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The Hierarchical Taxonomy of Psychopathology (HiTOP): A Quantitative Nosology Based on Consensus of Evidence

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Abstract

Traditional diagnostic systems went beyond empirical evidence on the structure of mental health. Consequently, these diagnoses do not depict psychopathology accurately, and their validity in research and utility in clinical

practice are therefore limited. The Hierarchical Taxonomy of Psychopathology (HiTOP) consortium proposed a model based on structural evidence. It addresses problems of diagnostic heterogeneity, comorbidity, and unreliability. We review the HiTOP model, supporting evidence, and conceptualization of psychopathology in this hierarchical dimensional framework. The system is not yet comprehensive, and we describe the processes for improving and expanding it. We summarize data on the ability of HiTOP to predict and explain etiology (genetic, environmental, and neurobiological), risk factors, outcomes, and treatment response. We describe progress in the development of HiTOP-based measures and in clinical implementation of the system. Finally, we review outstanding challenges and the research agenda. HiTOP is of practical utility already, and its ongoing development will produce a transformative map of psychopathology.

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1. INTRODUCTION

The Hierarchical Taxonomy of Psychopathology (HiTOP) consortium was formed in 2015 as a grassroots effort to articulate a fully empirical classification of psychopathology (**http://medicine.stonybrookmedicine.edu/HITOP**), a system defined strictly by findings of nosologic research.

The motive for proposing this classification was to aid clinical practice and mental health research. The consortium was organized by Roman Kotov, Robert F. Krueger, and David Watson. At inception it included 40 psychologists and psychiatrists, who made substantial scientific contributions to the classification of psychopathology. The consortium was based on a common understanding that (*a*) traditional diagnoses have fundamental limitations, (*b*) statistically derived (i.e., quantitative) constructs can address many of these limitations, (*c*) it is useful to organize constructs hierarchically from narrow to broad, (*d*) only constructs with sufficient empirical support should be included in the model (further constructs would be added as the science matures), and (*e*) the proposed classification can be used in research and clinical practice already, as many included constructs can be operationalized with existing measures.

This team published the first version of the HiTOP model in 2017 (Kotov et al. 2017). The consortium has grown substantially since then; it now includes 132 nosologists with diverse backgrounds and has produced 15 consortium publications to date as well as numerous papers by smaller groups. It has begun to have an impact on research and clinical practice, as evidenced by over 1,800 citations of consortium publications and ongoing HiTOP field trials in a network of clinics. This review describes the progress of the HiTOP initiative over the first 5 years and its future objectives. We discuss general issues and then specific topics pursued in the nine workgroups operating within the consortium.

2. LIMITATIONS OF TRADITIONAL NOSOLOGIES

The existing approach to psychiatric diagnosis was established in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) (APA 1980) and adopted globally in the tenth revision of the *International Classification of Diseases* (ICD) (WHO 1992). It specifies explicit diagnostic criteria and emphasizes observable characteristics. Although these developments improved the comparability of national health statistics and clarity of the diagnostic process (Kendell & Jablensky 2003), this approach nevertheless suffers from several shortcomings.

First, the fundamental assumption of DSM-III that all mental disorders are categories is not supported by data, as studies consistently have found evidence of continuity between psychopathology and normality (Haslam et al. 2020, Krueger et al. 2018). The most recent versions of DSM and ICD (i.e., DSM-5 and ICD-11) are beginning to introduce dimensional ratings, but most diagnoses remain categorical (APA 2013, Narrow et al. 2013, Reed et al. 2019). Second, this categorical nomenclature leads to loss of information and reduced reliability (MacCallum et al. 2003, Markon et al. 2011). Indeed, diagnoses show low stability over time (Bromet et al. 2011, Shea et al. 2002) and between diagnosticians (Regier et al. 2013). Third, traditional systems treat mental disorders as independent conditions, but co-occurrence (i.e., comorbidity) among them is very common (Caspi et al. 2020, Kessler et al. 2005). This substantially complicates research designs and clinical decision making. Fourth, many traditional diagnoses are quite heterogeneous and include symptoms that have little in common (Clark et al. 1995, Galatzer-Levy & Bryant 2013, Hasler et al. 2004). Fifth, many patients fall short of the criteria for any DSM-5 diagnosis despite having significant distress or impairment that indicates the need for care, so they receive a diagnosis of Other Specified/Unspecified disorder. This is a common diagnosis even though it provides little information about the illness (Goodman et al. 2017, Machado et al. 2007, Verheul & Widiger 2004).

These problems have significant consequences. The sluggish pace of discovery in psychiatry has been attributed in part to the failure of diagnoses to accurately represent psychopathology (Cuthbert & Insel 2013, Hyman 2010, Lilienfeld & Treadway 2016). Moreover, DSM and ICD offer limited guidance regarding care. Clinicians frequently forego a formal diagnostic assessment

and prescribe treatment based more on symptoms than on diagnosis (Ruggero et al. 2019b, Taylor 2016, Waszczuk et al. 2017), as many perceive diagnostic manuals as unhelpful (First et al. 2018).

3. QUANTITATIVE NOSOLOGY

In contrast, quantitative nosology follows findings of structural research to construct the classification of psychopathology (Kotov et al. 2017, Krueger et al. 2018). Rather than relying on the consensus of expert committees, the quantitative approach seeks consensus of studies on the natural organization of mental health. This approach has a history that spans 90 years of research to identify empirical constellations of signs and symptoms (e.g., Achenbach 1966, Eysenck 1944, Krueger et al. 1998, Lorr et al. 1963, Moore 1930, Overall & Gorham 1962, Wittenborn 1951). This work produced influential models and widely used instruments. Similar techniques were used to develop classifications of affect, personality traits, and cognitive abilities (Carroll 1993, Costa & McCrae 2008, Markon et al. 2005, McGrew 2009, Watson & Tellegen 1985). The resulting models achieved wide acceptance in their fields and proved to be effective guides for research and practice.

Importantly, quantitative research not only explicates latent structures but also tests their external validity. Identification of a natural structure is the first step in the development of a nosology, and investigation of its validity is an equally important next step. By 2016, the number of quantitative studies was sufficient for the HiTOP consortium to develop the first version of the system, which was finalized during an in-person meeting at the University of Chicago.

4. HiTOP MODEL

Three fundamental findings shaped HiTOP. First, psychopathology is best characterized by dimensions, as indicated by extensive research (Krueger et al. 2018). This approach addresses two shortcomings of traditional diagnoses. Specifically, dimensional description improves reliability (Markon et al. 2011, Narrow et al. 2013, Shea et al. 2002) and eliminates the need for Other Specified/Unspecified diagnoses, as every person has a standing on each dimension and thus is described. Nevertheless, some qualitative boundaries may exist in psychopathology. If categorical entities are identified and replicated, they would be added to HiTOP. Indeed, the term dimensional is not used in the name of the model, in recognition of openness to evidence on discrete entities.

Second, the natural organization of psychopathology can be discerned in co-occurrence of its features. Classification that follows co-occurrence ensures coherence of diagnostic entities, so that related signs and symptoms are assigned together to tightly knit dimensions, whereas unrelated features are placed on different dimensions. This addresses the problem of heterogeneity.

Third, psychopathology can be organized hierarchically from narrow to broad dimensions. Numerous studies have found that specific psychopathology dimensions aggregate into more general factors (e.g., Forbes et al. 2017, Kotov et al. 2017, Lahey et al. 2017, Michelini et al. 2019, Waszczuk et al. 2017). This hierarchical arrangement addresses the comorbidity problem. Patterns of comorbidity are represented by higher-order dimensions. Accordingly, comorbidity is measured and expressed in scores that researchers and clinicians can use. Higher-order dimensions can be targeted to focus on commonalities or alternatively controlled to focus on specific features.

HiTOP was formulated based on these principles. The model consists of hierarchically organized dimensions identified in covariation of psychopathology features (**Figure 1**). Signs, symptoms, and maladaptive behaviors are grouped into specific dimensions: symptom components and

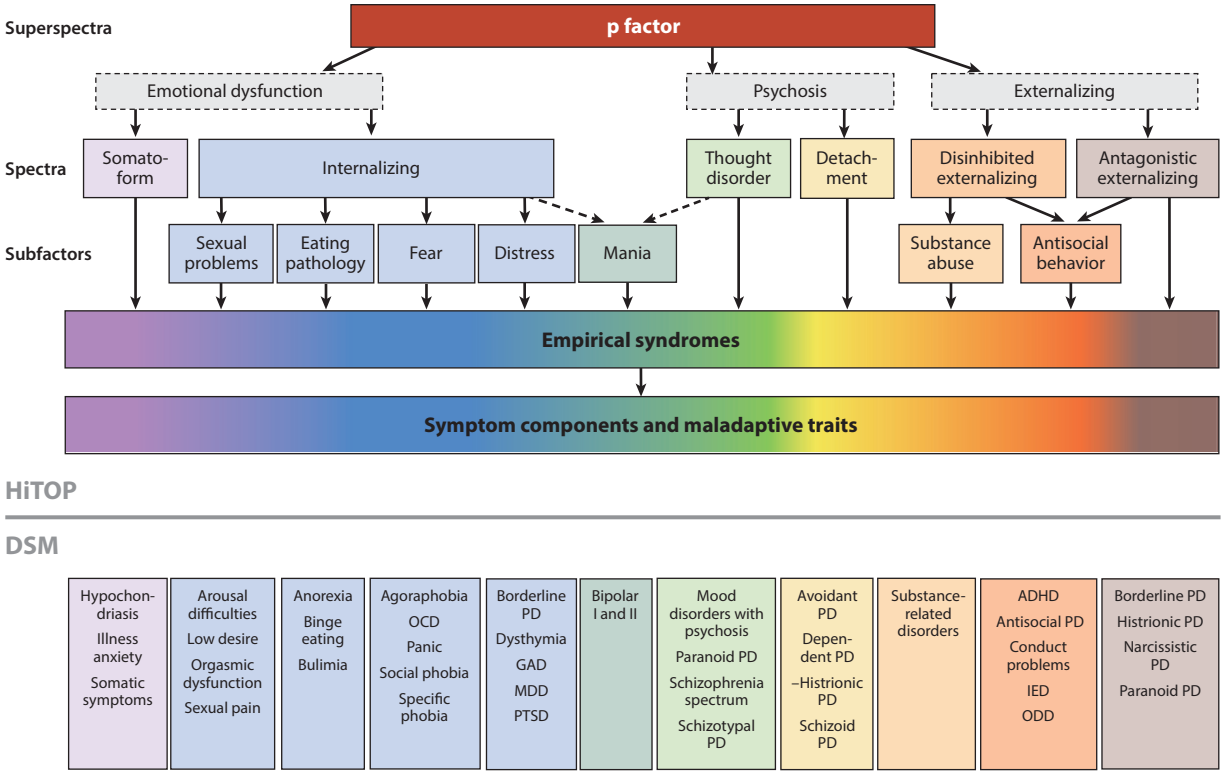

Figure 1

HiTOP model. DSM diagnoses are not included in the HiTOP model, but symptoms and signs that constitute them are in HiTOP. Dashed lines indicate dimensions included on a provisional basis. Emotional dysfunction, psychosis, and externalizing superspectra are hypothesized but not formally part of HiTOP at present. Symptoms of histrionic PD are negatively related to the detachment spectrum. Symptom components and maladaptive traits are listed in Kotov et al. (2017, figure 3). Abbreviations: ADHD, attention-deficit/hyperactivity disorder; DSM, *Diagnostic and Statistical Manual of Mental Disorders*; GAD, generalized anxiety disorder; HiTOP, Hierarchical Taxonomy of Psychopathology; IED, intermittent explosive disorder; MDD, major depressive disorder; OCD, obsessive–compulsive disorder; ODD, oppositional defiant disorder; PD, personality disorder; PTSD, posttraumatic stress disorder.

maladaptive traits (e.g., performance anxiety, separation insecurity). Over 100 such dimensions have been proposed (Kotov et al. 2017). Closely related components and/or traits are combined into dimensional syndromes (e.g., social anxiety). Clusters of syndromes form subfactors (e.g., fear). Larger clusters form spectra, six of which have been included in HiTOP so far. Spectra can be combined into superspectra, such as the general p factor and hypothesized emotional dysfunction, psychosis, and externalizing (Kotov et al. 2020). Importantly, HiTOP syndromes are dimensional and do not necessarily map onto traditional disorders. Studies often have used disorders to define higher-order HiTOP dimensions, but disorders are only proxies. HiTOP does not include DSM and ICD disorders; instead, it aims to model signs and symptoms described in these manuals (as well as additional symptoms) and reorganize them based on evidence.

HiTOP is focused on psychological dysfunction (e.g., experiencing irrational fears, perceiving one's own body as foreign) rather than its consequences for functioning in society (e.g., absenteeism from work, conflict with romantic partner). In this respect, HiTOP is aligned with ICD-11, which was designed to separate signs and symptoms from disability. In contrast, DSM-5 conflates psychological dysfunction and its consequences, and therefore distress or impaired

functioning in society is required for nearly all diagnoses (Clark et al. 2017). Both HiTOP and ICD-11 take the position that psychopathology can be significant whether or not the person is disabled by it. The primary reason DSM-5 includes consequences of psychopathology is a concern about overdiagnosis and pathologizing of normal experience. These issues are a product of categorical diagnosis—specifically, of its implication that disorders are qualitatively different from normality. In contrast, dimensional description emphasizes continuity of human experience. Although functioning in society is not part of the HiTOP model itself, functioning is useful to assess in addition to HiTOP profile.

5. SUPPORTING EVIDENCE

The HiTOP model was articulated in the first consortium paper that reviewed research on the structure of psychopathology and its external validity (Kotov et al. 2017). Subsequent consortium papers expanded the evidence base, especially for validity (Conway et al. 2019; Hopwood et al. 2020; Kotov et al. 2020; Krueger et al. 2018; Latzman et al. 2020; Perkins et al. 2020; Ruggero et al. 2019b; Waszczuk et al. 2019; Widiger et al. 2019a,b). Altogether, these papers reviewed 554 empirical studies or systematic reviews/meta-analyses of HiTOP dimensions. Specifically, 261 psychometric studies examined latent classes, latent dimensions, and changes in latent structures over time and developed omnibus measures of these structures. In addition, 134 genetic studies of multiple phenotypes (12 family, 82 twin, and 40 molecular) found that the genetic structure of psychopathology closely mirrors the structure of HiTOP. Also, 45 neuroscience studies linked HiTOP phenotypes to electroencephalographic, magnetic resonance imaging, and functional magnetic resonance imaging markers. Moreover, 66 studies found that HiTOP can provide clinicians with guidance on risk factors, cognitive impairment, everyday functioning, stress exposure, and prognosis. Further, 28 studies found that HiTOP is useful for predicting treatment outcome, selecting treatment, and providing targets for treatment development. Also, 20 studies reported that HiTOP descriptions improve reliability and are more acceptable to clinicians than are traditional diagnoses. In addition, 14 narrative reviews—each encompassing numerous studies—examined multiple validators of HiTOP dimensions and found support for the p factor, internalizing, disinhibited externalizing, and thought disorder spectra. Especially encouraging are findings of studies that compared the explanatory and predictive power of HiTOP with that of traditional diagnoses and found a twofold increase in power on average, strongly arguing for the greater utility of HiTOP.

This substantial body of evidence enabled HiTOP to characterize the majority of psychopathology. However, some conditions lacked the research needed for their inclusion (**Table 1**). Among 19 disorder classes of DSM-5, HiTOP incorporates 8 fully, 6 in part (some but not all conditions are covered), and 5 not at all. For those included, strength of evidence varied, resulting in some provisional placements (e.g., somatoform spectrum, cross-spectrum placement of mania).

6. FUNDAMENTAL CONCEPTS AND QUESTIONS

In addition to the three fundamental findings described above, several core concepts shaped HiTOP and require further elaboration.

6.1. Nature of Dimensions

The model is based on research that identified latent dimensions of psychopathology. Importantly, these dimensions are descriptive. They allow an informative and parsimonious description of psychopathology but are agnostic regarding causes (Kotov et al. 2017). We can hypothesize

Table 1 Strength of evidence for placement of psychopathology within HiTOP

DSM-5 disorder class	HiTOP spectrum (subfactor)	Structural evidence	Validation
Substance-related	Disinhibited (substance abuse)	Strong	Strong
Disruptive, impulse-control, and conduct	Disinhibited (antisocial behavior)	Strong; kleptomania and pyromania were not studied	Strong
Depressive	Internalizing (distress)	Strong	Strong
Anxiety	Internalizing (GAD on distress, others on fear)	Strong	Strong
Personality	Various spectra	Strong; limited for obsessive–compulsive PD	Variable, from strong to none
Schizophrenia spectrum	Thought disorder	Strong	Strong
Bipolar and related	Internalizing and thought disorder—provisional	Moderate	Moderate
Sexual dysfunctions	Internalizing (sexual problems)	Moderate	Limited
Trauma- and stressor-related	Internalizing (distress)	Strong (PTSD only)	Moderate (PTSD only)
Obsessive–compulsive and related	Internalizing	Moderate (OCD only)	Limited (OCD only)
Feeding and eating	Internalizing (eating)	Moderate for eating; feeding disorders were not studied	Limited
Somatic symptom	Somatoform—provisional	Limited	Limited
Neurodevelopmental	ADHD on disinhibited (antisocial behavior); other presently unknown	Moderate for ADHD; limited for others	Strong
Sleep–wake	Insomnia on internalizing (distress); others presently unknown	Strong (insomnia only)	Limited (insomnia only)
Neurocognitive	Presently unknown	None	Strong
Dissociative	Presently unknown	Limited	Limited
Elimination	Presently unknown	None	None
Gender dysphoria	Presently unknown	None	None
Paraphilic disorders	Presently unknown	None	None

Evidence reviewed in development of the HiTOP model was rated as strong (many studies with consistent results), moderate (several studies with consistent results or many with inconsistent results), limited (few studies), and none (no studies). Abbreviations: ADHD, attention-deficit/hyperactivity disorder; DSM-5, *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition; GAD, generalized anxiety disorder; HiTOP, Hierarchical Taxonomy of Psychopathology; OCD, obsessive–compulsive disorder; PD, personality disorder; PTSD, posttraumatic stress disorder.

that each HiTOP dimension is not just a cluster of symptoms but in fact indicates a specific psychological function (e.g., insomnia perhaps reflects sleep regulation; social withdrawal reflects attachment). Even if the hypothesis is accurate, these functions may be very complex mechanistically. Nevertheless, HiTOP facilitates the search for causes and mechanisms of psychopathology by identifying coherent constructs that can be measured reliably and are thus more tractable and informative than traditional diagnoses (e.g., dimension of negative symptoms rather than highly heterogeneous schizophrenia diagnosis) (Kotov et al. 2020). Moreover, HiTOP dimensions are open concepts. Traditional disorders can be defined precisely because they were constructed according to stated definitions (e.g., DSM-5 defines personality disorder). In contrast, HiTOP summarizes patterns observed in data, so tentative definitions of resulting constructs, such as internalizing, can be proposed but are not clear until extensive validation and theory development

have been completed. The best descriptions available at present are sets of signs and symptoms that characterize each dimension.

6.2. Scope of HiTOP

Thus far, HiTOP has been based on information obtained from reporters (i.e., via questionnaires and interviews) and some behavioral observations, but not task performance, such as on neuropsychological tests. However, the scope of the model is not limited to reports; it also includes tasks and other behavioral markers (e.g., digital phenotypes collected with mobile devices) that measure individual differences in psychological functions, including levels of impairment. Accordingly, the consortium is working to incorporate dimensions such as verbal memory and stereotyped behavior. In contrast, biological measures and processes observed within-person without clear between-person differences are not currently considered for inclusion.

6.3. Symptom–Trait Interface

HiTOP includes features of current status (signs and symptoms) and enduring characteristics (maladaptive traits), and relations between them are not yet fully explicated. The leading conceptualization is that symptoms and maladaptive traits differ only in time frame: A symptom component reflects current functioning (e.g., past week), whereas the corresponding trait reflects functioning on the same dimension in general—that is, over many years (DeYoung et al. 2020). Symptoms fluctuate over time, and traits also change but more slowly, so a trait level may be conceptualized as a moving average of the corresponding symptom (Fleeson & Gallagher 2009, Ormel et al. 2013, Wright & Simms 2016). For example, the disorganized symptoms dimension and the eccentricity trait can be considered the same construct, comprising the same behaviors, just seen in different time frames (Kotov et al. 2020). These parallels are not always clear, such as whether (*a*) alcohol dependence symptoms translate into a coherent trait when viewed from the lifetime perspective or (*b*) the identity problems trait manifests in behaviors that can be considered symptoms. Although most trait and symptom dimensions are linked, HiTOP likely includes some traitless symptoms and symptomless traits.

6.4. History-Within-Trait Conjecture

Is HiTOP able to capture lifetime history of psychopathology, or is it limited to current status? Maladaptive traits reflect functioning over some years, but trait measures may miss a past episode that would be identified by a diagnostic interview. Whether this is problematic depends on the purpose of the psychiatric history assessment; in many situations, it is done to inform prognosis (Croft et al. 2015, Koerner et al. 2011). Not all past episodes are predictive of future outcomes; for example, adolescent-limited antisocial behavior that fully resolved might not indicate increased risk of legal problems in a 45-year-old. Thus, we can posit a history-within-trait conjecture—a proposition that maladaptive traits fully capture the ability of psychiatric history to predict future psychopathology. Indeed, traits are among the most powerful predictors of future symptoms and diagnoses (Jeronimus et al. 2016). Etiologic factors underpinning mental disorders also shape traits (Barrantes-Vidal et al. 2015, Durbin & Hicks 2014, Klein et al. 2011), and vulnerabilities that elicited past episodes likely influenced traits as well; thus, trait measures capture this risk. Alternatively, past episodes that left no trace in current traits are not likely to recur (Conway et al. 2016, Durbin & Hicks 2014, Vittengl et al. 2014). This conjecture suggests that trait assessments can effectively replace traditional evaluation of lifetime history, but support for the conjecture is currently indirect.

6.5. Illness Course Features

At present, HiTOP does not explicitly include illness course features. Traditional features such as age of onset, number of episodes, length of illness, and remission are not directly applicable to dimensions. Alternative features that can be applied include individual differences in symptom trajectory over time, size and frequency of fluctuations around this trajectory, temporal sequence of change in different symptoms, and sensitivity of the symptom to external factors such as life stress and treatment. Measurement of these features requires intensive longitudinal assessments, which have become more feasible with the development of smartphone and mobile monitoring technologies (Wright & Woods 2020). As this science matures, longitudinal features will be incorporated into HiTOP.

Currently, HiTOP interfaces with longitudinal questions in two ways. First, it provides reliable phenotypes that enhance the statistical power and precision of longitudinal research. HiTOP dimensions have been used in more than 20 longitudinal studies, which demonstrated measurement invariance and substantial temporal stability (e.g., Eaton et al. 2013, Kotov et al. 2015, McElroy et al. 2018, Vollebergh et al. 2001). Second, cross-sectional comparisons between linked traits and symptoms can reveal some elements of illness trajectory. For example, a higher level of current depression than trait depressivity suggests an acute problem that is likely to return to the trait level. This comparison also can distinguish episodic depression from chronic depression. Such applications are intuitive but have not been rigorously tested. HiTOP's strengths and weaknesses for understanding development are discussed in Section 8.

6.6. Clinical Ranges

Clinical care often requires categorical decisions, and to be maximally useful, HiTOP needs to specify at what severity level a given action is indicated. Ranges can be identified on dimensions that are each tailored to different clinical actions (e.g., one for initiating antidepressant, another for hospitalization), as has been done in internal medicine for such dimensional variables as blood pressure, cholesterol, and weight (Kraemer et al. 2004). In mental health, this approach was implemented in clinical staging models (Shah et al. 2020). Currently, severity ranges have been specified for HiTOP based on statistical deviance: 1.0–1.5 SD above the mean is mild, 1.5–2.0 SD is moderate, and >2.0 SD is severe (Ruggero et al. 2019b). Such statistical ranges have performed well in other fields, including neuropsychological testing and medical blood tests. However, ranges that are optimized for a specific clinical decision require more complex considerations that weigh rates of false positives and false negatives associated with different cutoffs, costs of the negative outcome, and the effectiveness and cost of the intervention (Stasik-O'Brien et al. 2019). This optimization reflects a balance of costs and benefits, which entails value judgments and is not just a statistical problem. Internal medicine and other disciplines have navigated these challenges successfully and provide good models for HiTOP.

6.7. Hierarchy Levels

Numerous levels of a hierarchy can be identified reliably—for instance, one can look at the p factor, then two dimensions nested within it, then three dimensions, and so forth down to the most specific level, which appears to include over 100 dimensions (Goldberg 2006). Different levels are optimal for different objectives. For example, the p factor offers a succinct index of psychopathology that is ideal for certain administrative decisions (e.g., anticipating health care utilization), spectra such as detachment and antagonism are important in selection of treatment format (group versus individual), and symptom components such as anhedonia can provide specific targets for

treatment development (Kotov et al. 2016, Michelini et al. 2019). It is likely that only a handful of levels in the comprehensive hierarchy are uniquely useful and should be emphasized. **Figure 1** spotlights six such levels, but this number is subject to revision as more data become available. In the next several sections, we discuss specific topics pursued in each HiTOP workgroup: Revisions, Developmental, Quantitative Methods, Normal Personality, Genetics, Neurobiological Foundations, Utility, Clinical Translation, and Measures Development.

7. PROCESS OF REVISING HiTOP

The Revisions Workgroup was formed to ensure that the HiTOP model remains up-to-date with current research and that changes to the model are empirically based. Indeed, HiTOP is intended to be a living model, which requires an ongoing revision process. Moreover, certain limitations of the initial model need to be addressed, including provisional elements, gaps in coverage, and core questions described above. Therefore, there is a pressing need for consensual procedures to facilitate empirical modifications to the model. Multiple procedures for refining similar frameworks were developed previously, such as the processes for revision of DSM-IV (Regier et al. 2013) and the National Institute of Mental Health's Research Domain Criteria (RDoC) (Morris & Cuthbert 2012), but these protocols relied on committees and thus were particularly susceptible to preconceptions of committee members and special interests (Krueger et al. 2018). In contrast, the HiTOP consortium is committed to focusing on the evidence. Accordingly, the fundamental task for the Revisions Workgroup is to develop and implement procedures to ensure that elaboration of the HiTOP model is data driven.

Traditional diagnostic systems rely on the strategy for revision originally outlined in seminal work by Robins & Guze (1970). This approach begins with a clinical description and proceeds to validation by longitudinal illness course (follow-up studies), genetics (family studies), and biomarkers (laboratory studies). Importantly, clinical description may come from any source, including clinical experience of the person proposing the change to nosology. The HiTOP revision process also includes detailed validation but advances the approach of Robins & Guze (1970) by elaborating and formalizing the descriptive stage of revision. HiTOP considers quantitative evaluation of psychopathology to be the essential first step. Structural research evaluates the internal validity of the construct (Loevinger 1957), and once viable alternative structural models have been identified, external validation can help to select between these options.

The current HiTOP revisions protocol includes the following elements. First, proposals for changes to the model may be initiated by anyone, provided the team includes at least one consortium member to ensure in-depth knowledge of the HiTOP model. Second, the proposal is completed in standardized format and requires a thorough review of structural and external validity evidence, designed as a systematic review whenever possible. Third, proposals are shared with the entire consortium to benefit from the broad expertise of its members. Fourth, the revised proposal is reviewed using standardized criteria by a panel of experts in the topic recruited among consortium members. Fifth, based on consensus among members of the review panel, the Revisions Workgroup recommends either no change, provisional change, or a confirmed change to the model. Sixth, ratification of the proposal by representatives of consortium members results in formal change to the model, identified on the consortium website and optimally published in a peer-reviewed journal for broader dissemination.

The specific criteria used to evaluate proposals were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) (Guyatt et al. 2008) system, which is widely used in medicine to rate the quality of evidence for clinical practice recommendations.

There are clear parallels between the process of developing medical guidelines and revision of a nosology like HiTOP, although there are some clear differences too. In the HiTOP adaptation of the GRADE system, the criteria that contribute to the quality rating of the structural evidence include study design, risk of method bias, appropriateness of construct measurement, relevance of each study to the proposal (how directly each study targets the proposed change), discriminant validity (sufficient markers of diverse content included, and reasonable competing models tested), and effect size. When critical information is not available in published studies (e.g., comparison of competing models), proposers are encouraged to obtain and reanalyze the original data. Moreover, proposals are encouraged to evaluate external validity evidence in nine domains (Andrews et al. 2009) to support or clarify the position of the construct. Ultimately, this process is intended to be nimble enough to keep pace with a rapidly growing literature on the structure of psychopathology, but not so fickle as to result in numerous changes without substantiated support.

8. HiTOP OVER THE LIFE SPAN

The HiTOP model was developed based on research in children, adults, and older individuals, but the majority of data came from adults (Kotov et al. 2017). Consequently, generalizability of HiTOP outside the age range of 15 to 65 years is uncertain. The Developmental Workgroup was formed to fill these gaps and explicate developmental processes involved in HiTOP throughout the life span.

Many higher-order dimensions have been replicated in children, including the p factor, internalizing, externalizing, and thought disorder (e.g., Achenbach 2020, Laceulle et al. 2015, McElroy et al. 2018, Olino et al. 2014). However, the lower-order level likely shows more differences with age, as manifestations of psychopathology in youth depend in part on access to regulated items (e.g., cars, alcohol, firearms), peer influence, pubertal status, and developmental stage (Van Hulle et al. 2009). Conversely, in older individuals (ages 60+), aggressive and rule-breaking behaviors do not appear to form a coherent externalizing factor (Achenbach 2020)—an observation that may reflect a lower base rate or different etiology.

Another limitation is that HiTOP does not capture developmental progression within dimensions, such as unfolding of the disinhibited externalizing spectrum that often follows a predictable pattern with age (e.g., Moffitt 2018). It also does not capture the interplay between mental disorders over time (Caspi et al. 2020, Plana-Ripoll et al. 2019). Indeed, some HiTOP dimensions were found to predict future worsening of other dimensions (i.e., heterotypic continuity) (e.g., McElroy et al. 2018). Evolution of psychopathology over time may reflect an interface of stable factors (e.g., genetic liability) that maintain it and transient effects (e.g., stressful life event, treatment) that modify it. Also, dimensions can influence each other via evocative effects, such as alcohol abuse leading to job loss that then triggers depression. Moreover, the expression of HiTOP dimensions at a given age almost certainly depends on developmentally relevant stressors (e.g., peer stress in adolescence) and developmental stage, such as emergence of sex differences in depression with pubertal maturation (Hankin et al. 2015).

For HiTOP to become a more developmentally informed and developmentally appropriate system, several questions need to be addressed. Some issues are practical, such as adapting HiTOP measures to different age groups to facilitate developmental research. Others are conceptual, such as integrating individual differences in how dimensions codevelop within a person (e.g., whether inattention worsens with depression or these two dimensions progress independently). Finally, it is crucial to expand coverage of the system to include more childhood-onset psychopathology, such as autism or reactive attachment, and aging-related psychopathology, such as dementia.

9. DEVELOPMENT OF QUANTITATIVE METHODS

Improvement of the HiTOP model requires sophisticated statistical methods. The Quantitative Methods Workgroup was formed to apply cutting-edge analytic methods and develop new ones. The workgroup aims to address the following issues.

Commonly used structural models of psychopathology include a correlated factors model that places all latent dimensions on the same level of hierarchy (Kotov et al. 2011, Krueger et al. 1998, Markon 2010), a higher-order structure that adds levels for more general factors to represent features shared by specific dimensions (Conway et al. 2019, Waszczuk et al. 2017), and a bifactor model that also includes a general factor but removes shared variance from specific dimensions (Caspi et al. 2014, Lahey et al. 2012). Despite the increasing popularity of a general factor of psychopathology, concerns have been raised regarding potential biases that may result in the artifactual appearance of this factor (e.g., Bonifay et al. 2017). The Quantitative Methods Workgroup completed a simulation study to investigate such biases (Greene et al. 2019). Data were generated from a correlated factors model with a minor deviation (one residual correlation between indicators). Across many simulated data sets, the bifactor model fit the data better than the correct (correlated factors) model, underscoring limitations of fit indices in selecting between such structures. The workgroup is now expanding the simulation study to consider multiple other potential biases. Other ongoing workgroup projects include (*a*) development of recommendations for best practices in adjudicating structural models, (*b*) systematically testing replicability of different structural models across studies, (*c*) the biasing effect of zero inflation—common in psychopathology data—on estimates of latent structure, and (*d*) review of statistical issues in evaluating the external validity of a psychopathology hierarchy (a collaboration with the Utility Workgroup).

Another focus of the workgroup is to clarify the "dark matter of psychopathology"—conditions whose placement in HiTOP is uncertain, such as neurodevelopmental conditions, mania, and eating disorders. We will conduct new analyses that will test alternative placements of these conditions. In dark matter projects, the workgroup performs secondary analyses of existing data and also collaborates with the Measures Development Workgroup to explicate structures in data collected with instruments designed specifically for HiTOP.

10. NORMAL PERSONALITY AND HiTOP

Personality research studies individual differences throughout the general population, and HiTOP focuses on the pathological ranges of these dimensions. Consequently, research on the structure of general personality is directly relevant to HiTOP. Taxonomies of general personality were developed to organize all psychological attributes that humans can describe (e.g., comprehensive analyses of adjectives abstracted from dictionaries) (Goldberg 1993). These traits may be considered individual differences in psychological functions, and abnormalities in any of them fall within the scope of HiTOP, alongside other forms of dysfunction (e.g., intellectual deficits).

The Normal Personality Workgroup was formed to explicate relations between personality traits and HiTOP. This work is organized around the five-factor model (FFM), the predominant model of personality, which includes broad domains of emotional stability versus neuroticism, extraversion versus detachment, openness (or intellect), agreeableness versus antagonism, and conscientiousness versus disinhibition. FFM personality traits have significant implications for important life outcomes, including a variety of medical and mental health problems. According to Tackett & Mullins-Sweatt (2021, p. 743), "Research on personality and psychopathology has increased from just over 8,000 new research products in 2001 to over 20,000 new research products every year for the past 5 years" as of 2020.

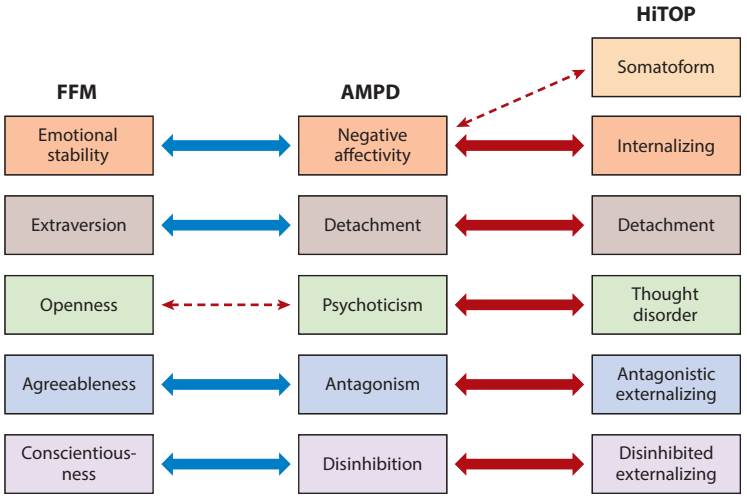

Figure 2

Crosswalk between domains of general personality, personality pathology, and HiTOP. Red arrows indicate positive signs of association. Blue arrows indicate negative signs of association. Dashed lines indicate associations that are weaker and not yet settled. Abbreviations: AMPD, Alternative Model of Personality Disorder; FFM, five-factor model; HiTOP, Hierarchical Taxonomy of Psychopathology.

Personality and psychopathology may be related because (*a*) they share etiology (spectrum model), (*b*) one plays a causal role in the development of another (predisposition or scar), and (*c*) one influences the presentation of another (pathoplasty). The spectrum relationship likely is central to understanding the interface of personality and HiTOP. Indeed, the five domains of the Alternative Model of Personality Disorder (AMPD) included in DSM-5 Section III align with the FFM domains (**Figure 2**), although the link between psychoticism and openness is unsettled.

HiTOP spectra, in turn, correspond closely to AMPD domains. These AMPD dimensions form the core of five HiTOP spectra, which include traits—alongside signs and symptoms—that are very similar to AMPD traits as detailed in the first paper of the Normal Personality Workgroup (Widiger et al. 2019b). Only the somatoform spectrum does not include traits currently, but it shows clear links to negative affectivity (Brandes & Tackett 2019). AMPD also includes a set of self–interpersonal impairments derived from psychodynamic theory. The second workgroup paper reviewed self–interpersonal impairments and concluded that they are fully captured by HiTOP (Widiger et al. 2019a).

The third workgroup paper proposed that most symptom and trait dimensions in HiTOP are the same constructs seen on different timescales (DeYoung et al. 2020). Other studies were completed by smaller teams within the workgroup. A special article collection (**https://www.sciencedirect.com/journal/journal-of-research-in-personality/special-issue/103DVMMM674**) in the *Journal of Research in Personality* included five articles that reviewed how each FFM domain links to HiTOP and psychopathology in general (Brandes & Tackett 2019, Lynam & Miller 2019, Mullins-Sweatt et al. 2019, Watson et al. 2019, Widiger & Crego 2019) as well as nine papers focused on specific empirical issues, such as personality–psychopathology associations in youth (Watts et al. 2019). Furthermore, a special issue of *Personality and Mental Health* included nine papers on diverse questions regarding HiTOP traits, such as their clinical applications in treatment of personality (Conway & Simms 2020). Indeed, if personality includes the predisposition to psychopathology, then perhaps personality should itself become the focus of intervention before dysfunction develops.

Accordingly, future work by the workgroup will focus on developing treatment protocols for general personality traits. For example, empirically validated treatment protocols already exist for neuroticism (Sauer-Zavala et al. 2017). Mullins-Sweatt et al. (2020) discussed potential psychotherapeutic and pharmacological treatment recommendations for HiTOP traits and the utility of a trait approach for clinical assessment, prognostication, and treatment planning. However, many of these recommendations are speculative or inferred from research on traditional diagnoses. Thus, an important scientific priority is to examine how HiTOP traits respond to various therapeutic techniques.

11. GENETICS

Genetics is an important validator of psychiatric nosology. The Genetics Workgroup reviewed a large body of family, twin, and molecular genetic studies and concluded that the genetic architecture of psychopathology is largely in line with the organization of the HiTOP model (Waszczuk et al. 2019). Accordingly, HiTOP offers an effective approach to genetic discovery and research on etiology.

11.1. Genetic Evidence for the HiTOP Model

In line with the dimensional approach embodied in HiTOP, behavioral and molecular genetic studies have demonstrated that genetic liability to psychopathology is continuously distributed in the general population and patient samples (Martin et al. 2018). For example, the same genetic factors influence mild and severe psychotic experiences, indicating that genetic liability to different levels of the thought disorder spectrum differs in degree rather than in kind (Zavos et al. 2014).

Psychiatric genetic research also has provided compelling evidence that genetic influences transcend diagnostic boundaries (Martin et al. 2018, Smoller et al. 2019) and may follow a multitiered hierarchical organization (Lahey et al. 2017) akin to HiTOP. Specifically, a proportion of genetic vulnerability is common across most mental disorders (i.e., pleiotropy), consistent with the HiTOP general factor. Conversely, other genetic vulnerabilities are specific to narrower HiTOP dimensions, such as spectra, traits, and symptom components. Thus, the genetic architecture of psychopathology includes genetic influences operating at different levels of specificity.

Numerous studies have observed genetic factors that align with HiTOP dimensions (Waszczuk et al. 2019). For example, a Swedish national study of >1.5 million siblings identified three genetic factors: general, specific to thought disorder, and specific to nonpsychotic disorders (Pettersson et al. 2016). Nonetheless, genetically informed studies are needed to evaluate the hypothesized genetic structure of several understudied HiTOP dimensions, such as the detachment spectrum and the sexual problems subfactor.

Analyses of genome-wide association studies (GWASs) have been consistent with the behavioral genetic evidence. They have found that a significant proportion of genomic influence is pleiotropic and common to numerous psychiatric disorders, whereas other genetic influences are disorder-specific (Grotzinger et al. 2019, Lee et al. 2019, Selzam et al. 2018). A structure with correlated internalizing, externalizing, thought disorder, and neurodevelopmental spectra has emerged from meta-analyses of GWAS data (Waldman et al. 2020). Overall, existing molecular genetic evidence supports several major HiTOP dimensions, and others can be tested as evidence becomes available for more forms of psychopathology.

11.2. Implications of HiTOP for Genetic Research

HiTOP promises to provide more valid and reliable phenotypes than traditional diagnoses to maximize statistical power and precision of genetic studies. HiTOP-based studies rather than the

case–control design can reveal more genetic loci for two reasons. First, under many conditions, dimensional characterization of psychopathology offers more statistical power in GWASs (Van der Sluis et al. 2013). Moreover, it is often more feasible to meet power requirements by assessing a full spectrum of psychopathology in a large, representative population than to recruit a sufficient number of cases with a rare disorder.

Second, HiTOP provides empirically validated phenotypes at each level of the hierarchy, allowing a search for genes operating with different specificity. Accordingly, some studies already have used higher-order spectra as targets for discovery GWASs. For example, a meta-analysis of generalized anxiety disorder, panic, agoraphobia, social phobia, and specific phobia GWASs identified novel variants associated with the overarching internalizing factor (Otowa et al. 2016). Conversely, focusing on symptom components, an anhedonia GWAS found 11 novel variants specific to this dimension (Ward et al. 2019). Overall, different genetic discoveries are expected to emerge at each level of the hierarchy, and HiTOP provides phenotypes for explicating this architecture systematically. Moreover, these more precise phenotypic definitions may help identify a larger number of genetic loci and build informative genetic tools, such as polygenic risk scores.

12. NEUROSCIENCE

The Neurobiological Foundations Workgroup investigates links between psychopathology and neurobiological systems as well as the ability of HiTOP dimensions to facilitate clinical neuroscience research. To date, the progress in identifying reliable neurobiological indicators of psychopathology has been limited despite the development of powerful tools for quantifying variation in the human brain. This issue is due primarily to the shortcomings of traditional diagnoses rather than to any inherent limitation of biological approaches to psychopathology (Gordon & Redish 2016, Insel et al. 2010, Latzman et al. 2020). In studies that assessed both diagnoses and dimensions, neural variables were more strongly linked to dimensions (Kircanski et al. 2018, Reininghaus et al. 2019). Diagnoses sometimes showed no associations even when significant results were observed for dimensions.

Numerous studies have confirmed associations between the internalizing spectrum and the extended amygdala as well as the amygdala's connections with the rostral anterior cingulate cortex (Hur et al. 2019, Marusak et al. 2016). A similarly robust literature links the externalizing superspectrum to reduced amplitude of the P300 event-related brain potential, an electrophysiological indicator of reduced cognitive control (Gao & Raine 2009, Venables et al. 2018). Research on the p factor has identified replicable associations with widespread reductions in cortical thickness (Romer et al. 2021). These findings are particularly robust, but many other associations also have been identified between HiTOP constructs and neurobiological markers (Michelini et al. 2020).

One important feature of HiTOP is that it enables researchers to test neurobiological mechanisms at multiple levels of the hierarchy in a single study, as different biological processes are likely to confer risk at different levels. For example, studies in the Philadelphia Neurodevelopmental Cohort found distinct neural correlates for dimensions corresponding to the p factor, externalizing, distress, fear, and thought disorder (Kaczkurkin et al. 2018, 2019; Shanmugan et al. 2016; Xia et al. 2018).

HiTOP also interfaces with initiatives to design etiologically based dimensional frameworks for psychopathology research, including RDoC (Insel et al. 2010), the National Institute on Alcohol Abuse and Alcoholism's Addictions Neuroclinical Assessment (ANA) (Kwako et al. 2016), and the National Institute on Drug Abuse's Phenotyping Assessment Battery (NIDA PhAB) (NCT03495869). These frameworks consist of dimensions grounded in neuroscience that encompass both behavior and biology. HiTOP provides a complementary system that can be

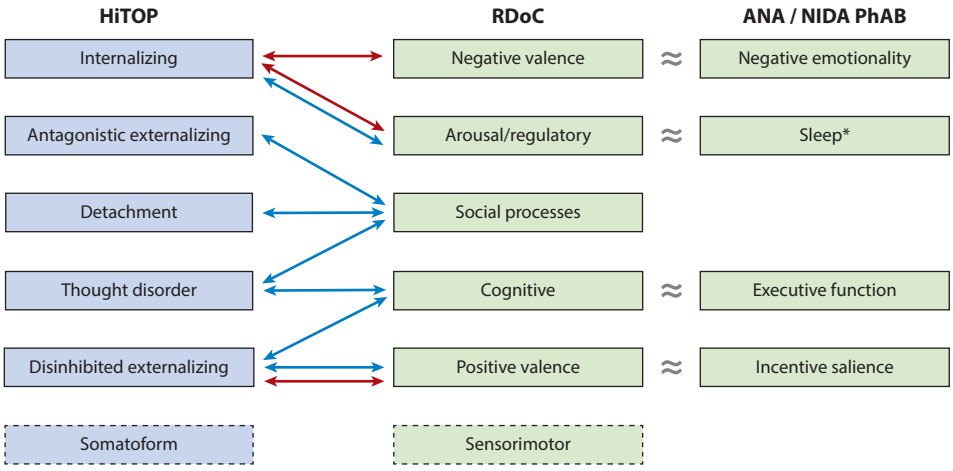

Figure 3

Crosswalk between HiTOP and National Institutes of Health frameworks. Depicted links between HiTOP and RDoC are the strongest and most consistent (Michelini et al. 2020). Red arrows indicate positive signs of association. Blue arrows indicate negative signs of association. Double arrows indicate that constructs within the RDoC domain show different signs. Approximate equality (≈) symbols show pairs of similar domains. The asterisk indicates a domain included in NIDA PhAB but not ANA. (NIDA PhAB domains that have not been mapped to RDoC are not depicted.) Abbreviations: ANA, Addictions Neuroclinical Assessment; HiTOP, Hierarchical Taxonomy of Psychopathology; NIDA PhAB, National Institute on Drug Abuse's Phenotyping Assessment Battery; RDoC, Research Domain Criteria.

used to link data on biobehavioral systems to patterns of signs and symptoms that lead people to seek treatment (e.g., Michelini et al. 2020). HiTOP also can facilitate clinical application of the biobehavioral frameworks by providing a crosswalk between constructs grounded in neuroscience and clinical presentations. **Figure 3** depicts the most consistent connections of HiTOP with RDoC, ANA, and NIDA PhAB.

13. UTILITY IN RESEARCH

HiTOP provides a new set of constructs and different degrees of resolution—from narrow components to broad spectra—for substantive psychopathology research. The Utility Workgroup was formed to study and facilitate applications of HiTOP in such research.

The first workgroup paper reported extensive evidence of utility (Conway et al. 2019). In addition to aforementioned genetic and neuroscience findings, prospective studies observed that HiTOP dimensions can capture effects of environmental stressors. Childhood maltreatment, peer victimization, racial discrimination, and other potent stressors that occur early in development appear to primarily predict individual differences in spectra and superspectra (e.g., Keyes et al. 2012, Snyder et al. 2019), and much of their effect on risk for traditional disorders is conferred indirectly through these higher-order dimensions. That said, some modest direct effects of life stress on disorders have been documented (e.g., Rodriguez-Seijas et al. 2015).

Also, HiTOP constructs are useful predictors of clinical outcomes, such as chronicity, impairment, and suicidality. Ample evidence indicates that dimensional phenotypes, regardless of breadth, are more informative than traditional diagnoses in prognostication (e.g., Eaton et al. 2013, Morey et al. 2012). They also account for psychosocial impairment both concurrently and prospectively, explaining differences in impairment several times better than categorical diagnoses

(e.g., Forbush et al. 2017). Other outcomes, such as suicidality and future treatment-seeking, appear to follow the same pattern (e.g., Morey et al. 2012, Sunderland & Slade 2015).

These applications have only scratched the surface of HiTOP's utility for research. HiTOP can advance substantive studies in many ways. First, HiTOP dimensions can serve as outcomes of experimental manipulations both in the lab and in a randomized clinical trial, although such applications are understudied. Second, HiTOP can be assessed directly with validated measures (Kotov et al. 2017), avoiding the complications of extracting dimensions from DSM-based data using tools like factor analysis that require larger samples. Third, modeling of symptom-level data enables investigators to simultaneously examine psychopathology at multiple levels of breadth in relation to the same criterion.

As research in this vein progresses, we will learn HiTOP's value not just as a nosology but also as a research tool. Accumulating evidence supports the utility of partitioning psychopathology into dimensions of varying breadth (Conway et al. 2019). This framework reveals—in ways that traditional nosologies cannot—what components of psychopathology, ranging from the p factor to homogenous symptom components, are most salient in a particular substantive question. This knowledge can help to develop more nuanced theories and improve economy in research design.

14. MEASURES DEVELOPMENT

HiTOP has to be directly measurable to fully realize its potential in research and practice. The consortium is working along two routes to address this need. First, the Clinical Translation Workgroup identified a set of HiTOP-consistent measures that can be used immediately (see Section 15). Second, the Measures Development Workgroup is constructing both questionnaire and interview tools. These instruments will measure all HiTOP dimensions and provide crucial comprehensive data for testing and revising HiTOP.

The Measures Development Workgroup includes more than 40 psychometrics experts and is organized in five subgroups structured by spectra (a single externalizing subgroup is responsible for both disinhibited and antagonistic spectra). Construction of measures is proceeding through three phases, guided by the principles of construct-valid scale development (Clark & Watson 2019, Loevinger 1957, Simms & Watson 2007). Phase 1 focused on construct definition and item development, followed by multiple data collections within each spectrum to develop preliminary scales. Scale development principles were articulated collaboratively across subgroups and designed to produce preliminary scales with good internal coherence and discriminant validity within the spectrum. Phase 1 is now complete. Phase 2 will provide cross-validation data. All preliminary scales will be administered together; the goals are to finalize the scales, study their joint structure, collect representative norms, and examine moderators of structure, such as gender/sex and ethnicity/race. Phase 2 will be completed in 2021. Finally, Phase 3 will focus on external validation of the questionnaire scales and development of an accompanying interview to provide another assessment modality. The HiTOP questionnaire will be available for use in 2021, and the interview is expected a year later.

Measure development is ongoing and uses state-of-the-science methods (e.g., item response theory and related structural methods). We plan to maximize the clinical utility of these measures by developing scales to assess functional impairments and integrating validity scales to detect problematic response patterns. HiTOP measures will be free, and both paper and online administration will be possible.

15. CLINICAL TRANSLATION

Nosology is a cornerstone of clinical practice as it can inform prognosis, help monitor illness course, facilitate communication, and guide treatment of patients and management of services.

However, the clinical utility of traditional diagnoses is low: They show weak reliability, provide little treatment guidance beyond cardinal symptoms, and are used primarily for billing, training, and communication among professionals (e.g., First et al. 2018, Regier et al. 2013, Taylor 2016, Verheul 2005, Zimmerman & Galione 2010). HiTOP was designed to improve the clinical utility of diagnosis.

The Clinical Translation Workgroup was formed to test whether the greater reliability and validity of HiTOP (described above in Section 5) enhance the clinical utility of diagnosis. A dimensional system presents challenges for clinical implementation, so the second goal of the workgroup is to identify these roadblocks and develop effective solutions.

One challenge is that instead of present versus absent status, diagnosis is a profile across dimensions. This description is more informative, but actionable ranges need to be specified on each dimension to make them practically useful. Ranges based on statistical deviance already exist, allowing a dimension to be categorized into normal, mild, moderate, and severe (Ruggero et al. 2019b). The workgroup is developing ranges tailored to specific purposes (e.g., starting preventive intervention, initiating psychotherapy, conducting suicide risk assessment), although this is a long-term process. Categorical descriptions also are needed for billing and administrative requirements, so the workgroup developed a crosswalk from HiTOP dimensions to ICD-10 codes.

Another obstacle is that HiTOP contains over 100 dimensions, which may be time-consuming to assess and difficult to interpret. Interpretation can be streamlined using the HiTOP hierarchy. First, the clinician may focus on the spectra to identify major problem areas (e.g., elevation on disinhibited externalizing indicates general lack of planning, impersistence, or risky or irresponsible behavior). Next, if a spectrum is elevated, dimensions within it may be examined to note relative elevations (e.g., opioid abuse). Accordingly, assessment can proceed in stages, beginning with a brief screening of spectra and then measuring symptoms and traits only within elevated spectra to minimize assessment burden. Moreover, treatments may be selected to target broad dimensions (e.g., transdiagnostic interventions like the Unified Protocol for internalizing; Barlow et al. 2017) or narrow symptoms (e.g., sleep restriction therapy for insomnia; Miller et al. 2014). Dimensions may interact with each other and with demographic characteristics to affect care (e.g., treatment for agitation may be different if agitation is present alongside severe substance abuse versus mania), and the workgroup is studying such combinations.

More research is needed to maximize the clinical utility of HiTOP, but the basic protocol for applying this system in practice has been outlined (Hopwood et al. 2020, Ruggero et al. 2019b). The Clinical Translation Workgroup developed tools to assist clinicians who want to use HiTOP in practice, along with a companion website (**https://hitop.unt.edu**). There, clinicians can find a listing of HiTOP-consistent measures and a suggested battery to capture the majority of HiTOP in approximately 45 min. It also measures impairment in daily functioning, an important complement to symptoms. This battery has been converted into an electronic instrument, the HiTOP DAT (HiTOP Digital Assessment and Tracker), which is free to any clinic or clinician upon request. The HiTOP DAT automatically scores patient responses and emails the clinician a profile of the respondent's HiTOP dimensions; T-scores indicate how elevations compare to normative community responses (**Figure 4**). A companion manual provides guidance on interpreting reports and integrating them into practice. Additional tools include billing crosswalk and publications on integration of HiTOP into training (Ruggero et al. 2019a). Clinicians have the opportunity to join an informal HiTOP clinical network that provides monthly updates about HiTOP-related research and engages clinicians in dialogue with the consortium.

Finally, the workgroup is leading field trials at a growing number of clinics—currently 10—across the country to test the feasibility of using this system in practice. These field trials provide an opportunity to pilot training material, understand how clinicians and patients interact with this

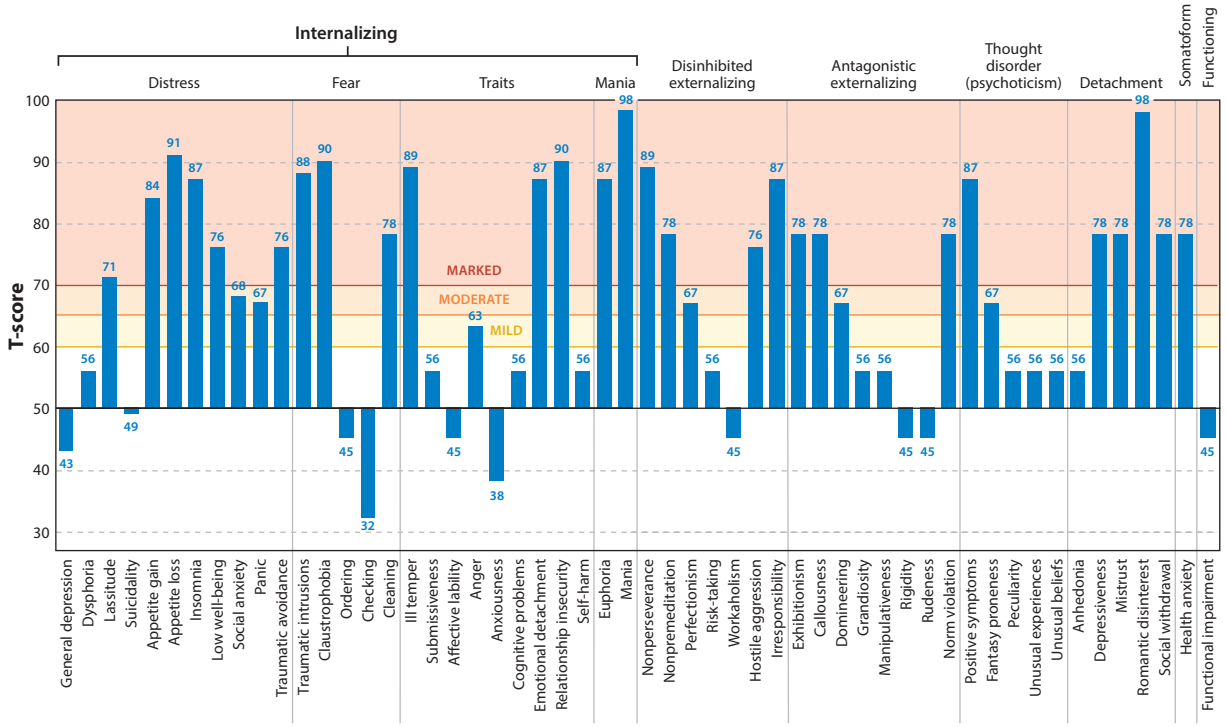

Figure 4

Illustrative HiTOP DAT profile: example of a patient without substance use problems (accordingly, dimensions of substance use are not shown). T-scores have a mean of 50 and standard deviation of 10 in the general population. Highlighting indicates score ranges of mild, moderate, and marked severity. Scales are grouped according to spectra and subfactors, as indicated at the top of the graph. An index of functioning in society is included. Abbreviations: HiTOP, Hierarchical Taxonomy of Psychopathology; HiTOP DAT, HiTOP Digital Assessment and Tracker.

new system, and identify barriers to implementation. Initial feedback suggests that the system can be used clinically already, but a number of enhancements and much further testing are needed to maximize its utility.

16. CONCLUSION

Formation of the HiTOP consortium was driven by the need to resolve the mismatch between traditional diagnoses and empirical evidence on the natural organization of psychopathology. The HiTOP system has made substantial strides in addressing problems of reliability, heterogeneity, and comorbidity that plague psychiatric diagnoses. It also is closely aligned with the genetic architecture of psychopathology and biobehavioral systems. HiTOP is superior to traditional systems in accounting for risk factors and outcomes of psychopathology. Development of HiTOP-based measures is underway, but existing instruments can be used to implement the system. In fact, the initial protocol for clinical application of HiTOP has been developed, and field trials are in progress. These significant advances over the first 5 years of the initiative were made possible by close collaboration of the many consortium members. Numerous challenges remain, and the consortium agenda for the next 5 years includes expanding coverage of psychopathology, clarifying placement of provisional elements, incorporating features of development and illness course into

the model, expanding knowledge of the system's validity and utility, completing the first set of HiTOP-based measures, addressing roadblocks to clinical translation of HiTOP, and many others. All are invited to contribute to this grassroots effort and to help construct a truly useful map of psychopathology.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review. R.K., R.F.K., and D.W. are founders of the Hierarchical Taxonomy of Psychopathology (HiTOP) consortium; M.K.F. and A.G.C.W. are cochairs of the Revisions Workgroup; I.D.W. and R.F.K. are cochairs of the Quantitative Methods Workgroup; S.N.M.-S. is a representative of the Normal Personality Workgroup; M.A.W. is chair of the Genetics Workgroup; C.G.D. and R.D.L. are cochairs of the Neurobiological Foundations Workgroup; C.C.C. and N.R.E. are cochairs of the Utility Workgroup; L.J.S. is chair of the Measures Development Workgroup; D.C.C. and C.J.R. are cochairs of the Clinical Translation Workgroup; and M.N.H. is chair of the Developmental Workgroup. The HiTOP consortium is a scientific collaboration rather than an incorporated organization. L.J.S., R.K., and C.J.R. are investigators on a project that has received funding from the National Institute of Mental Health (grant R56MH122537), which supports one aspect of measure development.

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