Vol. 15(1), pp. 1-9, July-September 2023
DOI: 10.5897/IJPC2023.0693
Article Number: A118BEA71136
ISSN 2141-2499

http://www.academicjournals.org/IJPC

ACADEMIC JOURNALS

International Journal of Psychology and Counselling

Full Length Research Paper

Do the HoNOS and the HiTOP converge? Factor structure and normative data in a diverse Norwegian patient sample

Cato Grønnerød

Department of Psychology, Faculty of Social Sciences, University of Oslo, Norway.

Received 9 May, 2023; Accepted 21 July, 2023

A large factor analysis of the Health of the Nation Outcome Scale (HoNOS) indicates similarities between HoNOS factors and Hierarchical Taxonomy of Psychopathology (HiTOP) spectra. A diverse sample of 866 Norwegian patients gathered in several studies was factor analyzed to try to replicate Speak et al.'s four factors and to do a conceptual analysis to connect the factors to HiTOP spectra. A primary severity factor emerged, mostly reflecting cognitive decline, thereby linking it to the Thought Disorder spectrum. Two other factors reflected the Internalizing and Externalizing spectra. Detachment and Antagonism were not represented, whereas one or two factors related to purely functional aspects emerged. The data provides grounds for discussion of both the structure of the HoNOS, and possibly the coverage of the HiTOP spectra. The sample also provides a useful normative sample for HoNOS use among hospital mental health care in Norway.

Key words: HoNOS, HiTOP, psychopathology, mental disorders, function, functional level, assessment, symptoms.

INTRODUCTION

Health of the Nation Outcome Scale, or HoNOS (Wing et al., 1998), is a simple tool for quality assurance of outcomes in mental healthcare treatment setting. By using HoNOS, staff can routinely obtain a quantified assessment of clinical and social areas of functioning in patients. Both present condition as well as changes over time may be evaluated. HoNOS is also very useful as a tool for structuring ongoing clinical work with the patient and it is designed to be implemented in a busy daily clinical routine, by various health professions, and without the requirement for extensive training.

Twelve items give a comprehensive overview of what areas are sufficiently assessed and what areas need complementing information and therefore require action. The items include problems with overactivity, self-harm, alcohol and drugs, cognition, physical condition, psychosis, depression, other symptoms, relationships, ADL (Activities of Daily Living), living conditions, and activity (work and spare time activities). Together they cover a very broad and diverse area of functioning. This means providing a simple solution to a very complex problem, which obviously entails concession on detail

E-mail: cato.gronnerod@psykomatikk.no.

and nuance.

Speak et al. (2015) and others have raised the question of whether the HoNOS should best be viewed as twelve independent scales, one scale with twelve items, or as consisting of subscales. Wing et al. (1998) suggested that the twelve items can be grouped into four broad dimensions based on a conceptual overlap, namely Behavior, Impairment, Symptoms, and Social Problems. Internal consistency for these dimensions varies substantially, however (0.00 to 0.69; Stedman et al., 1997). An early factor analysis based on 2,137 patients showed five somewhat different factors (Trauer, 1999). In this model, behavior, impairment and symptoms dimensions were kept, but the symptoms dimension was split into factors representing psychosis and depression. Additionally, the relationships item loaded on both depression and social problems.

Later analyses have pointed to four-factor models. Speak et al. (2015) found four factors based on a set of more than 50,000 patients: Personal well-being, Emotional well-being, Social well-being, and capitalize disturbance. None of the earlier factor models (Newnham et al., 2009; Trauer, 1999; Wing et al., 1998) replicated well in their dataset. On the other hand, Maddison et al. (2016) were unable to replicate the four factors in their set of 2,468 forensic patients. Later, Muncer and Speak (2016, 2017) found two factors: Depression, and Social and Cognitive Problems. Although the psychometric properties of the factors were acceptable, they warn that most models have problems. Some of the studies have been limited by a predominance of a single diagnosis, such as schizophrenia, showing the importance of obtaining data in a diverse sample for testing the factor structure of the mental health indicators. The models are not always overlapping very well, as shown by Speak et al. (2015). In sum, however, the four-factor model is based on a very large sample which should bode well for replicability in similarly diverse samples.

The four factors may also be informative in another important development, namely the HiTOP model (Kotov et al., 2017). The HiTOP has gained prominence as an alternative to diagnostic categorization. The top-level spectra, corresponding to factors or traits in other models, are defined as Somatization, Internalization, Externalization-Uninhibited, Externalization-Antagonistic, Thought Disorder, and Detachment. These spectra have been found by analyzing different datasets with various assessment methods. The spectra are to a large degree overlapping with both the DSM-5 (American Psychiatric Association, 2013) and ICD-11 (World Health Organization, 2020) personality disorder traits, and they are related to the Five Factor Model of personality (Widiger and Lowe, 2007). It seems that the future classification of mental disorders is to be found in some kind of consensus between these models (Wright et al., 2022; Wright and Simms, 2015), and the HiTOP model presently the only one of these that is broad enough in scope to achieve that.

Is there something to be learned from the HiTOP model when looking at HoNOS factors? There is a clear resemblance between some HoNOS factors and the HiTOP spectra. Personal well-being seems to relate to detachment (opposite poles), emotional well-being to internalization, social-well-being to antagonism, and severe disturbance to though disorder. Could it be that HoNOS is in fact capturing some features of the trait-like structure that the HiTOP model proposes? To examine this, the author analyzed a HoNOS data set from a diverse sample of inpatients and outpatients. First, he wanted to establish the factor structure and compare it with the models presented by Speak and colleagues. Second, he wanted to frame the factors within the conceptualization of the HiTOP spectra to see if this can improve our understanding of the factors. There is a concerted effort going on to develop effective and reliable assessments of the HiTOP spectra, and HoNOS might, perhaps somewhat surprisingly given its simplicity, inform that development, either through factor analyses, or perhaps more substantial discussions regarding the item contents. Third, the HoNOS data can serve as a normative data sample for patients in hospital mental health care in Norway.

METHODS

Subjects

The sample was constructed from several data sets gathered over many years in specialized mental health care units in Østfold Hospital, Norway. The data sets were generated from four service quality development projects, and therefore applied varied levels of stringency in the data collection process. The first data set of n = 644 was gathered during 2004 and 2005 in connection with a reorganization of inpatient sections at all five regional psychiatric clinics in the hospital. The second data set of n = 131 was collected during 2015 to 2017 in one of the three inpatient psychosis wards in the hospital. The third data set of n = 396 was gathered during the period 2018 to 2020 in one of the regional dependency clinics. The final data set of n = 29 was gathered from a reorganization project of a six-week outpatient group treatment program in one regional outpatient clinic. The scope for these three data sets were all broadly defined as encompassing the whole patient population in the specific data collection period. The total sample amounted to N = 1200, n = 866 of these included HoNOS ratings which formed the dataset that was analyzed.

Instruments

The HoNOS is a 12-item clinical rating scale for functional level assessment. The items include problems with overactivity, self-harm, alcohol and drugs, cognition, physical condition, psychosis, depression, other symptoms, relationships, ADL (Activities of Daily Living), living conditions, and activity (work and spare time activities). It is scored from 0 (no problems) to 4 (severe problems). The value 9 or x is recorded when the item rating cannot be recorded, these values were removed from the data file to prevent them from being interpreted as an ordinal value.

Diagnoses were set as part of regular clinical work and recorded continuously in the data set. All diagnoses were set using ICD-11. Global Assessment of Functioning (GAF) was also recorded as a

standard assessment in all clinics at the time of data gathering, using the split format of GAF-F (function) and GAF-S (symptoms).

Procedure

The assessments were made regularly by staff at the respective local clinics as a standard routine during the project periods. The assessments were always made by the person responsible for the patient's treatment, and most often also in teams together with other staff members that worked with the patient. In the first assessment, the proportion of missing data would sometimes be high due to lack of information at that time. The number of individuals conducting the assessment was recorded for the three most recent datasets, but not for the first one. Initially, all datasets contained personal information and additional assessment details; however, the present sample was derived solely from de-identified HoNOS data. The de-identification process involved categorizing ages into groups spanning 10 years (e.g., 25 for ages 20-29) and converting individual diagnoses into diagnostic groups (e.g., F2 for all F2x diagnoses). The author was granted access to the first data set of n = 644 from the leader of that project at the time, and he was the project leader for the collection of the three other data sets. The studies were approved by relevant ethical committees at the time (Østfold Hospital Trust Research Unit, Norwegian Social Sciences Data Services).

Analyses

Descriptive analyses were run to obtain means, standard deviations, and distribution measures. An Exploratory Factor Analysis (EFA) was performed as the HoNOS cannot be expected to represent HiTOP spectra directly; they should be regarded as latent factors represented by HoNOS items. The range of factors extracted was determined by two strategies: Eigenvalue over 1 plus scree plot, and parallel analysis. The sample of n = 866 included 12 HoNOS variables that went into the EFA. Eigenvalue and scree plot analysis indicated five factors, whereas parallel analysis using the 95th percentile Eigenvalues in the simulated data showed a threshold for keeping three factors. Solutions for three, four, and five factors were therefore explored, and all solutions were tested with both direct oblimin and varimax rotations. The two rotations essentially yielded the same results, differing only in the order of factors. Consequently, only the varimax rotation solutions are presented in this study. Factor loadings below 0.30 have been excluded from the tables for the sake of readability. All data analyses were performed using SPSS software version 27.

RESULTS

The sample of n = 866 consisted of 54.8% women and 45.2% men; the average age based on age group was 43 years. Nine percent were under involuntary treatment, and the rest under voluntary treatment. The distribution between diagnostic groups encompassing psychosis, depression, anxiety, and personality disorders as the main diagnosis was fairly equal (16.8, 16.8, 12.7 and 11.3%, respectively), confirming the diagnostic diversity of the sample. The number of days in treatment averaged 180 days but varied widely (SD = 598). A total of 147 patients had more than three-year-long treatment periods. These were defined as outliers, and the average age among the remaining patients was 111 days (3 - 4 months, SD = 152). Again, the variability of the treatment periods reflects a representative diversity of the general patient population in specialized mental health care. Table 1 shows the factors by items in previous studies.

The means, standard deviation, and distribution indices for the HoNOS items are shown in Table 2. Most items were skewed to the left, meaning that a score of 0 was most common for most ratings. Missing data also indicated that the rating was done early in the assessment when all necessary information was not available. The HoNOS total score correlated r = -0.54 (p < .001) with Global Assessment of Functioning – Function (GAF-F), and r = -0.49 (p < 0.001) with GAF symptoms (GAF-S) in the 130 patients where both were recorded.

In the main analyses of the factor structure, three solutions were explored. In the three-factor solution (Table 3 and Figure 1), the total variance explained was 33.8%. The first factor included Cognition, Psychosis, Relations, and ADL, Living Conditions and Activity. The second factor consisted of overactive, self-harm, symptoms, and relations, and the third factor only consisted of depression. The first factor was thus mostly a composite severity factor, whereas the second factor conceptually could correspond to the externalization spectra in a broad sense. The third corresponded to internalization. Interestingly, alcohol and drugs did not load above 0.30 on any factor, neither did physical condition.

The four-factor solution (Table 4 and Figure 2) had a total explained variance of 38.2% and indicated a conceptually more distinct structure. The first factor included cognition, psychosis, relations, and ADL, and was therefore more restricted to cognitive failures and its consequences. The second included ADL, Living Conditions, and Activity, which is clearly relatable to the functional domain. The third factor corresponded well to Externalization, with Overactivity, Self-Harm, and Alcohol and Drugs. The fourth corresponded to Internalization and included Depression and Symptoms. Physical Condition did not load above 0.30 on any factor in the four-factor model.

The five-factor solution (Table 5 and Figure 3) was even more granular and separated out functional aspects more clearly. The total variance explained was 42.5%. The first factor was cognitive failure, including cognition, psychosis, and relations. The second corresponded to externalization (overactivity, self-harm, and alcohol and drugs). The third factor singled out practical conditions of living conditions and activity. The fourth factor was a relatively clear representation of Internalization, including self-harm, depression and symptoms. The fifth factor separated out physical condition and ADL.

DISCUSSION

In this study, the factor structure of HoNOS was examined and conceptually compared to the HiTOP model, and the

Table 1. Factors by items in previous studies.

Item	Wing et al. (1998)	Trauer (1999)	Newnham et al. (2009)	Speak et al. (2015)
H1 overactive	Behavior	Behavior	Anti-social or behavior problem	Severe disturbance
H2 Self harm	Behavior	Depression	Anti-social or behavior problem	Emotional well-being
H3 Alcohol and drugs	Behavior	Behavior	Anti-social or behavior problem	Social well-being
H4 Cognition	Impairment	Impairment	Physical and psychological impairment	Personal well-being
H5 Physical condition	Impairment	Impairment	Physical and psychological impairment	Personal well-being
H6 Psychosis	Symptoms	Hallucinations	Physical and psychological impairment	Severe disturbance
H7 Depression	Symptoms	Depression	Symptoms	Emotional well-being
H8 Symptoms	Symptoms	Depression	Symptoms	Emotional well-being
H9 Relations	Social functioning	Depression	Anti-social or behavior problem	Social well-being
H10 ADL	Social functioning	Social functioning	Physical and psychological impairment	Personal well-being
H11 Living conditions	Social functioning	Social functioning	Socio-economic	Social well-being
H12 Activity	Social functioning	Social functioning	Socio-economic	Personal well-being

Table 2. HoNOS items mean, standard deviation, skewness, and kurtosis.

Item	n	M	SD	Skewness	Kurtosis
H1 Overactive	552	0.74	1.056	1.989	7.157
H2 Self Harm	524	0.54	1.139	2.931	12.430
H3 Alcohol and Drugs	774	1.56	1.631	0.718	0.837
H4 Cognition	523	1.07	1.114	0.749	-0.414
H5 Physical Condition	624	1.41	1.253	0.295	-1.070
H6 Psychosis	513	1.22	1.435	0.632	-1.166
H7 Depression	698	1.58	1.078	0.032	-0.756
H8 Symptoms	816	2.15	1.290	-0.535	-0.804
H9 Relations	691	2.10	1.165	-0.033	0.917
H10 ADL	552	1.64	1.293	0.433	0.692
H11 Living Conditions	530	0.93	1.471	1.656	2.906
H12 Activity	566	1.18	1.665	2.086	6.436

N = 866.

main conclusion is that three latent HoNOS factors clearly resemble HiTOP spectra, as can be seen in Table 6.

Overall, the three-factor solution is statistically somewhat sounder in the sense that the parallel analysis suggested three factors, but conceptually much more difficult to interpret. The four- and five-factor solutions are easier to interpret, and perhaps gives a better conceptual fit to the data

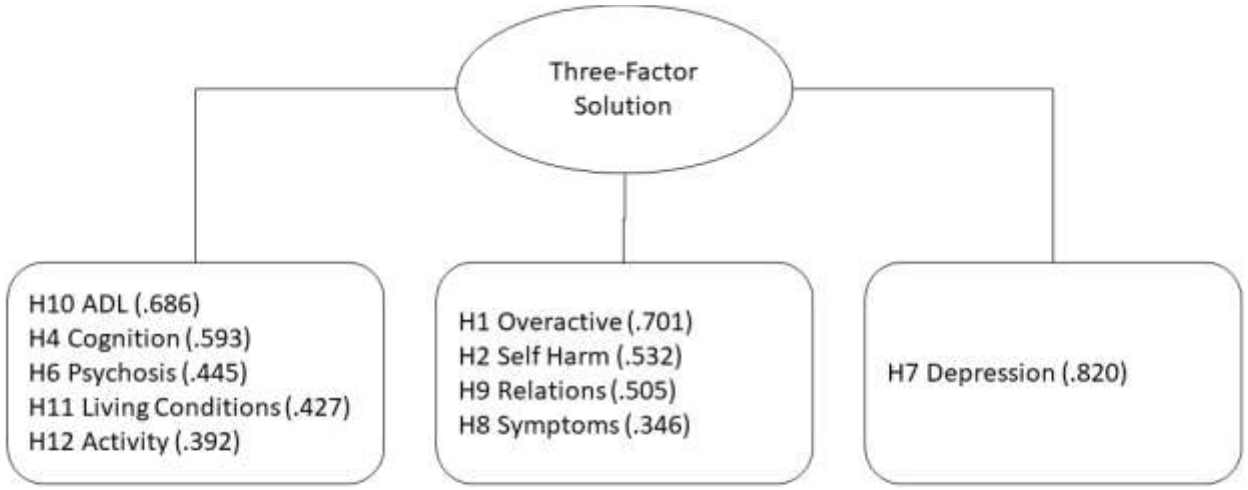

Figure 1. Three-factor solution. HoNOS items are sorted by factor loading, and only highest loading is shown.

Table 3. Rotated three-factor solution.

Item	Factor 1	Factor 2	Factor 3
H1 Overactive		0.701	
H2 Self Harm		0.532	
H3 Alcohol and Drugs			
H4 Cognition	0.593		
H5 Physical Condition			
H6 Psychosis	0.445		
H7 Depression			0.820
H8 Symptoms		0.346	
H9 Relations	*0.479*	0.505	
H10 ADL	0.686		
H11 Living Conditions	0.427		
H12 Activity	0.392		

R^2 = 33.8%. Exploratory factor analysis with varimax rotation. Secondary loadings in italics.

Table 4. Rotated four-factor solution.

Item	Factor 1	Factor 2	Factor 3	Factor 4
H1 Overactive	*0.455*		0.620	
H2 Self Harm			0.460	*0.361*
H3 Alcohol and Drugs			0.395	
H4 Cognition	0.624			
H5 Physical Condition				
H6 Psychosis	0.672			
H7 Depression				0.732
H8 Symptoms	*0.313*			0.368
H9 Relations	0.570		*0.300*	
H10 ADL	0.484	*0.454*		
H11 Living Conditions		0.575		
H12 Activity		0.501		

R^2 = 38.2%. Exploratory factor analysis with varimax rotation. Secondary loadings in italics.

Table 5. Rotated five-factor solution.

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
H1 Overactive	*0.412*	0.628			
H2 Self harm		*0.415*		0.420	
H3 Alcohol and drugs		0.405			
H4 Cognition	0.515				*0.397*
H5 Physical condition					0.505
H6 Psychosis	0.802				
H7 Depression				0.650	
H8 Symptoms				0.390	
H9 Relations	0.529	*0.315*			
H10 ADL	*0.353*		*0.325*		0.488
H11 Living conditions			0.476		
H12 Activity			0.679		

R^2 = 42.5%. Exploratory factor analysis with varimax rotation. Secondary loadings in italics.

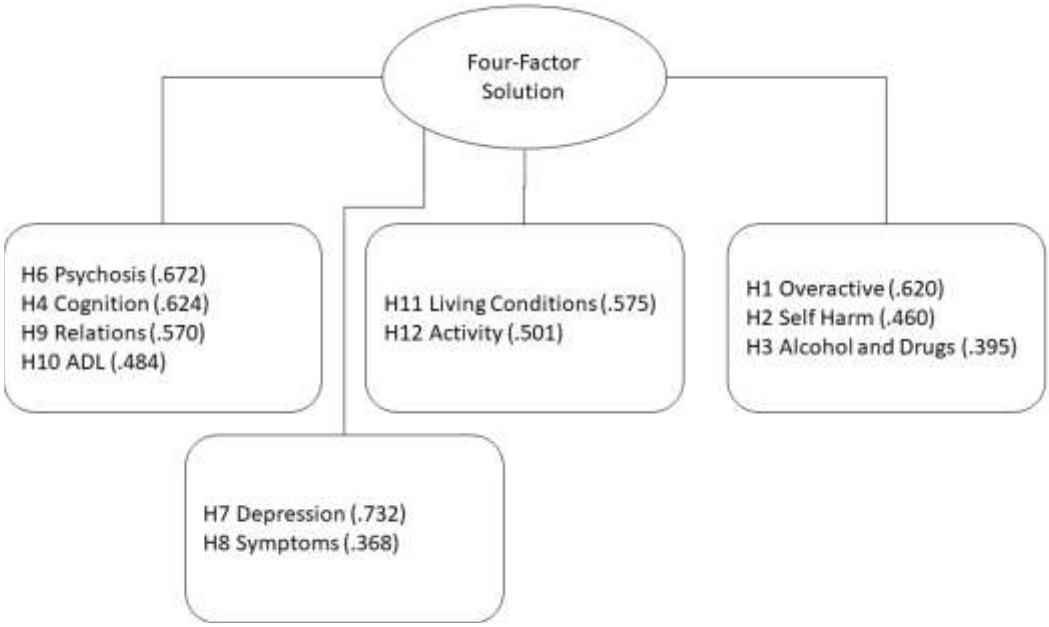

Figure 2. Four-factor solution. HoNOS items are sorted by factor loading, and only highest loading is shown.

but has a risk of being over-extracted. All factors did, however, have an Eigenvalue of 1 or higher. The first factor, which is mostly a severity factor, becomes increasingly focused on psychosis with an increasing number of factors in the solution, whereas the functional consequences get separated out into subordinate factors. The difference in item grouping between the four- and five-factor models mostly reflects how the purely functional items, such as Living Conditions and Activity, are grouped.

In sum, and keeping the weaknesses in mind, the author therefore regards the five-factor model as the most meaningful solution.

The first factor taps into a general severity aspect of psychopathology, mostly reflecting cognitive decline related to positive symptoms in psychosis. The proportion of psychosis in the current sample is relatively high, whereas the Speak et al. (2015) sample seems to have a higher proportion of milder mental disorders. This may limit the generalizability of the current results. At the same time, it may also reflect the fact that psychosis has a debilitating effect on most areas of functioning (McGorry, 2015), and will to a large extent shape how other areas of personality is expressed (Scholte-

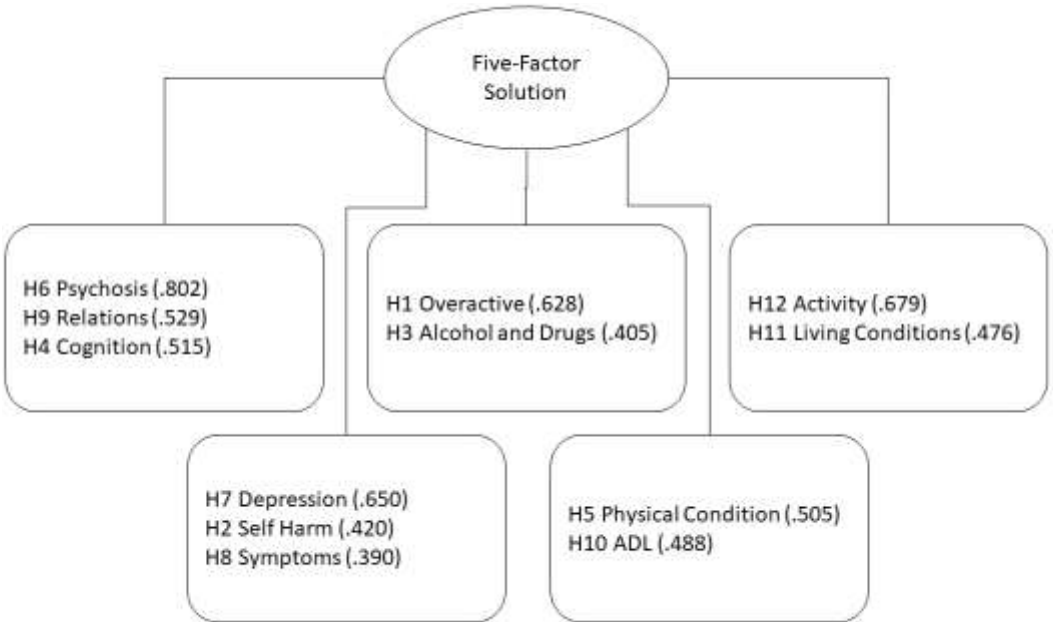

Figure 3. Five-factor solution. HoNOS items are sorted by factor loading, and only highest loading is shown.

Table 6. Conceptual HiTOP classification of HoNOS items based on five-factor model.

	Dimension	HoNOS Items
HiTOP	Somatization	(Possibly H8F)
	Internalization	H7 Depression H8 Symptoms H2 Self-Harm
	Thought disorder	H4 Cognition H6 Psychosis H9 Relations
	Detachment	(None)
	Disinhibited	H1 Overactive H3 Alcohol and drugs
	Antagonistic	(None)
Other	Functional impairment	H5 Physical condition H10 ADL
	Practical impairment	H12 Activity H11 Living conditions

HoNOS items sorted by factor weights. H2 Self-Harm is included in two dimensions because the factor loadings were almost equal.

Stalenhoef et al., 2016). The sample is still fairly representative of the population in inpatient and outpatient care in hospitals in Norway, as opposed to the population in "first line" of care in the municipalities.

The severity/psychosis factor is linked to the Thought Disorder spectrum in HiTOP. The factor was more broadly defined in the present data than what was found by Speak et al. (2015), who included H1 Overactive and H6 Psychosis in their Severe Disturbance Factor. The HiTOP thought disorder spectrum may be somewhat limited in its definition as it mostly encompasses psychotic symptoms. The present data, as well as ongoing discussion on the connection to Psychoticism, Openness to Experience, and eccentricity in general

(Ashton and Lee, 2019; Widiger and Crego, 2019), could suggest that a more useful conceptualization of this dimension is cognition in general, or cognitive dysfunction and decline more specifically.

Interestingly, relations was included in the first factor in all models (secondary loading in the three-factor solution), indicating the immediate consequences of cognitive decline, and the centrality of dysfunctional relations in all mental disorders (Wright et al., 2021). It did not, however, emerge as a separate factor that would map onto the HiTOP spectrum of Externalization - Antagonism. The item formulation is focused on functional consequences of dysfunctional relations, not on internal representations of object relations. Although the two are related, they may be rated differently according to information access and point of view. The DSM-5 Alternative Model for Personality Disorders (AMPD) Criterion A (American Psychiatric Association, 2013) captures more of the relational problems within the frame of global personality dysfunction (Morey et al., 2022). Although there seems to be some overlap (Martí Valls et al., 2023), this is different to the trait-based HiTOP model which corresponds to the DSM-5 AMPD Criterion B. The HoNOS Relations item may therefore be more indicative of a global decline in functionality.

The second factor primarily corresponds to the Externalizing super-spectrum, particularly focusing on the Externalizing - Disinhibited spectrum. Both overactivity and substance abuse signify manifestations of underregulated behavior, which can lead to self-harm. Additionally, some relational consequences load onto this factor, aligning well conceptually. While in the Speak et al. study, these items were distributed across three factors, in our analysis, they converge here. Notably, self-harm loads onto this factor; however, it's important to acknowledge that self-harm involves elements of both internalizing and externalizing tendencies. Interestingly, self-harm has posed challenges in terms of its meaningful placement within the HiTOP spectra, potentially indicating stronger associations with the general p-factor, as suggested by Bender (2019) and Widiger et al. (2019). The third and fifth factor reflects some of the core characteristics of the HoNOS, namely the purely functional items related to Living conditions, activity, ADL, and physical condition. These items probably cannot be expected to map onto HiTOP spectra in any meaningful manner, and they therefore represent functional aspects and consequences outside the realm of the trait based HiTOP model.

The fourth factor is indicative of Internalization, encompassing Depression, Self-Harm, and Symptoms. Notably, Self-Harm also demonstrates a secondary loading on the second factor, which is conceptually coherent. This factor aligns with the concept of Emotional Well-Being identified in the study by Speak and colleagues (2015). A significant proportion of symptom specifications in H8 are associated with internalizing phenomena, including anxiety, stress, and phobias. This observation suggests that the HiTOP spectrum pertaining to emotional well-being is a robust dimension in the context of HoNOS as well. The Somatization, Detachment, and Externalizing – Antagonistic HiTOP spectra did not appear to be linked to HoNOS items in any notable way. Although not feasible to test in the current data set because of very low scoring rate, Somatization is probably linked to H8F Somatization, sub-score in H8. The H8 sub-scores are poorly defined, however, and it could be argued that the sub-scoring should be abandoned altogether. The specific symptoms displayed by a patient would be more useful to categorize in more suitable and specific symptom scales.

The results highlight the fact that problems on an internal psychological level lead to decreases in functional level, and these effects are not well reflected in the HiTOP spectra. Two factors reflecting the purely functional aspects of the HoNOS emerged. Whether they should be combined into one factor or separated into functional and practical aspects is hard to decide on and perhaps not too important anyway. The point regarding the HiTOP is that the HoNOS seems to complement the internal structural personality-related aspects of the HiTOP spectra with concrete, external and tangible aspects such as living conditions and daily activities. These aspects are central parts of the functional consequences of having a mental disorder and will in most instances also help to define the level of severity the person is suffering under.

The relationship between HoNOS and HiTOP can be framed in two ways. One is whether the HiTOP needs to be expanded with spectra that are less tied to internal traits and structures and more tied to concrete and external factors related to mental disorders. The HiTOP is aiming to be a diagnostic alternative to DSM and ICD (Kotov et al., 2017) but seems to be less suited to capture the functional aspects that are part of the current diagnostic criteria for many diagnoses. Another frame would be to consider hierarchical models, where global functioning, traits, and behavior are conceptualized at different levels. This will need to extend beyond the hierarchical structure of traits themselves and include conceptual explanations of the relationship between levels and components. Examples of such models could be the Cybernetic Theory of Psychopathology (DeYoung and Krueger, 2018), the Personality Systems Framework (Mayer, 2019), or the Complex-Systems Approach to Personality (Fajkowska, 2015). Trait-based models are inherently limited by internalizing both causal and consequential factors of mental disorders, although they are useful as components of larger models.

The current results could be used as a starting point for a discussion on how to develop the HoNOS going forward. Some wording changes have already been suggested to increase comprehension (James et al., 2018), but without changing the contents of the items. As

more and more research is directed towards common dimensions underlying personality and psychopathology (Wright et al., 2021; Wright and Hallquist, 2014), future versions of the HoNOS could be more closely aligned with these dimensions. Perhaps the HoNOS can be aligned as a functional outcome measure for each of the HiTOP spectra. Even though the functional aspects are more prominent, there is no particular reason to believe that the HoNOS measures something completely unique and independent of the HiTOP dimensions. On the contrary, there are clear similarities, both by looking at the current and previous results. Still, a clear convergence is hard to find which indicates that there is some noise to be filtered out. The construction of this filter should be guided of what we now know of underlying dimensions. This would make the HoNOS more up to date and provide clearer utility as we move towards a common framework for personality and psychopathology.

ACKNOWLEDGEMENT

The author would like to thank Gjeldstad for access to data and Milena Nicolic for useful comments on the manuscript.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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