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Answering questions about the Hierarchical Taxonomy of Psychopathology (HiTOP): Analogies to whales and sharks miss the boat

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Abstract

This commentary discusses questions and misconceptions about HiTOP raised by Haeffel et al. (2021). We explain what the system classifies and why it is descriptive and atheoretical, highlighting benefits and limitations of this approach. We clarify why the system is organized according to patterns of covariation or comorbidity among signs and symptoms of psychopathology, and we discuss how it is designed to be falsifiable and revised in a manner that is responsive to data. We refer to the body of evidence for HiTOP's external validity and for its scientific and clinical utility. We further describe how the system is currently used in clinics. In sum, many of Haeffel et al.'s concerns about HiTOP are unwarranted, and for those concerns that reflect real current limitations of HiTOP, our consortium is working to address them, with the aim of creating a nosology that is comprehensive and useful to both scientists and clinicians.

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Critiques of the Hierarchical Taxonomy of Psychopathology (HiTOP) are welcome, especially because the model aspires to follow the scientific evidence and be practically useful. Critiques are essential for identifying how HiTOP can best achieve these dual missions. Haeffel et al. (2021) raise some important questions. They also display a number of misconceptions about HiTOP. We address their major concerns and misconceptions here and provide more detailed comments on specific misconceptions in our online supplement. HiTOP is based on an extensive body of evidence that we do not have space to review in full here, but it is covered in various publications by the HiTOP consortium (e.g., Kotov et al., 2017, 2020; 2021; Krueger et al., 2021; Watson et al., in press).

1. What does HiTOP classify?

Haeffel et al. (2021) repeatedly mischaracterize HiTOP as a system for classifying people. In fact, it classifies signs and symptoms of psychopathology (henceforth we use “symptoms” to refer to observable signs as well as subjective symptoms). Thus, HiTOP takes a variable-centered, rather than a person-centered, approach to classification. Symptoms are grouped into a hierarchy of dimensions based on their likelihood of manifesting in the same individual. This is very different from nosologies, including the Diagnostic and Statistical Manual of Mental Disorders (DSM), that classify people into discrete categories. In HiTOP, people are not classified but rather described by their position on each symptom dimension in the framework. Every level of the HiTOP hierarchy contains dimensional constructs representing patterns of covariation in the symptoms below them, with the core of the system being a level containing six dimensions called *spectra*. Haeffel et al.’s failure to recognize that HiTOP classifies symptoms rather than people renders a number of their specific arguments invalid or irrelevant (see online supplement).

2. Are descriptive nosologies useful?

Haeffel et al. argue that, because HiTOP is purely descriptive, it is not likely to be useful. Although we agree with them that a nosology based on valid theories of etiology would be more useful than one based on description alone, an accurate descriptive system can nonetheless be pivotal to advancing science, prior to clear etiological understanding. Haeffel et al. (2021) contrast HiTOP with biological taxonomies of organisms (e.g., whales and sharks), but in doing so they conflate the Linnaean classification system with more recent evolutionary taxonomies. Linnaeus developed an atheoretical taxonomy based on the morphology of organisms, a century before the theory of evolution. This system was imperfect, but it facilitated systematic study of biology and development of the theory of evolution (Winsor, 2009). In turn, the theory of evolution guided the revision of Linnaean taxonomy, making it more accurate and useful. Descriptive systems were likewise pivotal in other scientific disciplines, such as the Copernican model leading to Newton’s theory of gravitation, and Mendeleev’s periodic table of elements paving the way for the Bohr model and modern chemistry. Further, theoretical understanding does not necessarily make description obsolete. For example, in medical disciplines where etiology is better understood (e.g., oncology, infectious disease), diagnosis is often made based on symptoms and is

followed by medical tests as needed. Evidently, accurate descriptive systems can be useful as both catalysts and complements of etiological models.

In psychology, many fields rely on descriptive classifications, such as taxonomies of intelligence and personality, and these systems have proved fruitful scientifically, even when etiological theories are absent (John et al., 2008; McGrew, 2009). These taxonomies—like HiTOP—differ from the Linnaean system by being taxonomies of features (variables) rather than of individuals (people or species). Psychopathology lacked a comprehensive, empirically derived, descriptive system (Kotov et al., 2017), and the HiTOP consortium was launched to address this gap. Core goals of the consortium are to improve the reliability and validity of descriptions of psychopathology. These descriptions can facilitate development of theories that may lead to revisions of HiTOP, just as evolutionary theory led to revisions of the Linnaean system.

3. Why is HiTOP atheoretical, relying on covariation among symptoms rather than on etiology?

All scientific endeavors involve some theoretical commitments. HiTOP is no different, for example relying on the premise that co-occurrence of symptoms within individuals can inform diagnosis and treatment. Haeffel et al. criticize HiTOP for being “atheoretical,” in the sense that it is not derived from theories of etiology. However, etiological knowledge is currently insufficient to support theory-based diagnoses of patients with diverse presenting concerns. The danger in imposing an immature theory on data is that, if the guiding theory is incorrect, the resulting nosology may be invalid.

HiTOP is therefore guided by data, rather than etiological theory, organized by dimensions that consistently appear in analyses of patterns of covariation (comorbidity) among features of psychopathology and that also show evidence of external validity (Kotov et al., 2017). This approach maximizes coherence of constructs and distinctiveness between them. Moreover, extensive evidence indicates that such constructs capture information about common genetics, risk factors, biomarkers, and treatment response shared by co-occurring forms of psychopathology (Kotov et al., 2020; Krueger et al., 2021; Watson et al., in press). The DSM attempts to achieve something similar, but it often groups symptoms and disorders in ways that do not reflect empirical reality. For instance, DSM classifies generalized anxiety disorder (GAD) with other anxiety disorders, even though GAD is much more likely to co-occur with depressive disorders. In contrast, HiTOP follows empirical evidence of co-occurrence.

Haeffel et al. mistakenly believe that HiTOP attempts to “eliminate comorbidity.” HiTOP is not designed to eliminate comorbidity but, rather, to describe it accurately. The original presentation of HiTOP (Kotov et al., 2017, p. 458) noted, “Comorbidity conveys important information about shared risk factors, pathological processes, and illness course; a quantitative nosology formalizes this information, making it explicitly available to researchers and clinicians.” The hierarchical structure of HiTOP allows for the formal recognition of non-artifactual patterns of comorbidity at higher levels of the taxonomy while simultaneously maintaining important distinctions at lower levels.

Importantly, some psychopathological conditions may manifest in symptoms that do not typically co-occur, due to multifinality, in which the same underlying etiology leads to very different presentations (Haeffel et al. provide several examples from other medical disciplines). Currently, HiTOP will miss such constructs. However, to-date such constructs remain largely hypothetical in psychopathology. If they are verified in future research, HiTOP can evolve to include them. This point highlights the fact HiTOP is not wedded to any single method or type of construct and can evolve to include, for example, non-dimensional constructs or constructs manifesting multifinality, should evidence for such constructs emerge.

4. Is HiTOP sufficiently valid to facilitate psychopathology research?

Haeffel et al. question the validity of HiTOP and are skeptical of its ability to aid in scientific discovery. Both structural and validity evidence are considered when evaluating constructs for inclusion in HiTOP (Kotov et al., 2017, 2021). Validation of HiTOP is an ongoing process, but it has already produced a substantial body of evidence reviewed in consortium publications (see especially Kotov et al., 2020; Krueger et al., 2021; Watson et al., in press). To highlight two specific examples of HiTOP's validity and utility for research: (1) Accumulating evidence suggests that environmental exposures, such as childhood maltreatment and discrimination, are risk factors for HiTOP dimensions rather than DSM disorders (Conway et al., 2019). (2) Efficacy of many treatments, such as antipsychotics, serotonin reuptake inhibitors, and various psychotherapies, aligns with HiTOP spectra (Hopwood et al., 2020; Kotov et al., 2020; Watson et al, in press). HiTOP spectra have consistently been found to have meaningful associations with regard to risk factors, biomarkers, and treatment response, and similar validation efforts are underway for narrower HiTOP dimensions.

Haeffel et al. are especially pessimistic regarding genetic discovery in general and HiTOP's role in genetic discovery specifically. However, psychiatric genetics is currently making rapid advances. Robust and replicable associations have been demonstrated between many genetic polymorphisms and behavioral phenotypes, including diagnoses (e.g., schizophrenia) and dimensional risk factors (e.g., neuroticism) (Nagel et al., 2018; Smoller et al., 2019). Further, studies that directly compare HiTOP-concordant and DSM-concordant phenotypes in the same datasets consistently find that dimensional and hierarchical assessments lead to discovery of a larger number of relevant polymorphisms and more predictive polygenic risk scores (e.g., Linnér et al., 2019; Otowa et al., 2016; Stein et al., 2021). Additionally, substantial twin and molecular evidence indicates that genetic associations among forms of psychopathology largely parallel HiTOP's organization (Waszczuk et al., 2020).

5. Is HiTOP falsifiable and capable of evolution?

Haeffel et al. assert that "HiTOP does not feature the characteristics of a falsifiable, scientifically progressive, and evolving taxonomy." We beg to differ. Many of the studies that underpin HiTOP tested specific hypotheses or compared alternative hypotheses based on their fit to the data, using methods including structural equation modeling, taxometrics,

and other hypothesis-driven analytic procedures. For example, Kotov et al. (2011) compared the ability of seven models to account for associations among 25 psychiatric conditions.

Indeed, the position of every construct within HiTOP is a hypothesis (e.g., hyperarousal is currently part of the distress subfactor but could be moved to the fear subfactor if sufficient data indicate closer links to fear). The structural methods employed by the HiTOP consortium seek constructs that are maximally homogeneous and distinct from each other at each level of the hierarchy, with the hypothesis that these constructs will account for vulnerabilities and predict outcomes better than the more heterogeneous and overlapping categories of the DSM. A growing number of studies test this hypothesis by directly comparing the external validity of HiTOP and DSM (e.g., Martin et al., in press; Morey et al., 2012; Linnér et al., 2019).

To update HiTOP as new structural and validation studies become available, the consortium formed a Revisions Workgroup. This workgroup has designed a process for continuous evidence-based revision of the model (Kotov et al., 2021). The first set of revisions is in development, and anyone interested in proposing a change is encouraged to contact co-chairs of the workgroup (Drs. Forbes and Wright). We seek data to guide revisions of the model, such as clarifying placement of dimensions included in HiTOP provisionally (e.g., mania), incorporating other forms of psychopathology (e.g., autism), and tailoring the model to diverse demographic groups and cultures.

6. Is the generalizability of HiTOP limited?

The HiTOP model is based on structural studies that span from age 2 to 90 years and that include samples from many non-Western societies (see online supplement, p. 7, for examples). However, Haeffel et al. are not entirely unwarranted in their concerns about generalizability. Western samples are indeed over-represented in this literature, and very little research has been done on people over age 60. The consortium's Developmental Workgroup and Diversity, Equity, and Inclusion Workgroup are seeking datasets to fill these gaps and to identify demographic and cultural differences in the model. HiTOP will be revised according to their findings. The statistical methods that shape HiTOP have well-established procedures for elucidating differences between populations (e.g., tests of measurement invariance). This enables more rapid and transparent adaptation of nosology to new populations than the committee-based process of DSM.

7. Is HiTOP useable clinically, and how does it compare to DSM for that purpose?

Haeffel et al. make a number of erroneous claims about the clinical utility of HiTOP, including that there is no way for clinicians to assess it effectively or to use it in their practice. Regarding claim that clinicians cannot interpret a HiTOP profile effectively, we note that HiTOP has been shaped, in part, by research on measures such as the Child Behavior Checklist (Achenbach & Rescorla, 2003) and the Personality Inventory for DSM-5 (Krueger et al., 2012). Consequently, HiTOP aligns well with various widely-used instruments that many clinicians find helpful in their practice. The consortium recommends

a number of these instruments for assessing certain elements of the model in applied settings, and many of these have established norms and clinical cutoffs (Kotov et al., 2017). However, multiple existing measures must be combined to achieve good coverage of HiTOP. The consortium's Measure Development Workgroup is constructing a comprehensive new inventory expected to be ready for clinical use in 2022 (Simms et al., 2020). Meanwhile, the Clinical Translation Workgroup has assembled a battery of existing normed and validated self-report measures that assesses most of the model and requires 40 minutes to complete. The battery is free, self-administered, and automatically scored. The Workgroup also developed manuals, trainings, and online resources (https://hitop.unt.edu/introduction) to help clinicians with practical questions such as billing. The battery is currently being used in a dozen psychology and psychiatry clinics that participate in the HiTOP Field Trials to test questions about clinical utility of the system. All interested clinics are welcome to join the Field Trials by contacting Dr. Jonas.

Haeffel et al. believe that clinicians should use the DSM rather than HiTOP. However, clinicians use DSM diagnoses for billing much more than for case conceptualization or treatment decisions (First et al., 2018). Many clinicians report that formal diagnosis does not provide helpful guidance beyond cardinal symptoms. A chief objective of HiTOP is to make nosology more useful for clinicians. Three types of evidence support this aspiration. First, HiTOP dimensions show substantially higher reliability than DSM diagnoses (Markon et al., 2011). Second, growing evidence indicates that these dimensions account for about twice as much variance in crucial clinical variables such as functional impairment, service needs, and risk of suicide attempts, relative to DSM diagnoses (e.g., Forbush et al., 2017; Martin et al., in press; Morey et al., 2012). Third, surveys of clinicians generally find that they see more utility in HiTOP dimensions than in DSM diagnoses (e.g., Bornstein & Natoli, 2019).

Conclusion

We thank Haeffel et al. (2021) for raising these important questions. The HiTOP consortium has taken many strides, but its work is only beginning. There is much more to understand, build, and implement. A more valid and useful nosology would benefit the entire field: scientists, clinicians, and trainees. Hence, in addition to the research consortium, we organized the HiTOP Clinical Network for professionals interested in translation to care and the Trainee Network for students working toward a doctorate. We encourage everyone interested to join the effort (https://renaissance.stonybrookmedicine.edu/HITOP/GetInvolved).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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