed with the CIDI and were combined into a single bipolar disorder variable (present/absent). In the eating disorders dataset, bulimia and binge-eating disorder were assessed in all part II subjects in Romania, Brazil, and Poland and in a random part of part-II subjects in the other countries. combined into a single eating-disorder variable (anorexia nervosa was not included due to very low prevalence). The assessed PEs included hallucinations (visual and auditory) and delusions [insertion/withdrawal of thoughts, mind control by some strange force, ideas of reference (e.g. telepathy), plot to harm you/people following you]. In this dataset, PEs were assessed in all part II subjects in Brazil and Romania, and in a random part of the part II sample in the other countries. The six assessed PEs were used as individual input variables in the confirmatory factor analyses (CFAs).

Samples

To enable inclusion of as much disorders as possible, all current analyses were run in subjects in the part II sample within the age range of 18–44 years because most externalizing disorders (e.g. ADHD) were only assessed in these subjects to limit recall bias. Bipolar disorder, eating disorders and PEs were only assessed in subsamples. Therefore, models including these respective disorders were estimated in the subsets of countries, in which they were assessed.

The subsample that was used to investigate the structure of all common mental disorders included 10 samples from nine countries (Brazil, Colombia, Colombia-Medellin, Mexico, Murcia, North-Ireland, Peru, Poland, Romania, US; $n = 15\,499$). This dataset was also used to investigate the optimal placement of bipolar disorder. The additional placement of IED into the model was investigated in a subsample where IED was assessed (Brazil, Colombia, North-Ireland, Peru, Poland, Romania, US; $n = 12\,162$). The placement of eating disorders was investigated in a subsample ($n = 10\,585$) that included all subjects that were assessed for eating disorders with the CIDI. In Romania, Brazil, and Poland, eating disorders were assessed in all part II subjects. In the other countries, eating disorders were assessed in a random part of part-II subjects. The placement of PEs was investigated in a subsample of six countries, in which they were assessed in addition to common mental disorders and bipolar disorder (Brazil, Colombia, Mexico, Peru, Romania, US; $n = 5478$). In each of these countries, PEs were assessed in a random subsample and only those who had completed the psychosis section were included.

Analyses

Hypothesized models from the literature were fit to the WMH surveys data using CFAs. Multigroup-CFA (MG-CFA) was used to investigate structural invariance across countries. All CFAs were conducted with Mplus 7 (Muthén & Muthén, 1998–2012), using a mean and variance adjusted weighted least squares estimator. All CFAs were run using the Mplus procedures for

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Table 1. WMH sample characteristics by World Bank income categories[a]

Country by income category	Survey[b]	Sample characteristics[c]	Field dates	Age range	Sample size		Part II aged 18–44	Response rate[d]
					Part I	Part II		
I. Low- and lower middle-income countries								
Colombia	NSMH	All urban areas of the country (approximately 73% of the total national population)	2003	18–65	4426	2381	1731	87.7
Peru	EMSMP	Five urban areas of the country (approximately 38% of the total national population)	2004–5	18–65	3930	1801	1287	90.2
Total					(8356)	(4182)	(3018)	88.9
II. Upper middle-income countries								
Brazil – São Paulo	São Paulo Megacity	São Paulo metropolitan area.	2005–8	18–93	5037	2942	1824	81.3
Colombia – Medellin[e]	MMHHS	Medellin metropolitan area	2011–12	19–65	3261	1673	970	97.2
Mexico	M-NCS	All urban areas of the country (approximately 75% of the total national population)	2001–2	18–65	5782	2362	1736	76.6
Romania	RMHS	Nationally representative	2005–6	18–96	2357	2357	940	70.9
Total					(16 437)	(9334)	(5470)	80.5
III. High-income countries								
N. Ireland	NISHS	Nationally representative	2005–8	18–97	4340	1986	907	68.4
Poland	EZOP	Nationally representative	2010–11	18–65	10 081	4000	2276	50.4
Spain – Murcia	PEGASUS – Murcia	Murcia region	2010–12	18–96	2621	1459	631	67.4
United States	NCS-R	Nationally representative	2001–3	18–99	9282	5692	3197	70.9
Total					(26 324)	(13 137)	(7011)	60.8
TOTAL N					(51 117)	(26 653)	(15 499)	69.9

[a]The World Bank (2012) Data. Accessed 12 May 2012 at: http://data.worldbank.org/country. Some of the WMH countries have moved into new income categories since the surveys were conducted. The income groupings above reflect the status of each country at the time of data collection. The current income category of each country is available at the preceding URL.

[b]NSMH (The Colombian National Study of Mental Health); EMSMP (La Encuesta Mundial de Salud Mental en el Peru); MMHHS (Medellín Mental Health Household Study); M-NCS (The Mexico National Comorbidity Survey); RMHS (Romania Mental Health Survey); NISHS (Northern Ireland Study of Health and Stress); EZOP (Epidemiology of Mental Disorders and Access to Care Survey); PEGASUS-Murcia (Psychiatric Enquiry to General Population in Southeast Spain-Murcia); NCS-R (The US National Comorbidity Survey Replication).

[c]Most WMH surveys are based on stratified multistage clustered area probability household samples in which samples of areas equivalent to counties or municipalities in the US were selected in the first stage followed by one or more subsequent stages of geographic sampling (e.g. towns within counties, blocks within towns, households within blocks) to arrive at a sample of households, in each of which a listing of household members was created and one or two people were selected from this listing to be interviewed. No substitution was allowed when the originally sampled household resident could not be interviewed. Several WMH surveys (Poland, Spain-Murcia) used country resident or universal health-care registries to select respondents without listing households. Four of the 10 surveys are based on nationally representative samples.

[d]The response rate is calculated as the ratio of the number of households in which an interview was completed to the number of households originally sampled, excluding from the denominator households known not to be eligible either because of being vacant at the time of initial contact or because the residents were unable to speak the designated languages of the survey. The weighted average response rate is 69.9%.

[e]Colombia moved from the "lower and lower middle income" to the "upper middle income" category between 2003 (when the Colombian National Study of Mental Health was conducted) and 2010 (when the Medellin Mental Health Household Study was conducted), hence Colombia's appearance in both income categories. For more information, please see footnote *a*.

complex designs and included WMH surveys design variables (clusters and strata) to account for effects of the complex design (Asparouhov, 2005) and weights to adjust for differential probabilities of selection and discrepancies with census data (see Heeringa *et al.* 2008 for more info on sampling weights and design variables in WMH). The comparative fit index (CFI) and the root mean square error of approximation (RMSEA) were used to evaluate model fit, with a CFI $\geqslant$ 0.95 and an RMSEA $\leqslant$ 0.06 indicating good fit to the data (Hu & Bentler, 1999).

In the MG-CFAs, the model with the best cross-national fit was estimated with increasing levels of invariance across countries: *configural invariance* (similar patterns of factor loadings and item thresholds; loadings and thresholds may differ across countries), *partial invariance* (constrained factor loadings across countries, freely estimated item thresholds in each country), and *scalar invariance* (factor loadings and item thresholds constrained across countries). The difference in CFI between models with different levels of invariance (ΔCFI) was used to compare models with different levels of measurement invariance. A difference of $\geqslant$0.01 has previously been suggested to indicate a meaningful difference when comparing two groups (Cheung & Rensvold, 2002).

Results

Bivariate associations

Table 2 shows the tetrachoric correlations between the lifetime disorders. The highest correlations among common disorders were observed between MDE and dysthymia (0.82), ODD and CD (0.71), MDE and GAD (0.65), GAD and PTSD (0.65), ADHD and ODD (0.65), and dysthymia and GAD (0.61). In addition, high correlations were observed between several of the PEs. The lowest correlations among common disorders were observed for agoraphobia with CD (0.24) and agoraphobia with substance abuse (0.19), eating disorder with CD (0.21), and specific phobia with substance abuse. In addition, lower correlations were observed between many of the PEs and other disorders.

Structural model of the common mental disorders

A simple two-factor model and a higher order model with distress and fear subfactors were estimated (Fig. 1*a*; Table 3). Of these models, the higher order model showed the best fit to the data (CFI = 0.985; RMSEA = 0.017), in line with a large body of previous work (Krueger *et al.* 1998; Krueger, 1999; Vollebergh *et al.* 2001; Watson, 2005; Krueger & Markon, 2006; Slade & Watson, 2006; Eaton *et al.* 2013*a*; Kotov *et al.* 2017). In this model, all disorders showed considerable standardized loadings on their respective factors, the fear and distress factors showed considerable loadings on the second-order internalizing factor and the correlation between the second-order internalizing and externalizing factors was 0.61. Similar results were found when the analyses were run in a subset of countries that also assessed IED.

Structural validity

The invariance of the model of common mental disorders (minus IED) across countries was tested with MG-CFA using country as the group variable. When fitted to the individual samples, good fit of the model was observed in Brazil (CFI = 0.969; RMSEA = 0.017), Colombia (CFI = 0.975; RMSEA = 0.015), Colombia-Medellin (CFA = 0.976; RMSEA = 0.022), Mexico (CFI = 0.982; RMSEA = 0.016), and the US (CFI = 0.98; RMSEA = 0.022). In the remaining countries (North Ireland, Murcia, Poland, Romania, and Peru), model fitting was complicated by correlations close to 0 (or negative) in the disorder correlation matrix (mostly due to low frequencies of one or more disorders), which led to parameter estimates that were hard to interpret. Subsequent measurement-invariance analyses were therefore conducted with the first five samples from four countries. The results (Table 4) showed that the model with configural invariance across the five samples fit the data well (CFI = 0.978; RMSEA = 0.019). Constraining the first-order and second-order factor loadings led to a small decrease in fit (CFI = 0.976; RMSEA = 0.018). Constraining all first- and second-order factor loadings and all item thresholds to be the same across samples (scalar invariance) led to a larger decrease in fit (CFI = 0.962; RMSEA = 0.021; ΔCFI = 0.016). The decrease in CFI from the configural model to the model with constrained factor loadings (ΔCFI = 0.002) indicated that partial invariance did hold across the five samples. The decrease in CFI from the configural model to the scalar model (ΔCFI = 0.016) indicated that the model did not have scalar invariance across the five samples.

Structural model of common disorders and bipolar disorders

The placement of bipolar disorder in the higher order model was investigated next (Table 3). Different ways of grouping bipolar disorder with the internalizing factor all led to better fit than grouping it with the externalizing domain. Models with bipolar disorder loading separately on the second-order internalizing factor alongside the distress and fear subfactors [in line with Forbush & Watson (2013) and Kotov *et al.*(2015)] showed slightly better fit (CFI = 0.982; RMSEA = 0.017) than a configuration with bipolar disorder loading on either the fear or distress subfactors, or bipolar disorder cross-loading on the fear and distress subfactors [as found by Eaton *et al.* (2013*a*, *b*); CFI = 0.980; RMSEA = 0.018], but the difference in model fit was very small, suggesting that bipolar disorder can be grouped with the internalizing domain.

Structural model of common disorders and eating disorders

The placement of eating disorders in the higher order model was investigated next. In line with previous work (Forbush *et al.* 2010; Forbush & Watson, 2013), placing eating disorders as a subdomain under the internalizing domain led to better fit than grouping eating disorders with the externalizing domain. However, unlike previously found, a model with eating disorders loading directly on the internalizing factor (i.e. as a separate internalizing subdomain) alongside the distress and fear subfactors was not the best-fitting solution. A model with eating disorders loading on the distress and/or on the fear subfactor(s) showed better fit. However, fit was very similar across the latter models (all RMSEA = 0.015) making it hard to draw definite conclusions about the best subfactor grouping of eating disorders (see Fig. 1*b* for an illustration of the model with eating disorders loading on the distress subfactor).

Structural model of common disorders and PEs

A model with all PEs loading on a separate factor alongside the internalizing and externalizing factors fit the data well (Table 3; CFI = 0.972; RMSEA = 0.015) and a higher order model with a

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Table 2. Tetrachoric correlations of lifetime common mental disorders, bipolar disorder, eating disorder, and psychotic experiences

	MDE	Dysth.	GAD	PTSD	PD	Ago	SAD	Sp. Phob.	ADHD	ODD	CD	Substance	IED	Eat	Bipol.	PE1: Vis. Hal.	PE2: Aud. Hal.	PE3: Thought	PE4: Mind cont.	PE5: Telepathy
MDE	–																			
Dysth	0.82[a]																			
GAD	0.65[a]	0.61[a]																		
PTSD	0.56[a]	0.46[a]	0.51[a]																	
PD	0.47[a]	0.46[a]	0.49[a]	0.46[a]																
Ago.	0.46[a]	0.44[a]	0.44[a]	0.38[a]	0.55[a]															
SAD	0.50[a]	0.49[a]	0.50[a]	0.44[a]	0.47[a]	0.65[a]														
Sp. Phob.	0.42[a]	0.38[a]	0.38[a]	0.38[a]	0.45[a]	0.58[a]	0.52[a]													
ADHD	0.39[a]	0.42[a]	0.36[a]	0.42[a]	0.37[a]	0.34[a]	0.45[a]	0.31[a]												
ODD	0.36[a]	0.36[a]	0.34[a]	0.41[a]	0.34[a]	0.28[a]	0.43[a]	0.31[a]	0.65[a]											
CD	0.34[a]	0.35[a]	0.32[a]	0.40[a]	0.38[a]	0.24[a]	0.38[a]	0.28[a]	0.57[a]	0.71[a]										
Substance	0.29[a]	0.27[a]	0.28[a]	0.32[a]	0.30[a]	0.19[a]	0.29[a]	0.19[a]	0.38[a]	0.48[a]	0.55[a]									
IED	0.40[b]	0.34[b]	0.40[b]	0.31[b]	0.38[b]	0.33[b]	0.39[b]	0.31[b]	0.43[b]	0.44[b]	0.48[b]	0.35[b]	–							
Eat.	0.36[c]	0.32[c]	0.33[c]	0.31[c]	0.25[c]	0.39[c]	0.35[c]	0.31[c]	0.39[c]	0.27[c]	0.21[c]	0.28[c]	–[e]	–						
Bipol.	0.52[a]	0.43[a]	0.45[a]	0.38[a]	0.44[a]	0.48[a]	0.44[a]	0.39[a]	0.46[a]	0.46[a]	0.43[a]	0.42[a]	–[e]	–[e]	–					
PE 1: Vis. Hal.	0.27[d]	0.28[d]	0.34[d]	0.29[d]	0.29[d]	0.23[d]	0.19[d]	0.26[d]	0.19[d]	0.26[d]	0.18[d]	0.12[d]	–[e]	–[e]	0.24[d]	–				
PE 2: Aud. Hal.	0.39[d]	0.38[d]	0.22[d]	0.37[d]	0.35[d]	0.20[d]	0.22[d]	0.26[d]	0.21[d]	0.23[d]	0.14[d]	0.17[d]	–[e]	–[e]	0.28[d]	0.72[d]	–			
PE 3: Thought	0.48[d]	0.35[d]	0.44[d]	0.41[d]	0.39[d]	0.35[d]	0.34[d]	0.31[d]	0.32[d]	0.25[d]	0.21[d]	0.27[d]	–[e]	–[e]	0.37[d]	0.64[d]	0.62[d]	–		
PE 4: Mind cont.	0.45[d]	0.37[d]	0.39[d]	0.20[d]	0.29[d]	0.23[d]	0.05[d]	0.24[d]	0.17[d]	0.16[d]	0.17[d]	0.12[d]	–[e]	–[e]	0.25[d]	0.64[d]	0.69[d]	0.84[d]	–	
PE 5: Telepathy	0.41[d]	0.41[d]	0.33[d]	0.21[d]	0.24[d]	0.16[d]	0.15[d]	0.14[d]	0.33[d]	0.30[d]	0.25[d]	0.25[d]	–[e]	–[e]	0.29[d]	0.76[d]	0.65[d]	0.73[d]	0.82[d]	–
PE 6: Delusion	0.44[d]	0.36[d]	0.30[d]	0.51[d]	0.43[d]	0.46[d]	0.42[d]	0.37[d]	0.35[d]	0.17[d]	0.33[d]	0.34[d]	–[e]	–[e]	0.39[d]	0.46[d]	0.55[d]	0.77[d]	0.65[d]	0.58[d]

All correlation coefficients estimated with Mplus 7.0.

MDE, major depressive episode; Dysth, dysthymia; PTSD, post-traumatic stress disorder; GAD, generalized anxiety disorder; PD, panic disorder; Ago, agoraphobia; SAD, social anxiety disorder; Sp.Phob, specific phobia; ADHD, attention-deficit hyperactivity disorder; CD, conduct disorder; ODD, oppositional-defiant disorder; Substance, substance abuse disorder (with/without dependence); PE, psychotic experience; Vis. Hal., having a visual hallucination; Aud.Hal, having an auditory hallucination; Thought, believing that thoughts are extracted from or inserted into your head ; Mind cont., feeling that your mind was taken over by a strange force; Telepathy, believing that a strange force tries to communicate with you (e.g. through special signs from the radio or TV); Delusion: believing that there is a plot going on against you or that people follow you.

[a]Estimated in sample including Colombia, Peru, Romania, Brazil, Northern Ireland, Poland, Murcia, Medellin, Mexico, and the United States ($n = 15\,499$).

[b]Estimated in subsample including Colombia, Peru, Romania, Brazil, Northern Ireland, Poland, and the United States ($n = 12\,162$).

[c]Estimated in sample including the complete data or a random subsample that got the eating disorders assessment from Colombia, Peru, Romania, Brazil, Northern Ireland, Poland, Murcia, Medellin, Mexico, and the United States ($n = 10\,585$).

[d]Estimated in subsample including complete data or a random subsample that got the psychotic experiences assessment from Colombia, Peru, Romania, Brazil, Mexico, and the United States ($n = 5478$).

[e]IED was not investigated together with eating disorders bipolar disorder and PEs; eating disorders were not investigated together with IED, bipolar disorders, and PEs.

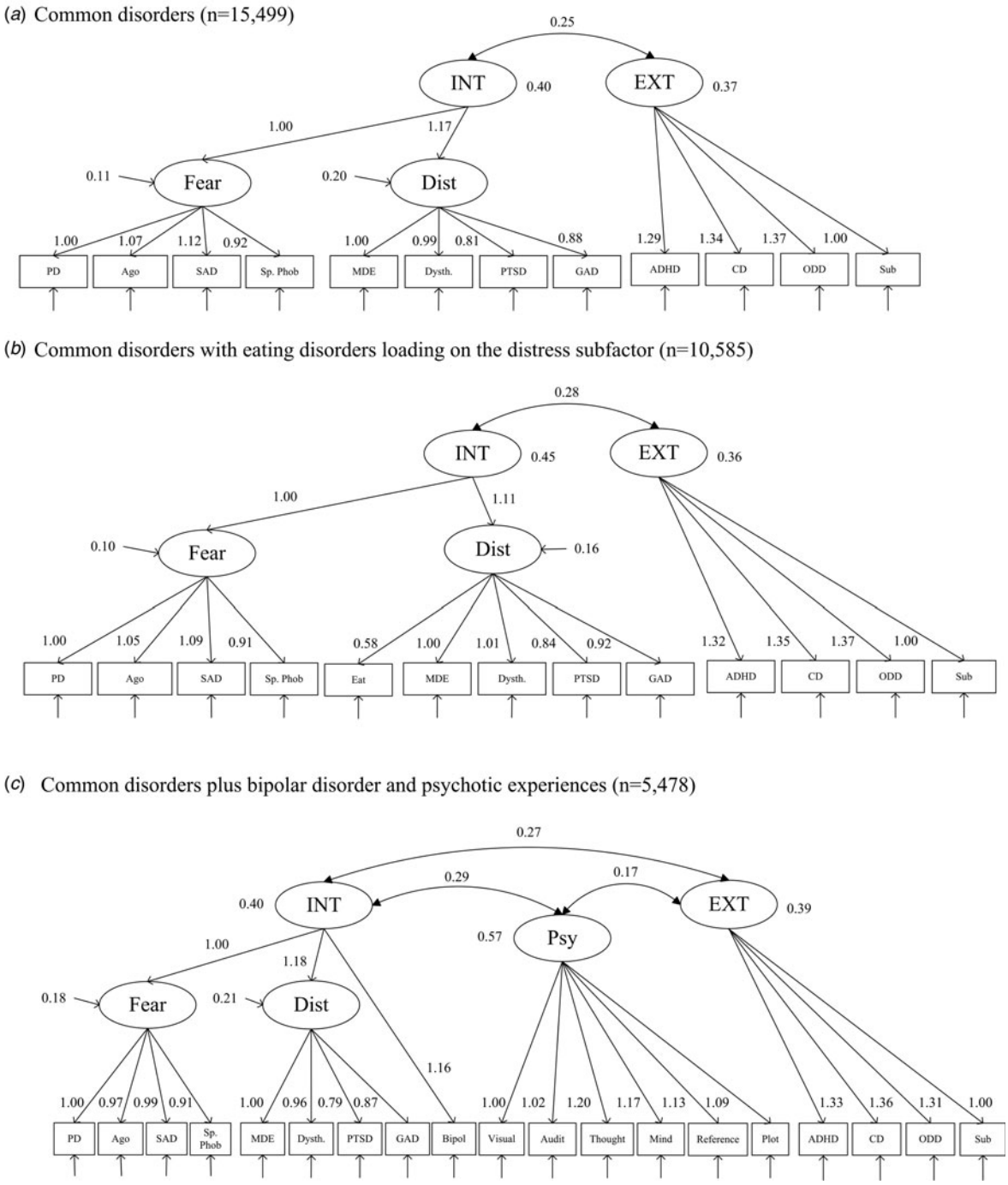

Fig. 1. Factor loadings (unstandardized) of different structural models in the WMH surveys. One loading per factor was fixed to 1 for model identification. INT, internalizing; EXT, externalizing; PSY, psychotic experiences; PD, panic disorder; Ago, agoraphobia; SAD, social anxiety disorder; Sp.Phob, specific phobia; MDE, major depressive episode; Dysth, dysthymia; PTSD, post-traumatic stress disorder; GAD, generalized anxiety disorder; ADHD, attention-deficit hyperactivity disorder; CD, conduct disorder; ODD, oppositional-defiant disorder; Sub, substance abuse disorder (with/without dependence); Eat, eating disorder; Bipol, bipolar disorder; Visual, having visual hallucination; Audit, having auditory hallucination; Thought, having ideas of thought extraction or thought insertion; Mind, feeling that your mind was taken over by an external force; Reference, feeling that a strange force tries to communicate with you; Plot, belief in an unjust plot that is going on to harm you.

PEs factor, and distress and fear subfactors for the internalizing factor showed even better fit (CFI = 0.984; RMSEA = 0.011).

Structural model of common disorders, bipolar disorder, and PEs

A model with all common disorders, bipolar disorder, and PEs was estimated next. IED and eating disorders were not included in these analyses because they were only assessed in smaller subsamples. Several higher order models were compared, evaluating whether bipolar disorder could be better grouped with the internalizing disorders, with the PEs, or with both (see Table 3). The results showed that a model with bipolar disorders set to load directly on the internalizing factor (see Fig. 1*c*) fit the data better than a model with bipolar disorder loading on the same factor as the PEs. Setting bipolar disorder to cross-load on both factors

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Table 3. Confirmatory factor analyses of the structure of common and uncommon mental disorders

Included disorders	Sample (#countries)	Factor model	Fit indices		
			#FP	CFI	RMSEA (90% CI)
MDE, dysthymia, panic disorder, PTSD, social phobia, specific phobia, agoraphobia, GAD, ADHD, ODD, conduct disorder, substance abuse[a]	15 499 (10)	Two-factor model[b]	25	0.968	0.024 (0.022–0.026)
		Higher order model[c] with *fear* and *distress* subfactors	27	0.985	0.017 (0.015–0.019)
MDE, dysthymia, panic disorder, PTSD, social phobia, specific phobia, agoraphobia, GAD, ADHD, ODD, conduct disorder, substance abuse[a] **+ IED**	12 162 (7)	Two-factor model[b]	27	0.971	0.022 (0.020–0.024)
		Higher order model[c] with *fear* and *distress* subfactors and IED loading on the externalizing factor	29	0.983	0.017 (0.015–0.019)
MDE, dysthymia, panic disorder, PTSD, social phobia, specific phobia, agoraphobia, GAD, ADHD, ODD, conduct disorder, substance abuse[a] **+ bipolar disorders**	15 499 (10)	Higher order model[c] with bipolar disorder loading directly on the second-order internalizing factor	28	0.983	0.017 (0.015–0.018)
		Higher order[c] with bipolar disorder loading directly on the externalizing factor	28	0.974	0.021 (0.019–0.022)
		Higher order[c] model with bipolar disorder loading on the *fear* subfactor	29	0.979	0.019 (0.017–0.020)
		Higher order[c] model with bipolar disorder loading on the *distress* subfactor	29	0.977	0.020 (0.018–0.021)
		Higher order[c] model with bipolar disorder loading on the *fear* and *distress* subfactor	30	0.980	0.018 (0.017–0.020)
MDE, dysthymia, panic disorder, PTSD, social phobia, specific phobia, agoraphobia, GAD, ADHD, ODD, conduct disorder, substance abuse[a] **+ eating disorders**	10 585 (10)[d]	Higher order: eating disorders loading directly on internalizing	28	0.977	0.018 (0.016–0.021)
		Higher order[c]: eating disorders loading on *fear*	29	0.986	0.015 (0.013–0.017)
		Higher order[c]: eating disorders loading on *distress*	29	0.984	0.015 (0.013–0.018)
		Higher order[c]: eating disorders loading on *fear and distress*	30	0.986	0.015 (0.013–0.017)
MDE, dysthymia, panic disorder, PTSD, social phobia, specific phobia, agoraphobia, GAD, ADHD, ODD, conduct disorder, substance abuse[a] **+ psychotic experiences**	5478 (6)[e]	Three-factor[b]: PEs load on their own factor	39	0.972	0.015 (0.012–0.017)
		Higher order with PEs loading on their own factor	41	0.984	0.011 (0.008–0.014)
MDE, dysthymia, panic disorder, PTSD, social phobia, specific phobia, agoraphobia, GAD, ADHD, ODD, conduct disorder, substance abuse[a] **+ bipolar disorder and psychotic experiences**	5478 (6)[e]	Higher order with bipolar loading on the internalizing factor	43	0.983	0.011 (0.009–0.013)
		Higher order with bipolar loading on the PE factor	43	0.959	0.017 (0.015–0.019)
		Higher order with bipolar loading on the internalizing and PE factors	43	0.984	0.011 (0.009–0.013)

[a]Including abuse and dependence.
[b]Model without cross-loadings and with freely estimated correlation(s) between factors.
[c]Model with freely estimated correlation between the higher-order factors.
[d]Eating disorders were assessed in random subsamples in 7 of the 10 included countries.
[e]Psychotic experiences were assessed in random subsamples in 4 of the 6 samples.

did not improve fit much (same RMSEA) compared with the first model. In this model, bipolar disorders showed a very small standardized loading on the PEs factor (−0.19), which differed strongly in terms of direction and magnitude from the other PEs loadings (0.76–0.91).

Discussion

We addressed several unresolved issues regarding the structure of mental disorders using the largest cross-national dataset to date encompassing a relatively wide selection of both internalizing

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Table 4. Analyses of measurement invariance across five samples of the higher order structural model of common mental disorders

Model	Model parameters	Fit indices		
		CFI	RMSEA (90% CI)	ΔCFI
1. Configural invariance	– First- and second-order factor loadings, item thresholds and factor correlations unconstrained	0.978	0.019 (0.016–0.022)	–
	Fixed parameters: – Factor means and first-order factor intercepts = 0 across countries for model identification – Factor variances = 1 across countries – Item residual variances = 1 across countries			
2. Partial invariance	– First- and second-order factor loadings constrained – Item thresholds and correlations unconstrained	0.976	0.018 (0.015–0.021)	0.002
	Fixed parameters: – Factor means and first-order factor intercepts = 0 across countries for model identification – Factor variances = 1 across countries – Item residual variances = 1 across countries			
3. Scalar invariance	First- and second-order factor loadings and item thresholds constrained – Factor means, factor correlations unconstrained	0.962	0.021 (0.019–0.024)	0.016
	Fixed parameters: – First-order factor intercepts = 0 across countries for model identification – Factor variances = 1 across countries – Item residual variances = 1 across countries			

CFI, comparative fit index; RMSEA, root mean squared error of approximation.
All models testing invariance across 10 samples.
All models estimated with the θ parameterization in Mplus 7 (Muthén & Muthén, 1998–2012).

and externalizing disorders, and both common and uncommon disorders. Overall, we found that a higher order model with an internalizing and externalizing factor and fear and distress subfactors, described the structure of common mental disorders well. Investigations of measurement invariance of this structure across five selected countries showed that the factor loadings can be assumed to be stable. Investigations of the placement of uncommon disorders into the model showed that eating disorders and bipolar disorder could be grouped under the internalizing factor and that PEs were best modeled as a separate domain within the model. When bipolar disorder and PEs were included together in a single model, bipolar disorder was still best grouped with the internalizing domain (but not with a specific subfactor).

The results confirmed the higher order structure of common mental disorders that has been observed in many previous studies (i.e. Krueger *et al.* 1998; Krueger, 1999; Vollebergh *et al.* 2001; Watson, 2005; Krueger & Markon, 2006; Slade & Watson, 2006; Miller *et al.* 2008; Eaton *et al.* 2013*b*). Importantly, the current findings about measurement invariance showed that the structure was relatively stable across five different countries. These findings align with the only previous cross-national study that also found evidence for metric cross-national measurement invariance (Krueger *et al.* 2003). The current results extend on these previous findings by showing that a higher order model that encompasses a full range of externalizing disorders, instead of only substance-related problems, fits the data well and shows metric invariance across countries.

When investigated together with the common mental disorders, bipolar disorder was found to be best grouped with the internalizing factor, in line with previous research showing bipolar/mania to be an internalizing subfactor (e.g. Forbush & Watson, 2013; Kotov *et al.* 2015). Other authors found bipolar disorder to cross-load on the distress and fear subfactors when investigated in the context of other internalizing disorders (Eaton *et al.* 2013*a*, *b*), but such model configurations were not found to fit better in the current study. These results indicate that, in the context of the included common mental disorders, bipolar disorder shows a clear general association with the internalizing domain. Previously, bipolar disorders have also been shown to be partly related to a 'thought problems' dimension together with, e.g. psychosis (Kotov *et al.* 2017). Therefore, this was also evaluated by investigating a model that included both bipolar disorder and PEs. These analyses showed that grouping bipolar disorder strictly with the PEs led to a decrease in fit and letting bipolar disorder cross-load on the internalizing and PEs factor did hardly improve fit. This could be explained by the fact that the internalizing and PEs factors were already strongly correlated, making the added cross-loading redundant. In addition, the fact that six PEs from a single interview module (see below for further discussion) were used and just a single bipolar-disorder indicator, could have made the setup of the analysis suboptimal to evaluate the existence of a broad thought-disorder factor. Finally, an alternative explanation may be that there is a significant heterogeneity in our measure of bipolar disorder. As it consists of different subtypes and represents different episodes, it is possible that some subtypes or episodes may be more strongly related to either internalizing disorders or thought problems.

As previously observed (Forbush *et al.* 2010; Forbush & Watson, 2013), models grouping eating disorders with the internalizing disorders fit best to the data. Setting eating disorders to load on the fear, distress or both subfactors led to similar model fit, but led to better fit than setting eating disorders to load directly on the internalizing domain. These findings suggest

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that, when investigated in the context of common mental disorders, eating disorders show a general association with the internalizing domain and its subdomains, although its exact placement remained somewhat unclear. These somewhat ambiguous findings could partly be related to the fact that only one pooled eating-disorder indicator was used in the current model. It could be that a separate eating disorder (sub)factor could be identified if more individual indicators were used, also including anorexia nervosa.

In line with previous findings that PEs reflect a separate mental-health domain (i.e. 'thought problems') alongside the internalizing and externalizing domains (e.g. Markon, 2010; Wright *et al.* 2013), the current results showed that a model with PEs loading on their own separate factor fit the data well. Interestingly, this factor showed considerable correlation with the internalizing factor, indicating that PEs are related to other mental disorders, in line with previous work showing the cross-diagnostic importance of PEs (Rössler *et al.* 2011; Fusar-Poli *et al.* 2012; Werbeloff *et al.* 2012).

The current results align with previous work in the WMH surveys. Kessler *et al.* (2011*a*, *b*) investigated the role of the internalizing and externalizing domains in the development of comorbidity patterns within persons over time and showed that these were explained to a strong degree by within-domain clustering. The current results confirmed that the 2-factor structure of mental disorders and expanded on these results by providing more insight into the finer-grained structure and placement of mental disorders into a higher order factor model.

An important implication of the higher order model is that variations in mental health/disorders could be explained by causal influences that occur at different levels with different degrees of disorder specificity. Some influences can be disorder-specific, some occur at the level of the subfactor and are shared with a limited set of other disorders (i.e. other fear or distress disorders), and some occur at the level of the higher order domains (i.e. internalizing or externalizing) and are shared with all other disorders within the domain.

It is important to note that there are also influences that are very non-specific and influence all disorders, irrespective of their grouping with first- or second-order factors (Lahey *et al.* 2017). Indeed, the internalizing and externalizing domains have been repeatedly shown to be robustly correlated, which could indicate the existence of an overarching general factor of psychopathology that accounts for the shared variance of all disorders ('*p*-factor'; Caspi *et al.* 2017; Lahey *et al.* 2017). To investigate this, bifactor models can be used that incorporate both a general factor and domain-specific group factors (e.g. Lahey *et al.* 2017). Although it has been pointed out that bifactor models can become complex and very hard to interpret (Eid *et al.* in press; Koch *et al.* in press), their use in structural research of mental disorders is an interesting topic for further investigation.

There are some limitations that should be kept in mind when interpreting the findings of this study. First, the analyses were limited to those WMH surveys with data on all disorders and to subjects in the age range of 18–45 years, which may limit the generalizability of the findings to other populations. Second, the models were fitted on cross-national datasets but prevalence rates could differ across surveys. Still, the investigations of measurement invariance indicated that at least partial invariance across countries could be assumed, although only part of the countries could be included in these analyses as some countries showed very low disorder frequencies. Investigations of measurement invariance across larger sets of countries will probably only be possible with smaller models that include a very limited range of disorders. This could be done in future research. Third, PEs, rather than psychotic disorders and schizophrenia were assessed and included in the analyses. On the one hand, this could seem somewhat inconsistent, as all other modeled mental problems were included as formal disorders. On the other hand, PEs are more common than full-blown psychotic disorders, which provides more possibilities to model the full psychotic spectrum, irrespective of diagnosis. However, it is possible that some of the observed clustering of PEs in the analyses can be explained by the fact that they were assessed differently from the other diagnoses. Finally, the general indices of fit indicated good fit for all tested models. As such all model comparisons were among models that (objectively) fit the data well and were often based on very small differences in fit.

The current results show that the structure of mental disorders is best represented by a higher order factor model with some degree of cross-national stability. In addition, eating disorders were shown to group with the internalizing domain, bipolar disorder was shown to group most strongly with the internalizing domain and PEs were shown to group with their own domain that was correlated with the other domains.

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References

Asparouhov T (2005) Sampling weights in latent variable modeling. *Structural Equation Modeling* **12**(3), 411–434.

Bijl RV, Ravelli A and van Zessen G (1998) Prevalence of psychiatric disorder in the general population: results of The Netherlands mental health survey and incidence study (NEMESIS). *Social Psychiatry and Psychiatric Epidemiology* **33**(12), 587–595.

Carragher N, Krueger RF, Eaton NR and Slade T (2015) Disorders without borders: current and future directions in the meta-structure of mental disorders. *Social Psychiatry and Psychiatric Epidemiology* **50**(3), 339–350.

Caspi A, Houts RM, Belsky DW, Goldman-Mellor SJ, Harrington H, Israel S *et al.* (2017) The p factor: one general psychopathology factor in the structure of psychiatric disorders? *Clinical Psychological Science* **2**(2), 119–137.

Cheung GW and Rensvold RB (2002) Evaluating goodness-of-Fit indexes for testing measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal* **9**, 233–255.

Eaton NR, Keyes KM, Krueger RF, Balsis S, Skodol AE, Markon KE *et al.* (2012) An invariant dimensional liability model of gender differences in mental disorder prevalence: evidence from a national sample. *Journal of Abnormal Psychology* **121**(1), 282–288.

Eaton NR, Keyes KM, Krueger RF, Noordhof A, Skodol AE, Markon KE *et al.* (2013*b*) Ethnicity and psychiatric comorbidity in a national sample: evidence for latent comorbidity factor invariance and connections with disorder prevalence. *Social Psychiatry and Psychiatric Epidemiology* **48**(5), 701–710.

Eaton NR, Krueger RF, Markon KE, Keyes KM, Skodol AE, Wall M *et al.* (2013*a*) The structure and predictive validity of the internalizing disorders. *Journal of Abnormal Psychology* **122**(1), 86–92.

Eaton NR, Krueger RF and Oltmanns TF (2011) Aging and the structure and long-term stability of the internalizing spectrum of personality and psychopathology. *Psychology and Aging* **26**(4), 987–993.

Eaton NR, Rodriguez-Seijas C, Carragher N and Krueger RF (2015) Transdiagnostic factors of psychopathology and substance use disorders: a review. *Social Psychiatry and Psychiatric Epidemiology* **50**(2), 171–182.

Eid M, Geiser C, Koch T and Heene M (in press) Anomalous results in g-factor models: explanations and alternatives. *Psychological Methods* **22** (3), 541–562

Farmer RF, Seeley JR, Kosty DB and Lewinson PM (2009) Refinements in the hierarchical structure of externalizing psychiatric disorders: patterns of lifetime liability from mid-adolescence through early adulthood. *Journal of Abnormal Psychology* **118**(4), 699–710.

Forbush KT, South SC, Krueger RF, Iacono WG, Clark LA, Keel PK *et al.* (2010) Locating eating pathology within an empirical diagnostic taxonomy: evidence from a community-based sample. *Journal of Abnormal Psychology* **119**(2), 282–292.

Forbush KT and Watson D (2013) The structure of common and uncommon mental disorders. *Psychological Medicine* **43**(1), 97–108.

Fusar-Poli P, Bonoldi I, Yung AR, Borgwardt S, Kempton MJ, Valmaggia L *et al.* (2012) Predicting psychosis: meta-analysis of transition outcomes in individuals at high clinical risk. *Archives of General Psychiatry* **69**(3), 220.

Hasin D and Kilcoyne B (2012) Comorbidity of psychiatric and substance use disorders in the United States: current issues and findings from the NESARC. *Current Opinions in Psychiatry* **25**(3), 165–171.

Heeringa SG, Wells EJ and Hubbard F (2008) Sample designs and sampling procedures. In: Kessler RC, Üstun TB, editors. *The WHO World Mental Health Surveys: Global Perspectives on the Epidemiology of Mental Disorders*. New York, NY: Cambridge University Press, pp. 14–32.

Hicks BM, Blonigen DM, Kramer MD, Krueger RF, Patrick CJ, Iacono WG *et al.* (2007) Gender differences and developmental change in externalizing disorders from late adolescence to early adulthood: a longitudinal twin study. *Journal of Abnormal Psychology* **116**(3), 433–447.

Hu L and Bentler PM (1999) Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling* **6**, 1–55.

Kendler KS, Aggen SH, Knudsen GP, Røysamb E, Neale MC and Reichborn-Kjennerud T (2011) The structure of genetic and environmental risk factors for syndromal and subsyndromal common DSM-IV axis I and all axis II disorders. *American Journal of Psychiatry* **168**(1), 29–39.

Kessler RC, Cox BJ, Green JG, Ormel J, McLaughlin KA, Merikangas KR *et al.* (2011*a*). The effects of latent variables in the development of comorbidity among common mental disorders. *Depression and Anxiety* **28**(1), 29–39.

Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S *et al.* (1994) Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. *Results from the National Comorbidity Survey. Archives of General Psychiatry* **51**(1), 8–19.

Kessler RC, Ormel J, Petukhova M, McLaughlin KA, Green JG, Russo LJ *et al.* (2011*b*) Development of lifetime comorbidity I the world health organization world mental health surveys. *Archives of General Psychiatry* **68**(1), 90–100.

Kessler RC, Petukhova M and Zaslavsky AM (2011*c*) The role of latent internalizing and externalizing predispositions in accounting for the development of comorbidity among common mental disorders. *Current Opinions in Psychiatry* **24**(4), 307–312.

Keyes KM, Eaton NR, Krueger RF, Skodol AE, Wall MM, Grant B *et al.* (2013) Thought disorder in the meta-structure of psychopathology. *Psychological Medicine* **43**(8), 1673–1683.

Koch T, Holtmann J, Bohn J and Eid M (in press) Explaining general and specific factors in longitudinal, multimethod, and bifactor models: some caveats and recommendations. *Psychological Methods*. Advance online publication July 24. http://dx.doi.org/10.1037/met0000146

Kotov R, Chang SW, Fochtmann LJ, Mojtabai R, Carlson GA, Sedler MJ *et al.* (2011*a*) Schizophrenia in the internalizing-externalizing framework: a third dimension? *Schizophrenia Bulletin* **37**(6), 1168–1178.

Kotov R, Krueger RF, Watson D, Achenbach TM, Althoff RR, Bagby RM *et al.* (2017) The hierarchical taxonomy of psychopathology (HiTOP): a dimensional alternative to traditional nosologies. *Journal of Abnormal Psychology* **126**(4), 454–477.

Kotov R, Perlman G, Gámez W and Watson D (2015) The structure and short-term stability of the emotional disorders: a dimensional approach. *Psychological Medicine* **45**(8), 1687–1698.

Kotov R, Ruggero CJ, Krueger RF, Watson D, Yuan Q and Zimmerman M (2011*b*) New dimensions in the quantitative classification of mental illness. *Archives of General Psychiatry* **68**(10), 1003–1011.

Kramer MD, Krueger RF and Hicks BM (2007) The role of internalizing and externalizing liability factors in accounting for gender differences in the prevalence of common psychopathological syndromes. *Psychological Medicine* **38**(1), 51–61.

Krueger RF (1999) The structure of common mental disorders. *Archives of General Psychiatry* **56**(10), 921–926.

https://doi.org/10.1017/S0033291717003610 Published online by Cambridge University Press

Krueger RF, Caspi A, Moffitt TE and Silva PA (1998) The structure and stability of common mental disorders (DSM-III-R): a longitudinal-epidemiological study. *Journal of Abnormal Psychology* **107**(2), 216–227.

Krueger RF, Chentsova-Dutton YE, Markon KE, Goldberg D and Ormel J (2003) A cross-cultural study of the structure of comorbidity among common psychopathological syndromes in the general health care setting. *Journal of Abnormal Psychology* **112**(3), 437–447.

Krueger RF and Markon KE (2006) Reinterpreting comorbidity: a model-based approach to understanding and classifying psychopathology. *Annual Review of Clinical Psychology* **2**, 111–133.

Krueger RF, Markon KE, Patrick CJ, Benning SD and Kramer MD (2007) Linking antisocial behavior, substance use, and personality: an integrative quantitative model of the adult externalizing spectrum. *Journal of Abnormal Psychology* **116**(4), 645–666.

Krueger RF, Markon KE, Patrick CJ and Iacono WG (2005) Externalizing psychopathology in adulthood: a dimensional-spectrum conceptualization and its implications for DSM-V. *Journal of Abnormal Psychology* **114**(4), 537–550.

Lahey BB, Krueger RF, Rathouz PJ, Waldman ID and Zald DH (2017) A hierarchical causal taxonomy of psychopathology across the life span. *Psychological Bulletin* **143**(2), 142–186.

Markon KE (2010) Modeling psychopathology structure: a symptom-level analysis of Axis I and II disorders. *Psychological Medicine* **40**(2), 273–288.

Markon KE and Krueger RF (2005) Categorical and continuous models of liability to externalizing disorders: a direct comparison in NESARC. *Archives of General Psychiatry* **62**(12), 1352–1359.

Miller MW, Fogler JM, Wolf EJ, Kaloupek DG and Keane TM (2008) The internalizing and externalizing structure of psychiatric comorbidity in combat veterans. *Journal of Traumatic Stress* **21**(1), 58–65.

Mineka S, Watson D and Clark LA (1998) Comorbidity of anxiety and unipolar mood disorders. *Annual Review of Psychology* **49**, 377–412.

Muthén LK and Muthén BO (1998–2012) *Mplus User's Guide*, 7th edn., Los Angeles, CA: Muthén & Muthén.

Pennell B, Mneimneh Z, Bowers A, Chardoul S, Wells J, Viana M *et al.* (2008) Implementation of the world mental health surveys. In Kessler R and Üstün T (eds). *The WHO World Mental Health Surveys: Global Perspectives on the Epidemiology of Mental Disorders*, pp. 33–57. Cambridge University Press: Cambridge, UK.

Rössler W, Hengartner MP, Ajdacic-Gross V, Haker H and Angst J (2011) Sub-clinical psychosis symptoms in young adults are risk factors for subsequent common mental disorders. *Schizophrenia Research* **131**(1), 18–23.

Røysamb E, Kendler KS, Tambs K, Orstavik RE, Neale MC, Aggen SH *et al.* (2010) The joint structure of DSM-IV axis I and axis II disorders. *Journal of Abnormal Psychology* **120**(1), 198–209.

Sher KJ and Trull TJ (1996) Methodological issues in psychopathology research. *Annual Review of Psychology* **47**, 371–400.

Slade T and Watson D (2006) The structure of common DSM-IV and ICD-10 mental disorders in the Australian general population. *Psychological Medicine* **36**(11), 1593–1600.

South SC and Jarnecke AM (2017) Structural equation modeling of personality disorders and pathological personality traits. *Personality Disorders: Theory, Research, and Treatment* **8**(2), 113–129.

Teesson M, Slade T and Mills K (2009) Comorbidity in Australia: findings of the 2007 national survey of mental health and wellbeing. *Australian and New Zealand Journal of Psychiatry* **43**(7), 606–614.

Vollebergh WA, Iedema J, Bijl RV, de Graaf R, Smit F and Ormel J (2001) The structure and stability of common mental disorders: the NEMESIS study. *Archives of General Psychiatry* **58**(6), 597–603.

Vrieze SI, Perlman G, Krueger RF and Iacono WG (2012) Is the continuity of externalizing psychopathology the same in adolescents and middle-aged adults? A test of the externalizing spectrum's developmental coherence. *Journal of Abnormal Child Psychology* **40**(3), 459–470.

The World Bank. (2009) Data and Statistics. Accessed May 12. http://go.worldbank.org/D7SN0B8YU0

Watson D (2005) Rethinking the mood and anxiety disorders: a quantitative hierarchical model for DSM-V. *Journal of Abnormal Psychology* **114**(4), 522–536.

Werbeloff N, Drukker M, Dohrenwend BP, Levav I, Yoffe R, van Os J *et al.* (2012) Self-reported attenuated psychotic symptoms as forerunners of severe mental disorders later in life. *Archives of General Psychiatry* **69**(5), 467–475.

Widiger TA and Clark LA (2000) Toward DSM-V and the classification of psychopathology. *Psychological Bulletin* **126**(6), 946–963.

Wright AG, Krueger RF, Hobbs MJ, Markon KE, Eaton NR and Slade T (2013) The structure of psychopathology: toward an expanded quantitative empirical model. *Journal of Abnormal Psychology* **122**(1), 281–294.

https://doi.org/10.1017/S0033291717003610 Published online by Cambridge University Press