Clarifying the Placement of Obsessive-Compulsive Disorder in the Empirical Structure of
Psychopathology

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Abstract

Recent work on the empirical structure of psychopathology has aimed to address some limitations that can arise from traditional categorical classification approaches. This research has focused on modeling patterns of co-occurrence among traditional diagnoses, uncovering a variety of well-validated dimensions (or *spectra*) of psychopathology, spanning common and uncommon mental disorders. A model integrating these empirically derived spectra (the Hierarchical Taxonomy of Psychopathology; HiTOP) has been proposed. However, the placement of obsessive-compulsive disorder (OCD) within this model remains unclear, as studies have variably found OCD to fit best as part of the Fear, Distress or Thought Disorder spectra. One reason for this may be the heterogeneity of symptoms experienced by individuals with OCD, which is lost when analysing categorical diagnoses. For example, different symptom clusters within OCD—such as washing and contamination versus obsessions and checking—may be differentially associated with different spectra in the HiTOP model. The aim of this study was to test this hypothesis. Data were collected in an anonymous online survey from community participants ($n = 609$), largely with elevated symptoms of mental illness, and analyzed in a factor analytic framework treating OCD as a unitary construct and as four separate symptom clusters. The results indicated that OCD and its constituent symptom clusters had significant loadings of varying strength on the Fear and Thought Disorder spectra. These findings suggest that OCD may be best characterized as cross-loading on both the Fear and Thought Disorder spectra, and highlight the importance of accounting for diagnostic heterogeneity in future research.

Keywords: obsessive-compulsive disorder, OCD symptom-clusters, Hierarchical Taxonomy of Psychopathology, HiTOP, nosology, mental illness

Clarifying the Placement of Obsessive-Compulsive Disorder in the Empirical Structure of Psychopathology

The diagnosis and classification of mental illness is a cornerstone of clinical psychology. While the introduction of the *Diagnostic Statistical Manual of Mental Disorders* (DSM) and the *International Classification of Diseases* (ICD) brought order to chaos in clinical psychology research (e.g., Clark, Cuthbert, Lewis-Fernandez, Narrow, & Reed, 2017), the foundations of these traditional categorical taxonomies are largely built on a rich history of clinical observation and expert consensus, rather than being data-driven (Kotov et al., 2017; Kotov, Krueger, & Watson, 2018). The field is now moving to address some of the limitations of traditional diagnoses, such as low reliability, high rates of comorbidity, and heterogeneity within diagnoses, which has led to a variety of new approaches to conceptualizing psychopathology (e.g., Borsboom, 2017; Cuthbert & Insel, 2013; Hoffman & Hayes, 2019; McGorry et al., 2006). One such approach is the Hierarchical Taxonomy of Psychopathology (HiTOP; see Figure 1), which summarizes research to date on the latent structure of mental disorders, and includes empirically derived dimensions that span approximately two-thirds of the diagnoses in the DSM-5 (Kotov et al., 2017).

Despite gaining rapid traction in the field (Conway et al., 2019), an important limitation of the HiTOP framework is that much of the research to date has focused on modelling the patterns of comorbidity among traditional categorical diagnoses, which means that heterogeneity within the diagnoses cannot be accounted for (Kotov et al., 2017). This unaccounted-for heterogeneity is one likely explanation for the inconsistent results in the literature examining the placement of obsessive-compulsive disorder (OCD) in the HiTOP framework, which has been found to variably load on the Fear, Distress, and Thought Disorder spectra (see Figure 1), as described below. The aim of this study was to test whether the symptom clusters that comprise OCD are differentially associated with different spectra

in the HiTOP model, accounting for the inconsistencies in the literature to date.

OCD in an empirical model of psychopathology

In the current HiTOP model (Figure 1), OCD is under the Fear spectrum, alongside other disorders, such as panic disorder, agoraphobia, specific phobia, and separation anxiety disorder. This is consistent with the findings of several quantitative studies on the structure of psychopathology that included OCD (Lahey et al., 2007; Slade, 2007; Slade & Watson, 2006; Watson, 2005), as well as the shared core features of worry and avoidance behaviors among these disorders (Abramowitz & Jacoby, 2014; Rozenman et al., 2017). However, there is also some empirical support for OCD belonging under the Distress spectrum, alongside major depression and generalized anxiety disorder (Cox, Clara, Hills, & Sareen, 2010); or under the Thought Disorder spectrum alongside schizophrenia spectrum disorders, dissociative, and schizotypal personality disorders (e.g., Caspi et al., 2014; Laceulle et al., 2015). One study included cross-loadings for OCD with both the Fear and Thought Disorder spectra (Kotov, Perlman, Gamez & Watson, 2015).

These inconsistencies in the placement of OCD are at odds with the robust and replicable findings for many of the other disorders in the HiTOP model (Kotov et al., 2017; Krueger & Markon, 2006). One explanation might be the well-documented heterogeneity within the diagnostic category of OCD (e.g., Abramowitz & Jacoby, 2014). For example, four robust symptom dimensions have been identified in multiple symptom measures of OCD: (1) obsession and checking, (2) symmetry and ordering, (3) washing and contamination, and (4) hoarding (e.g., Bloch et al., 2008; du Mortier et al., 2019; Leckman et al., 1997; Stein et al., 2010; Summerfeldt et al., 2010; Summerfeldt, Richter, Antony, & Swinson, 1999; Watson et al., 2004). We turn now to briefly discuss each of these symptom dimensions, and available evidence regarding their patterns of co-occurrence with other domains of psychopathology.

The obsession and checking symptom dimension refers to checking compulsions and obsessions of an aggressive, sexual, religious, or somatic nature (Bloch et al., 2008). Several studies have found statistically significant relationships between obsession and checking and dissociation, major depression, generalized anxiety, worry, dysthymia, panic disorder, social phobia, agoraphobia, and substance abuse (Hasler et al., 2005; Leckman et al., 2010; Raines et al., 2015; Rufer et al., 2005). These associations provide preliminary evidence of links between this cluster and disorders on the Fear, Distress, Externalizing and Thought Disorder spectra of the HiTOP model.

The symmetry and ordering symptom dimension contains ordering and arranging compulsions, repeating rituals and counting compulsions, and obsessions with symmetry (Bloch et al., 2008). Existing literature here has demonstrated associations between the symmetry and ordering symptom cluster of OCD and worry, panic disorder, specific phobia, agoraphobia, bipolar disorder, and dissociation (Hasler et al., 2005; Leckman et al., 2010; Raines et al., 2015; Rufer et al., 2005). These findings indicate associations between symmetry and ordering and disorders on the Fear, Distress and Thought Disorder spectra of the HiTOP model.

The washing and contamination symptom dimension comprises obsessions surrounding contamination, accompanied by washing and cleaning compulsions (Bloch et al., 2008). In contrast to the broad associations of the symptom dimensions mentioned above, the washing and contamination cluster has shown a more specific association with the Fear spectrum (Hasler et al., 2005; Leckman et al., 2010; Raines et al., 2015). For example, Raines et al. (2015) examined a structural model that operationalized the Fear spectrum through symptoms of panic disorder, and the Distress spectrum through symptoms of worry, examining whether OCD symptom dimensions were more closely associated with one or the other. Raines et al. found that washing and contamination was the only symptom dimension

to load specifically with the panic disorder symptoms; all other symptom domains cross-loaded with worry.

Finally, the hoarding symptom dimension involves obsessions and compulsions relating to the collection of large quantities of items and resistance to discarding valueless items (Wu & Watson, 2005). Hoarding symptoms have been associated with bipolar disorder, binge-eating disorders, panic disorder, social anxiety, generalized anxiety, alcohol dependence, and paranoid, schizotypal, and obsessive-compulsive personality disorders (de Mathis et al., 2016; Leckman et al., 2010; Wheaton, Timpano, LaSalle-Ricci, & Murphy, 2008). These findings indicate associations between hoarding symptoms and disorders on the Fear, Distress, Externalizing, and Thought Disorder spectra of the HiTOP model.

Notably, evidence suggests that hoarding disorder is empirically distinct from OCD (Abramowitz et al., 2008; Angelakis et al., 2016; 2019; Chmielewski & Watson, 2008; Leckman & Bloch, 2008; Weiss & Khan, 2015; Wu & Watson 2005). As a result, hoarding is often excluded from analyses of OCD clusters (e.g., Hasler et al., 2005; Raines et al., 2016). However, acquiring behaviors and difficulty discarding possessions in particular can present as compulsions with or without related obsessions (e.g., surrounding harm coming to oneself or one's family; Leckman & Bloch, 2008). As such—and to allow a preliminary test of where hoarding symptoms may fit within the HiTOP model—we tested models with and without items measuring obsessions and compulsions related to hoarding in the present analyses.

To better understand the placement of OCD in an empirical taxonomy, symptom-level analyses (i.e., using individual symptoms as the units of analysis, rather than traditional categorical diagnoses) offer a useful tool for parsing the heterogeneity within disorders. Two symptom-level analyses of the Internalizing spectrum have found OCD symptoms to form their own dimension—most closely related to mania symptoms (Waszczuk et al., 2017) or a Fear dimension (Dornbach-Bender et al., 2017). However, these studies did not include

Thought Disorder or Externalizing spectra to allow for tests of divergence from the Internalizing spectrum. Wright et al. (2013) did symptom-level analyses of 33 symptoms spanning ten mental disorders, including psychosis and alcohol and drug use disorders, allowing for preliminary tests of whether OCD symptoms diverge from the Internalizing spectrum and/or convergence with the Thought Disorder or Externalizing spectra. The analyses included five ordinal indicators of lifetime OCD symptoms, the first four each reflecting one of the four symptom dimensions mentioned earlier, and a fifth reflecting ‘other’ intrusive thoughts with or without associated compulsions. Wright et al. (2013) found these five symptoms to form their own OCD sub-spectrum under the Internalizing spectrum, alongside Fear and Distress, and distinct from Psychosis and Externalizing spectra. Finally, Forbes et al. (2020) examined the hierarchical structure of a large number of symptoms spanning 16 domains of psychopathology and found OCD symptoms formed a single component under Thought Disorder. All these studies were based on exploratory factor analyses of symptoms or symptom clusters, and all found that the symptoms of OCD were more likely to co-occur with one another than with symptoms of other disorders. However, to our knowledge, no studies to date have tested whether the symptom clusters that comprise OCD may be differentially associated with the Fear, Distress, Thought Disorder, and/or Externalizing spectra, which could account for the inconsistencies in the literature to date. This was the aim of the present study.

The present study

We took a model trimming approach in a confirmatory factor analysis (CFA) framework to test whether the four well-validated symptom dimensions of OCD were differentially associated with the Fear, Distress, Thought Disorder, and/or Externalizing spectra in a community sample including targeted recruitment of participants with lived experience of mental illness. We hypothesized that OCD as unitary construct (i.e., treated as

a single disorder-level dimension) would be most strongly related to the Fear spectrum, in line with the HiTOP model (Kotov et al., 2017). We also hypothesized that the symmetry and ordering cluster would have stronger associations with the Fear, Distress or Thought Disorder spectra (i.e., not Externalizing); and that the washing and contamination cluster would be related to the Fear spectrum specifically (Hasler et al., 2005; Leckman et al., 2010; Raines et al., 2015; Rufer et al., 2005). We did not have specific hypotheses regarding the obsession and checking or hoarding clusters, as extant research suggests that they covary with disorders related to all spectra operationalized in the present study. As mentioned above, we examined models with and without hoarding symptoms, as hoarding disorder is empirically distinct from OCD (cf. Angelakis et al., 2019). Finally, we hypothesized that accounting for the heterogeneity of OCD would improve model fit. In the present analyses, this hypothesis corresponds to varying patterns of cross-loadings being required to account for the placement of the four symptom clusters in the model such that removing the corresponding paths from the model results in worse model fit. These hypotheses were made *a priori* and submitted as part of a statistical plan for research coursework during the data collection phase of the project. The *a priori* analytic plan did not guide the primary analyses in the present study, but is summarized in the data analysis section below, the corresponding results are reported in the supplementary materials, and the differences in the results are interpreted in-text.

Method

Participants and Procedure

Participant recruitment aimed to capture a sample with representation and variation in experiences with symptoms of mental illness, ideally with a large representation of individuals with experiences of obsessive-compulsive disorder. A total of 816 individuals living in Australia aged 16 and over began the online survey, including 115 (14.1%) participants recruited from the first-year Psychology student pool at [omitted for blinding]

who completed the survey in exchange for course credit. The remaining participants were recruited from the community by means of social media networks and advertising (e.g., large Facebook groups for individuals with lived experiences of mental illness), special interest organisations (e.g., Tourette Syndrome Association of Australia, and SANE Australia [a national mental health charity]), and flyers located around Sydney seeking participants interested in improving our understanding of mental health and OCD. Community participants had the option to enter a draw for AUD\$100 as compensation for their time. Our Facebook advertisements included broad parameters (over 16 years of age, living in Australia with potential interests in health, mental health and psychology) and yielded the most interest from women aged 18–24 and men aged 18–24 and 45–54.

Participants completed an anonymous online survey that included demographic questions and a battery of self-report measures presented in randomized order to prevent any ordering bias. All of the self-report measures except for OCD and alcohol use were sourced from the emerging measures in Section III of *DSM-5* (APA, 2013). Two validity check items were included to ensure data quality. The first was an instructed item response (i.e., “Select All of the Time”) (Gummer, Roßmann, & Silber, 2018). The second was a reverse-worded version of a duplicate item (i.e., “I am not good at planning ahead” and “I am good at planning ahead”) (Berinsky, Margolis, & Sances, 2014). Both of these validity checks were sourced from empirical articles that reliably measured global and local attention in online surveys (Berinsky et al., 2014; Gummer et al., 2018). Those who failed both attention checks—i.e., did not select the instructed response and varied by more than one point (on a 5-point Likert scale) in their responses to the reverse-coded item pair—were excluded from analysis, as were individuals who completed less than 50% of the survey to maximize data

quality.¹ The instructed response item and reverse-coded item “I am good at planning ahead” were generated for this survey and thus were not included in the calculation of any total scores for analysis.

A total of 609 participants were included in the analytic sample (30.2% male, 66.5% female, 3.3% self-identified as other) with a mean age of 31.6 years (standard deviation = 15.88, range = 16 – 81 years). The most common education level was graduation from High School ($n = 272$, 44.7%). The majority of participants reported having an Australian ethnic background ($n = 453$, 74.4%) and speaking English only at home ($n = 537$, 88.2%). All procedures were approved by the [omitted for blinding] Human Research Ethics Committee.

Measures

OCD. The Y-BOCS Self-Report (YBOCS-SR; Baer, 1991) was the basis for the four-factor model of OCD and demonstrates good construct and convergent validity with the original YBOCS (Summerfeldt et al., 2010; Wu, Watson, & Clark, 2017). The YBOCS-SR contains both a symptom checklist and a severity measure, totalling 69 items, however, in line with Leckman et al. (1997), the miscellaneous section of the checklist was excluded from analysis, leaving 52 items. Following previous research (e.g., du Mortier et al., 2019; Wu et al., 2007) response scales were adjusted from dichotomous to dimensional 5-point Likert scales (0 = Not present, through to 4 = Very Severe). Items were assigned to symptom clusters per Leckman et al. (1997). Overall, the YBOCS-SR total score had high internal consistency ($\alpha = .96$). The four symptom clusters demonstrated appropriate internal consistency relative to their scale length (Ziegler, Kemper, & Kruey, 2014): obsession and

¹ In total, 207 individuals were excluded from analysis. These participants did not differ in terms of sex (32.9% male, 65.7% female, 1.4% self-identified as other; $\chi^2(2) = 2.21, p = .332$) or age (mean 29.5 years, standard deviation = 15.14, range = 16 – 75; $t(811) = -1.66, p = .097$). Like the sample included for analysis, the most common education level was graduation from High School ($n = 97$, 47.1%), and the majority of excluded participants reported an Australian ethnic background ($n = 152$, 73.4%) and speaking English only at home ($n = 176$, 85.0%).

checking (22 items, $\alpha = .93$); symmetry and ordering (5 items, $\alpha = .87$); washing and contamination (12 items, $\alpha = .92$); and hoarding (2 items, $\alpha = .49$). The lower reliability of the hoarding scale was considered when interpreting the results.

Fear measures. The following three measures were sourced from the Dimensional Anxiety Scales for *DSM-5* (Beesdo-Baum et al., 2012) and have demonstrated good validity for assessing symptoms of panic disorder, social anxiety disorder, and specific phobias (Beesdo-Baum et al., 2012). Respondents indicated the extent to which the 10 items in each measure had applied to them in the last seven days on a 5-point Likert scale (0 = Not at all, through to 4 = Almost all the time). The specific measures were as follows:

The *Severity Measure for Panic Disorder – Adult* (Craske et al., 2013a), which demonstrated high internal consistency in the present sample ($\alpha = .95$). The *Severity Measure of Social Anxiety Disorder (Social Phobia) – Adult* (Craske et al., 2013b), which also exhibited high internal consistency ($\alpha = .95$). Lastly, the *Severity Measure for Specific Phobia – Adult* (Craske et al., 2013c) which had adequate internal consistency ($\alpha = .89$).

Distress measures. The *Severity Measure for Depression – Adult* (Kroenke, Spitzer, & Williams, 2013) was adapted from the Patient-Health Questionnaire–9 (Kroenke & Spitzer, 2002). This measure demonstrates good convergent and construct validity for major depression (Kroenke & Spitzer, 2002). Participants respond to 9 items on a 4-point Likert scale (0 = Not at all, through to 3 = Nearly every day) based on the last seven days. This measure had high internal consistency in the current sample ($\alpha = .92$).

The *Severity Measure for Generalized Anxiety Disorder – Adult* (Craske et al., 2013d) measured symptoms of generalized anxiety with good validity and reliability (Beesdo-Baum et al., 2012) and high internal consistency in the present sample ($\alpha = .93$). Participants respond to 10 items on a 5-point Likert-scale (0 = Never, through to 4 = All of the time) based on their last seven days.

The *Kessler Psychological Distress Scale* (K10, Andrews & Slade, 2001) is a well-validated measure of general psychological distress (Mewton et al., 2016). Participants respond to 10 items based on the past 4 weeks, with a 5-point response scale (1 = None of the time, through to 5 = All of the time). The K10 demonstrated high internal consistency in this sample ($\alpha = .94$).

Thought Disorder measures. Measurement of unusual beliefs and experiences and perceptual dysregulation was based on the corresponding subscales of the *Personality Inventory for the DSM-5* (PID-5, Krueger, Derringer, Markon, Watson, & Skodol, 2013a), which is a dimensional assessment of maladaptive personality traits, with high construct validity (Al-Dajani, Gralnick, & Bagby, 2016). Participants report the extent to which items describe them on a 4-point Likert scale (0 = Very False or Often False, through to 3 = Very True or Often True). 12 items measure perceptual dysregulation and 8 items measure unusual beliefs and experiences. Both demonstrated adequate internal consistency in the present sample ($\alpha = .92$ and $\alpha = .86$, respectively).

The *Severity of Dissociative Symptoms – Adult* (Dalenberg & Carlson, 2010) was adapted from the Brief Dissociative Experiences Scale for the *DSM-5* (Dalenberg & Carlson, 2010), which was in turn adapted from the well-validated Dissociative Experiences Scale (Van Ijzendoorn & Schuengel, 1996). Participants respond to 8 items on a 5-point Likert scale (0 = Not at all, through to 4 = More than once a day), regarding how often they have experienced the described items over the last seven days. This measure had adequate internal consistency in the current sample ($\alpha = .84$).

Externalizing measures. Two scales from the brief form of the *PID-5* (Krueger, Derringer, Markon, Watson, & Skodol, 2013b) were used to measure symptoms of disinhibition and antagonism. Each contained 5 items, using the same time frame and response scale as the *PID-5* long form described above. Both disinhibition and antagonism

items showed adequate internal consistency relative to scale length (Ziegler et al., 2014)— $\alpha = .85$ and $\alpha = .74$, respectively.

The *Alcohol Use Disorder Identification Test* (AUDIT, Saunders, Aasland, Babor, de la Puente, & Grant, 2001) measures symptoms of alcohol abuse by asking participants to respond to 10 different items on a 5-point Likert scale, where responses range from zero to four, with response scales matched to the specific item content. The AUDIT has high predictive and construct validity (Lundin, Hallgren, Balliu, & Forsell, 2015) and adequate internal consistency in the current sample ($\alpha = .83$).

Statistical Analyses

After computing univariate and bivariate statistics in SPSS version 25, latent variable models were estimated in Mplus version 7. The total scores from each measure described above were standardized prior to analysis to avoid issues with model identification. Models were estimated using maximum likelihood estimation with robust standard errors to account for the non-normality of the observed variables (Table 1), and were identified by standardizing the latent variables (mean of 0 and variance of 1). Individual model fit was assessed according to fit criteria proposed by Hu and Bentler (1999), including the Comparative Fit Index (CFI) where a score of above 0.95 indicates good model fit and a score above .9 indicates adequate fit; the root mean square error of approximation (RMSEA), where a score less than .06 indicates good fit and a score less than .08 indicates adequate fit (e.g., Schumacker & Lomax, 2004); and the standardized root mean squared residual (SRMR) where a score below .08 indicates good fit. Comparative model fit of each set of models using the same observed variables was assessed using the Bayesian Information Criterion (BIC), where lower values indicate better fit.

The *a priori* analytic plan included 21 confirmatory factor analyses with OCD represented as either a total score on the YBOCS (*unitary OCD models*) or as separate

symptom clusters (*symptom cluster models*), focusing on comparing models with OCD and each symptom cluster tested in turn as an indicator of the Fear, Distress, Externalizing, or Thought Disorder spectra. Two exploratory models were also tested to better understand the results, and the results of all of these models are reported in the Supplementary Materials.

Based on feedback during the review process, we took a model trimming analytic approach instead to better understand which factor loadings represented important parameters in the models (e.g., to test whether cross-loadings were required to adequately fit the patterns in the data). After testing the fit of the base HiTOP model (i.e., not including OCD), we tested a *unitary OCD model* and a *symptom cluster model*, in line with the original analytic plan. The *unitary OCD model* started with OCD loading on all four of the latent variables (Fear, Distress, Externalizing, and Thought Disorder), and these loadings were incrementally removed (i.e., fixed to zero) based on the cross-loading with the largest p -value at each step. As each loading was removed, model fit was compared to the preceding model based on BIC and the Satorra-Bentler chi-square difference test (Satorra & Bentler, 2010). When the removal of a factor loading resulting in an increase in BIC and a significant chi-square difference test ($p < .05$), the loading was deemed necessary and retained. The same approach was taken in the *symptom cluster model*, which started with all four symptom clusters (obsession and checking, symmetry and ordering, washing and contamination, and hoarding) loading on all four latent variables. The *symptom cluster model* included a YBOCS factor to account for the shared method variance among the four symptom subscales. Finally, a version of the *symptom cluster model* excluding hoarding was tested to reflect the omission of hoarding symptoms from the diagnosis of OCD symptom in DSM-5 (cf. Angelakis et al., 2019).

Results

The present sample had substantial clinically significant psychopathology (Table 1).

For example, 81% of participants had clinically significant symptoms in at least one of the domains with established cut-off criteria, including 67% with clinically significant distress, as defined by the Australian Bureau of Statistics' recommended cut-off score for high distress (Australian Bureau of Statistics, 2012). OCD was especially well represented in this sample, as over half of the participants exceeded the recommended cut-off for detecting clinically significant symptoms (Farris, McLean, Van Meter, Simpson & Foa, 2008). The correlation matrix in Table 2 displays results consistent with the psychopathology literature, where the majority of indicators tend to be moderately to strongly correlated (Krueger, 1999). A noteworthy exception here is alcohol abuse, which was weakly correlated with other symptom domains and correspondingly had weak and non-significant factor loadings in all models.

Factor Analyses

The model fit statistics are shown in Table 3. The base HiTOP model (not including any OCD variables) and the trimmed models all had adequate model fit. The trimmed *unitary OCD model* (i.e., treating OCD as a single dimension) included similar cross-loadings for OCD from both the Thought Disorder ($\lambda = .43$ [.30-.57]) and Fear ($\lambda = .36$ [.23-.49]) spectra (see Figure 2).

The trimmed *symptom cluster model* also included cross-loadings for all of the symptom clusters (Figure 3): The obsession and checking symptom cluster had similar cross-loadings from both the Thought Disorder ($\lambda = .39$ [.22-.57]) and Fear ($\lambda = .37$ [.23-.51]) spectra, and a weak cross-loading with Externalizing ($\lambda = .11$ [.01-.21]). The washing and contamination symptom cluster also had similar cross-loadings from both the Thought Disorder ($\lambda = .24$ [.07-.41]) and Fear ($\lambda = .29$ [.13-.45]) spectra. The symmetry and ordering symptom cluster loaded on the Fear spectrum ($\lambda = .37$ [.22-.51]) with a somewhat weaker cross-loading to the Thought Disorder spectrum ($\lambda = .21$ [.05-.37]). Finally, the hoarding

symptom cluster loaded on the Thought Disorder spectrum ($\lambda = .40$ [.24-.57]) with a weaker cross-loading to the Fear spectrum ($\lambda = .17$ [.02-.33]). Analyses excluding the hoarding symptom cluster were nearly identical for the other clusters (see Table 3 and Figure S3).

The results in Table 3 alone illustrate that the symptom clusters required different patterns of factor loadings (i.e., dropping even the weakest cross-loading for obsession and checking on Externalizing resulted in a significant decrement in model fit). However, to further test whether accounting for heterogeneity in OCD at the symptom cluster level was important, we also tested whether the loadings for the four symptom clusters on the Fear and Thought Disorder spectra could be constrained to equality for each latent variable. Adding these constraints resulted in significantly worse model fit ($\chi^2(6) = 25.19, p < .0005$), indicating that the patterns of the loadings for the symptom clusters were different.

In the pre-planned confirmatory factor analyses, the best *unitary OCD model* included OCD under the Thought Disorder spectrum; the best *symptom cluster models* included both the obsession and checking cluster and the and hoarding cluster under Thought Disorder, and both the washing and contamination cluster and the symmetry and ordering cluster under Fear. The results are presented in full in the supplementary materials, and are considered in interpreting the results below.

Discussion

The current study aimed to account for inconsistencies in the extant literature that has examined the location of OCD in an empirical model of psychopathology; studies have variably found evidence that OCD forms part of the Fear, Distress and Thought Disorder spectra in the current HiTOP model (see Figure 1). We hypothesized that the inconsistent placement for OCD in the literature could be due to its heterogeneity, characterized by four well-validated symptom clusters. Specifically, we expected that these symptom clusters would be differentially associated with different spectra of psychopathology. We tested a

variety of models in factor analytic frameworks, representing OCD both as a unitary construct and divided into four constituent symptom clusters. We found that OCD and all four symptom clusters had significant associations of varying strength with the Thought Disorder and Fear spectra; none were significantly associated with the Distress spectrum. We now turn to discuss these results in the context of the extant literature.

Unitary OCD. In line with the current HiTOP model, we hypothesized that OCD would be most strongly associated with the Fear spectrum when treated as a unitary construct. In contrast to this hypothesis, OCD fit best under the Thought Disorder spectrum when forced to load on a single spectrum, and in a model-trimming framework the best model had cross-loadings of similar strength to both Fear and Thought Disorder. These results are broadly consistent with the literature that has found OCD to be associated with the Fear and/or Thought Disorder spectra, but at odds with the majority of studies that have found OCD to be part of the Fear spectrum specifically.

A likely reason for the predominant finding that OCD loads on Fear is that a significant proportion of the literature has not included sufficient indicators to identify a Thought Disorder spectrum (i.e., there is been no opportunity to model the relationship of OCD with Thought Disorder in these studies; Lahey et al., 2007; Rozenman et al., 2017; Sellbom et al., 2008; Slade, 2007; Slade & Watson, 2006). When studies have identified both Fear and Thought Disorder spectra, OCD has tended to either cross-load between the two (e.g., Kotov et al., 2015), or fit well as part of the Thought Disorder spectrum (e.g., Caspi et al., 2014; Laceulle et al., 2015).

Notably, the sample used in the present study had elevated mean scores and substantial variability in the symptom scales identifying the Thought Disorder spectrum (see Table 1; cf. Quilty, Ayearst, Chmielewski, Pollock, & Bagby, 2013), which avoided the restriction of range and suppressed covariation with these scales that might be expected in

typical community samples. Taken together with the literature, the results in the present study indicate that both Thought Disorder and Fear spectra play substantive and integral roles to conceptualizing OCD. This perspective could integrate the discrepant findings in the literature and provides a preliminary case for considering OCD as an indicator of both the Fear and Thought Disorder spectra in the next revision of the HiTOP framework.

OCD Symptom Clusters. When dividing OCD into its constituent symptom clusters, our findings provided mixed support for our (largely non-specific) hypotheses. For example, the symmetry and ordering cluster fit best under the Fear spectrum when forced to load on a single spectrum and loaded most strongly on Fear in the model-trimming framework; in the latter it also had a somewhat weaker cross-loading to Thought Disorder. This is consistent with the extant literature which finds significant associations between symmetry and ordering and Fear-related disorders (Hasler et al., 2005; Leckman et al., 2010; Raines et al., 2015; Rufer et al., 2005), as well as elements of dissociation and mania common in Thought Disorders (Hasler et al., 2005; Leckman et al., 2010).

The washing and contamination cluster also fit best under the Fear spectrum when forced to load on a single spectrum, as hypothesized, but had a similar strength cross-loading on Thought Disorder in the model-trimming framework that was not hypothesized. The literature suggests that washing and contamination concerns most commonly co-occur with panic and eating disorders (Hasler et al., 2005; Raines et al., 2005), which aligns with the broad Internalizing spectrum in the HiTOP model, rather than Thought Disorder (Kotov et al., 2017). One explanation for the unexpected association with Thought Disorder may be that many of the symptoms themselves have elements of both phobic anxiety and psychosis-like symptoms. For example, the feared aversive outcomes that drive obsessions and compulsions may contain aspects of delusion, such as “washing my hands three times prevents my entire family from dying”.

The obsession and checking cluster fit best under the Thought Disorder spectrum when forced to load on a single spectrum, and but had a similar strength cross-loading on the Fear spectrum in the model-trimming framework as well as a weak cross-loading on the Externalizing spectrum, in line with the existing literature (e.g., Leckman et al., 2010; Raines et al., 2015; Rufer et al., 2005). The weak association with the Externalizing spectrum may reflect an association with substance use specifically (Rufer et al., 2005). It is possible that this association would have been stronger had we included more varied indicators of Externalizing, particularly of substance use.

Finally, hoarding symptoms fit best under Thought Disorder when forced to load on a single spectrum and loaded most strongly on the Thought Disorder spectrum in the model-trimming framework; in the latter it also had a somewhat weaker cross-loading on Fear. This finding is consistent with the similarity between the nature of obsessions in OCD and hoarding with the nature of obsessions within Thought Disorder indicators like schizophrenia (Chmielewski & Watson, 2008; Wu & Watson, 2005). The somewhat weaker association with the Fear spectrum is also consistent with findings relating hoarding symptomatology to symptoms of panic and social anxiety disorders, which were direct indicators of Fear in the present study (de Mathis et al., 2016; Leckman et al., 2010; Wheaton, Timpano, LaSalle-Ricci, & Murphy, 2008).

In order to reflect the literature indicating that hoarding is empirically distinct from OCD (Abramowitz et al., 2008; Chmielewski & Watson, 2008; Leckman & Bloch, 2008; Weiss & Khan, 2015; Wu & Watson, 2005), we also tested a model that did not include the hoarding symptom cluster (cf. Angelakis et al., 2019), which did not affect the results for the other clusters. While the results in the present study may provide preliminary evidence for incorporating Hoarding Disorder into the HiTOP framework as part of the Thought Disorder and/or Fear spectra, hoarding-related symptoms were only measured with two items here

about obsessions and compulsions related to hoarding, limiting both construct validity and reliability. It will be essential for future research to include reliable and valid measures of Hoarding Disorder symptoms specifically to test where they belong in the HiTOP framework.

A key hypothesis for this study was that models that accounted for the heterogeneity of OCD would improve model fit. In line with extant research, OCD symptoms formed a coherent and distinct dimension of psychopathology (i.e., requiring correlated errors in the CFA approach and a method factor in the model trimming approach; Dornbach-Bender et al., 2017; Waszczuk et al., 2017; Wright et al., 2013). However, as discussed above, the symptoms clusters had differential patterns of association with the transdiagnostic spectra in the HiTOP model, and the unitary OCD and symptom cluster models all required cross-loadings to more than one spectrum. These results highlight important heterogeneity at both the disorder- and symptom cluster-level of OCD. As mentioned above, we expect that the shared underlying processes captured by the Fear and Thought Disorder dimensions are also likely to extend beyond the symptom clusters to the level of individual symptoms.

Interestingly, neither OCD as a unitary construct nor any of the symptom clusters showed a substantive association with the Distress spectrum (cf. Cox et al., 2010; Raines et al., 2015). One explanation for this may be that when patterns of comorbidity among traditional diagnostic categories are a focus (e.g., Cox et al., 2010), the intrinsic measurement of clinically significant distress associated with the symptoms of OCD may inflate the relationship with Distress. Further, the exclusive focus in Raines et al. (2015) on worry symptoms to index the Distress spectrum may have inflated the associations with intrusive and uncontrollable thoughts in OCD. Notably, these studies also found equally strong or even stronger associations for OCD as a unitary construct and broken down into symptom clusters with indicators of the Fear spectrum. The present study arguably operationalized the HiTOP model more appropriately for adjudicating the position of OCD.

Taken together, our results highlighted a consistent pattern of associations for OCD and its constituent symptom clusters with both the Fear and Thought Disorder spectra. Incorporating cross-loadings for OCD to these spectra the HiTOP model would acknowledge the internal coherence of OCD symptoms as well as the important heterogeneity in these symptoms and would accommodate the majority of the findings in other studies to date. We propose that future research on other domains of psychopathology would also benefit from accounting for heterogeneity within traditional diagnostic constructs by taking a symptom- or symptom cluster-level approach to modelling the structure of psychopathology (e.g., Conway, Latzman, & Krueger, 2019; Forbes et al., 2020; Waszczuk et al., 2017). Taking this approach could reconcile other divergent results in the literature (e.g., for Post-Traumatic Stress Disorder; Kotov et al., 2017), and would improve our understanding of the heterogeneity within diagnoses that is lost when we focus on diagnostic categories as well as the detailed structure of psychopathology.

Limitations and Future Directions

Some strengths of this study included the high rates of psychopathology in the sample and being the first to test where symptom clusters from the four-factor model of OCD fit into a broad characterization of the HiTOP framework. The focus on patterns of covariation in current symptom presentation will also have reduced the heterogeneity obscured by examining lifetime experiences of psychopathology. However, there were also several important limitations—in addition to those discussed above—that should be considered in interpreting the results, such as the non-representative nature of the sample and the need for replicating and extending these results in future research. For example, it is important to note that both the model-trimming approach and the large number of *a priori* models compared present a risk of over-fitting the data used here. Future research should take a more restricted confirmatory approach to analyses now that a candidate symptom-cluster level model for

OCD in the empirical structure of psychopathology is clearer. Further, our choice of self-report measures may have narrowed the construct validity of the Distress and Externalizing spectra in particular. For example, the measure of general distress had substantial conceptual overlap with the measures of generalized anxiety and depression, and the Externalizing spectrum was dominated by personality pathology. Using disinhibition and antagonism scales from the same inventory (i.e., the PID-5 Brief Form; Krueger et al., 2013) may have resulted in an Externalizing spectrum measuring personality traits, rather than externalizing symptoms broadly. This seems particularly likely given alcohol use was a weak indicator of the spectrum despite the substantial representation of participants meeting clinical cut-off scores for alcohol misuse in the AUDIT (31%; Saunders, Aasland, Babor, de la Puente, & Grant, 2001). Future research should thus use different and more diverse measures to provide comprehensive coverage of psychopathology and test the robustness of these findings. Finally, the miscellaneous OCD items measured in the YBOCS were omitted from analysis in the four-factor model, in line with Leckman et al. (1997). However, this model was created before the importance of components such as mental rituals were highlighted (McKay et al., 2004) and they were therefore classified as miscellaneous. Future research should perhaps not sacrifice symptom detail (i.e., exclude items from well-validated measures) for the sake of parsimony (Forbes et al., 2020).

Conclusion

The current study aimed to clarify the placement of OCD within an empirical framework of psychopathology. When testing OCD as a unitary construct, the findings added to the literature arguing that OCD is related to the Thought Disorder spectrum, which is at odds with the current HiTOP model where OCD is only included an indicator of the Fear spectrum (Figure 1). However, the heterogeneous symptom clusters that compose OCD were differentially related to the Fear and Thought Disorder spectra, as well as closely related to

one another. OCD might thus be best accounted for as an indicator of both the Fear and Thought Disorder spectra. We propose that future research should consider taking a more detailed approach to understanding the structure of psychopathology to improve our understanding of heterogeneous diagnoses.

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Table 1.

Descriptive statistics of the observed variables (n = 609)

Symptom Domain	Observed range	Mean (SD)	Skew	Kurtosis	% exceeding clinical cut-off criteria
OCD Symptom Checklist	0–120	27.5 (24.22)	1.21	1.15	-
OCD Severity Ratings	0–44	11.2 (8.73)	0.67	- 0.12	53.2
Obsession and Checking	0–64	15.6 (14.03)	1.19	1.01	-
Symmetry and Ordering	0–20	5.0 (4.70)	1.17	0.75	-
Washing and Contamination	0–39	5.7 (7.53)	1.80	3.14	-
Hoarding	0–8	2.2 (1.81)	0.93	0.57	-
Social Phobia	0–40	12.5 (10.39)	0.65	- 0.62	35.6
Specific Phobia	0–40	9.2 (9.22)	1.02	0.32	27.1
Panic Disorder	0–40	9.1 (9.86)	1.07	0.11	19.6
General Distress	10–50	25.9 (10.24)	0.38	- 0.49	67.4
Major Depression	0–27	11.2 (7.77)	0.37	- 0.93	52.4
Generalized Anxiety	0–40	13.2 (9.5)	0.60	- 0.49	40.6
Disinhibition	0–15	3.5 (3.54)	0.96	0.09	7.9
Antagonism	0–15	2.8 (2.76)	1.36	2.06	2.7
Alcohol Abuse	0–29	5.9 (5.32)	1.21	0.10	31.1
Unusual Beliefs and Experiences	0–24	4.9 (5.05)	1.16	0.83	4.6
Perceptual Dysregulation	0–36	8.9 (8.20)	0.93	0.17	6.6
Dissociation	0–32	8.8 (6.92)	1.05	0.61	-

Note: those marked with ‘-’ under the column ‘% exceeding cut-off criteria’ are indicated as such because there are no established cut-off criteria for these scales. Established cut-off criteria indicate clinically significant (mild or greater) levels of each symptom domain (Australian Bureau of Statistics, 2012; Andrews & Slade, 2001; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Beesdo-Baum et al., 2012; Farris, McLean, Van Meter, Simpson, & Foa, 2008; Kroenke, Spitzer, & Williams, 2013; Samuel et al., 2013. SD = Standard Deviation; OCD = Obsessive Compulsive Disorder.

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Table 2.

Correlation Matrix of Indicators

	OCD	O/C	S/O	W/C	H	SPEC	SOC	PD	GD	ANX	MDD	DIS	ALC	ANT	UBE	PDYS	DISS
OCD																	
O/C	.94**																
S/O	.81**	.68**															
W/C	.81**	.61**	.60**														
H	.75**	.67**	.76**	.48**													
SPEC	.53**	.52**	.40**	.41**	.33**												
SOC	.62**	.64**	.46**	.41**	.45**	.57**											
PD	.63**	.64**	.49**	.43**	.44**	.60**	.78**										
GD	.58**	.60**	.43**	.39**	.41**	.53**	.74**	.69**									
ANX	.65**	.67**	.51**	.44**	.49**	.61**	.83**	.79**	.80**								
MDD	.53**	.58**	.39**	.33**	.39**	.48**	.73**	.66**	.88**	.77**							
DIS	.41**	.44**	.26**	.24**	.32**	.24**	.34**	.31**	.33**	.34**	.34**						
ALC	.02	.05	-.02	.01	-.03	-.03	-.03	-.00	-.04	-.02	-.01	.25**					
ANT	.17**	.21**	.09*	.07	.12**	.03	.08	.06	.12**	.09*	.11**	.35**	.12**				
UBE	.48**	.48**	.38**	.34**	.40**	.36**	.40**	.42**	.38**	.43**	.36**	.37**	-.01	.22**			
PDYS	.62**	.67**	.44**	.40**	.47**	.49**	.63**	.61**	.62**	.64**	.61**	.45**	-.00	.25**	.56**		
DISS	.60**	.63**	.42**	.40**	.46**	.47**	.63**	.60**	.62**	.63**	.61**	.43**	-.01	.25**	.52**	.76**	

Note: O/C = Obsession and Checking; S/O = Symmetry and Ordering, W/C = Washing and Contamination, H = Hoarding, SPEC = Specific Phobia, SOC = Social Anxiety, PD = Panic Disorder, GD = General Distress, ANX= Generalized Anxiety, MDD = Major Depression, DIS = Disinhibition, ALC = Alcohol Abuse, ANT = Antagonism, UBE = Unusual Beliefs and Experiences, PDYS = Perceptual Dysregulation, DISS = Dissociation. * $p < .05$, ** $p < .01$

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Table 3. *Model Fit Indices for the Factor Analyses*

Model	Factor loading	<i>p</i>	Free parameters	SRMR	CFI	RMSEA	BIC	Chi-square difference test
Base HiTOP (no OCD)	-	-	42	0.047	0.95	0.083	15802.40	-
Unitary OCD								
All cross-loadings	-	-	48	0.046	0.95	0.079	17087.58	-
Drop OCD on Distress	-0.16	0.178	47	0.046	0.95	0.079	17083.32	$\chi^2(1) = 1.90, p = .168$
<i>Drop OCD on Externalizing</i>	<i>0.09</i>	<i>0.058</i>	<i>46</i>	<i>0.046</i>	<i>0.95</i>	<i>0.079</i>	<i>17081.95</i>	$\chi^2(1) = 4.87, p = .027$
Drop OCD on Fear	0.36	<0.0005	45	0.049	0.94	0.083	17107.19	$\chi^2(1) = 23.70, p < .0001$
Symptom components								
All cross-loadings	-	-	70	0.044	0.95	0.071	20970.72	-
Drop H on Distress	-0.04	0.788	69	0.044	0.95	0.071	20964.41	$\chi^2(1) = 0.07, p = .791$
Drop S/O on Externalizing	0.03	0.601	68	0.044	0.95	0.070	20958.31	$\chi^2(1) = 0.27, p = .603$
Drop W/C on Externalizing	0.03	0.673	67	0.044	0.95	0.069	20952.28	$\chi^2(1) = 0.18, p = .671$
Drop S/O on Distress	-0.09	0.521	66	0.044	0.95	0.068	20946.61	$\chi^2(1) = 0.40, p = .527$
Drop O/C on Distress	-0.10	0.458	65	0.044	0.95	0.067	20941.29	$\chi^2(1) = 0.57, p = .450$
Drop H on Externalizing	0.06	0.227	64	0.044	0.95	0.067	20936.87	$\chi^2(1) = 1.47, p = .225$
<i>Drop W/C on Distress</i>	<i>-0.20</i>	<i>0.183</i>	<i>63</i>	<i>0.044</i>	<i>0.95</i>	<i>0.067</i>	<i>20933.42</i>	$\chi^2(1) = 1.76, p = .185$
Drop O/C on Externalizing	0.11	0.035	62	0.044	0.95	0.067	20935.82	$\chi^2(1) = 8.27, p = .004$
Symptom components - excluding Hoarding								
All cross-loadings	-	-	63	0.045	0.95	0.070	19780.91	-
Drop W/C on Externalizing	0.04	0.620	62	0.045	0.95	0.069	19774.89	$\chi^2(1) = 0.25, p = .617$
Drop S/O on Externalizing	0.02	0.775	61	0.045	0.95	0.068	19768.57	$\chi^2(1) = 0.08, p = .773$
Drop S/O on Distress	-0.11	0.450	60	0.045	0.95	0.068	19762.90	$\chi^2(1) = 0.57, p = .450$
Drop O/C on Distress	-0.04	0.664	59	0.045	0.95	0.067	19756.72	$\chi^2(1) = 0.19, p = .663$
<i>Drop W/C on Distress</i>	<i>-0.13</i>	<i>0.360</i>	<i>58</i>	<i>0.045</i>	<i>0.95</i>	<i>0.066</i>	<i>19751.55</i>	$\chi^2(1) = 0.84, p = .359$
Drop O/C on Externalizing	0.12	0.023	57	0.044	0.95	0.067	19755.96	$\chi^2(1) = 9.50, p = .002$

Note: The selected model for each model set is italicized. BIC cannot be compared between the models separated by sub-headings in the table, as these models are based on different observed variables. Factor loading is the standardized (STDYX) factor loading that was dropped in the model; *p* is the *p*-value of that loading, SRMR = standardized root mean squared residual, CFI = comparative fit index, RMSEA = root mean square error of approximation, BIC = Bayesian information criterion, chi-square difference test it the Satorra-Bentler scaled chi-square difference test comparing the nested model (fixing the listed factor loading to zero) to the preceding model. H = Hoarding, S/O = Symmetry and Ordering, W/C = Washing and Contamination, O/C = Obsession and Checking.

Figure Captions

Figure 1. The current HiTOP model. SAD = Separation Anxiety Disorder, OCD = Obsessive Compulsive Disorder, MDD = Major Depressive Disorder, GAD = Generalized Anxiety Disorder, PTSD = Post-Traumatic Stress Disorder, PD = Personality Disorder, ODD = Oppositional Defiant Disorder, ADHD = Attention-Deficit Hyperactivity Disorder, IED = Intermittent Explosive Disorder.).

Kotov, Krueger, Watson et al. (2017). The Hierarchical Taxonomy of Psychopathology (HiTOP): A dimensional alternative to traditional nosologies. *Journal of Abnormal Psychology*, 126, 454-477. 2017. American Psychological Association. Reprinted with permission.

Figure 2. The best trimmed model when OCD is represented as a total score on the YBOCS-SC. OCD is highlighted in grey. Error terms are not shown. Standardized factor loadings are presented. SPEC = Specific Phobia, SP = Social Phobia, PD = Panic Disorder, GD = General Distress, ANX= Generalized Anxiety, MDD = Major Depressive Disorder, DIS = Disinhibition, ALC = Alcohol Abuse, ANT = Antagonism, UBE = Unusual Beliefs and Experiences, PDYS = Perceptual Dysregulation, DISS = Dissociation

Figure 3. The best trimmed model with the symptom clusters included as separate variables. Symptom clusters are highlighted in grey. Error terms are not shown. Standardized factor loadings are presented. S/O = Symmetry and Ordering, W/C = Washing and Contamination, O/C = Obsession and Checking, H = Hoarding, SPEC = Specific Phobia, SP = Social Phobia, PD = Panic Disorder, GD = General Distress, ANX= Generalized Anxiety, MDD = Major Depression, DIS = Disinhibition, ALC = Alcohol Abuse, ANT = Antagonism, UBE = Unusual Beliefs and Experiences, PDYS = Perceptual Dysregulation, DISS = Dissociation, YBOCS = variable to account for the shared method variance among the YBOCS subscales.

Figure 1.

Figure 2.

Figure 3.