School of Population Health

Using the Hierarchical Taxonomy of Psychopathology (HiTOP) as a Framework to Dimensionally Map Neurodevelopmental Disorders.

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Declaration

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This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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Acknowledgement of Country

We acknowledge that Curtin University works across hundreds of traditional lands and custodial groups in Australia, and with First Nations people around the globe. We wish to pay our deepest respects to their ancestors and members of their communities, past, present, and to their emerging leaders. Our passion and commitment to work with all Australians and peoples from across the world, including our First Nations peoples are at the core of the work we do, reflective of our institutions' values and commitment to our role as leaders in the Reconciliation space in Australia.

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Copyright Statement

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Thesis Abstract

Psychopathology is most commonly conceptualised according to the categorical framework of the *Diagnostic and Statistical Manual of Mental Disorders – 5 – Text Revised* (DSM-5-TR). However, there is a growing body of evidence that advocates for the dimensional expression of psychopathology to remedy several issues of categorical mental disorder systems (e.g., extensive co-occurrence). One such dimensional model is the *Hierarchical Taxonomy of Psychopathology* (HiTOP), which maps the components of mental disorders under a series of spectra and superspectra, thereby allowing for the elicitation of dimensional syndromes (i.e., the presentation of these components). Presently, however, neurodevelopmental disorders (NDDs) are largely not considered by the HiTOP, thus limiting our understanding of early-life psychopathology in a dimensional sense. Therefore, our overarching aim in this two-study thesis was to investigate the components of various NDDs in relation to how they might map within the HiTOP, as well as illuminate the nature of the dimensional syndromes that arise within this framework. We used exploratory factor analysis and latent profile analysis to highlight the components and syndromes, respectively. In study one, we investigated the HiTOP position of traits of autism spectrum disorder (ASD) by considering their conceptual overlap with schizotypal personality traits. We found a large degree of overlap, indicated by a shared factor we called Detachment, alongside a smaller factor of Psychoticism. We then expanded the scope in study two to again consider the HiTOP position of ASD alongside attention-deficit/hyperactivity disorder (ADHD), specific learning disorder, and tic disorders, as well as commonly reported NDD-related experiences of extreme demand avoidance, sluggish cognitive tempo, and emotional dysregulation. We found that ASD traits again loaded onto a Detachment factor, ADHD loaded onto Disinhibition, and specific learning disorder and tic disorders onto Psychoticism. NDD-related experiences also loaded onto the HiTOP structure, with loadings largely dispersed throughout, although sluggish cognitive tempo solely loaded onto Disinhibition. We also found throughout both studies a series of reliable dimensional syndromes resulting from these factors, which largely reflected the presence of the General "*p*" Factor of Psychopathology. Both studies provide preliminary evidence for the dimensional expression of various NDDs and NDD-related experiences with specific reference to HiTOP position. These findings may help inform future research into the HiTOP position of other NDDs, thereby allowing for increased descriptive utility when assessing and diagnosing these conditions as a set of dimensions.

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Chapter 1: Introduction to Thesis

Within this chapter, I discuss the nature and structure of the Hierarchical Taxonomy of Psychopathology (HiTOP), a dimensional model which has been used to remedy four major issues surrounding the general use of categorical mental disorders: (1) disorder co-occurrence and diagnostic overlap; (2) disorder heterogeneity; (3) disorder reliability; and (4) lack of subthreshold conceptualisation. I then discuss the extent to which the HiTOP currently maps categorical mental disorders, as well as the status of neurodevelopmental disorders within the HiTOP, to date a comparatively overlooked area of HiTOP exploration.

General Introduction

Until recently, mental disorders have only been outlined in the *Diagnostic and Statistical Manual of Mental Disorders - Text Revised* (DSM-5-TR; American Psychiatric Association [APA], 2022) within a categorical framework. A *categorical framework*, as the name suggests, refers to the classification of a condition as a category, such that an individual either does or does not qualify for a diagnosis of a disorder. A *dimensional framework* alternatively classifies mental disorders via a series of spectra, encompassing individual differences within symptoms and traits. The official foundation of the DSM-5-TR is categorical in nature, but the dimensional *Alternate Model of Personality Disorders* has been included in section III of the DSM-5-TR (APA, 2022). This is an emerging model for psychiatric use due to various issues of utility identified within the traditional categorical model of personality disorders (e.g., extensive diagnostic co-occurrence; Fowler & Oldham, 2013), and is in the process of being integrated within the broader HiTOP framework (Bornstein, 2019; Widiger et al., 2019). With the increasing advancement of the HiTOP, there is growing interest in expressing dimensional psychopathologies outside of personality disorders (Kotov et al., 2021). Advancements in other dimensional models of

psychopathology such as the Research Domain Criteria (Cuthbert, 2022; Michelini et al., 2021) also support the need in finding dimensional alternatives to psychopathology, considering recent linkage between the Research Domain Criteria and the HiTOP (Michelini et al., 2021).

The Hierarchical Taxonomy of Psychopathology (HiTOP)

The HiTOP is a broad attempt to highlight dimensional components of all mental disorders outlined in the DSM-5-TR, and is organised according to multiple layers (i.e., a hierarchy; Kotov et al., 2021). See Figure 1a for a visual display of the current HiTOP structure. The first layer constitutes the *General "p" Factor of Psychopathology*, which accounts for most aspects of all mental conditions into a unitary dimension. Secondly, there are three resulting superspectra situated underneath the "*p*" factor: (1) *Emotional Dysfunction*; (2) *Psychosis*; and (3) *Externalising*. All three superspectra have corresponding symptom components and maladaptive personality traits, which essentially showcase increasing levels of pervasiveness. *Symptom components* largely represent situation-dependent and/or transient aspects of current-state psychopathology (e.g., social anxiety), whereas *maladaptive personality traits* represent more pervasive patterns of behaviour and predisposition to specific psychopathology (e.g., perfectionism; DeYoung et al., 2022). These symptoms and personality traits constitute various dimensional syndromes (i.e., combinations) of psychopathology, which should be differentiated from categorical syndromes, which are not based on a standardised set of variables found in dimensional models (Kotov et al., 2021). See Figure 2a for a visual comparison between categorical and dimensional syndromes.

Figure 1a

The Current HiTOP Model.

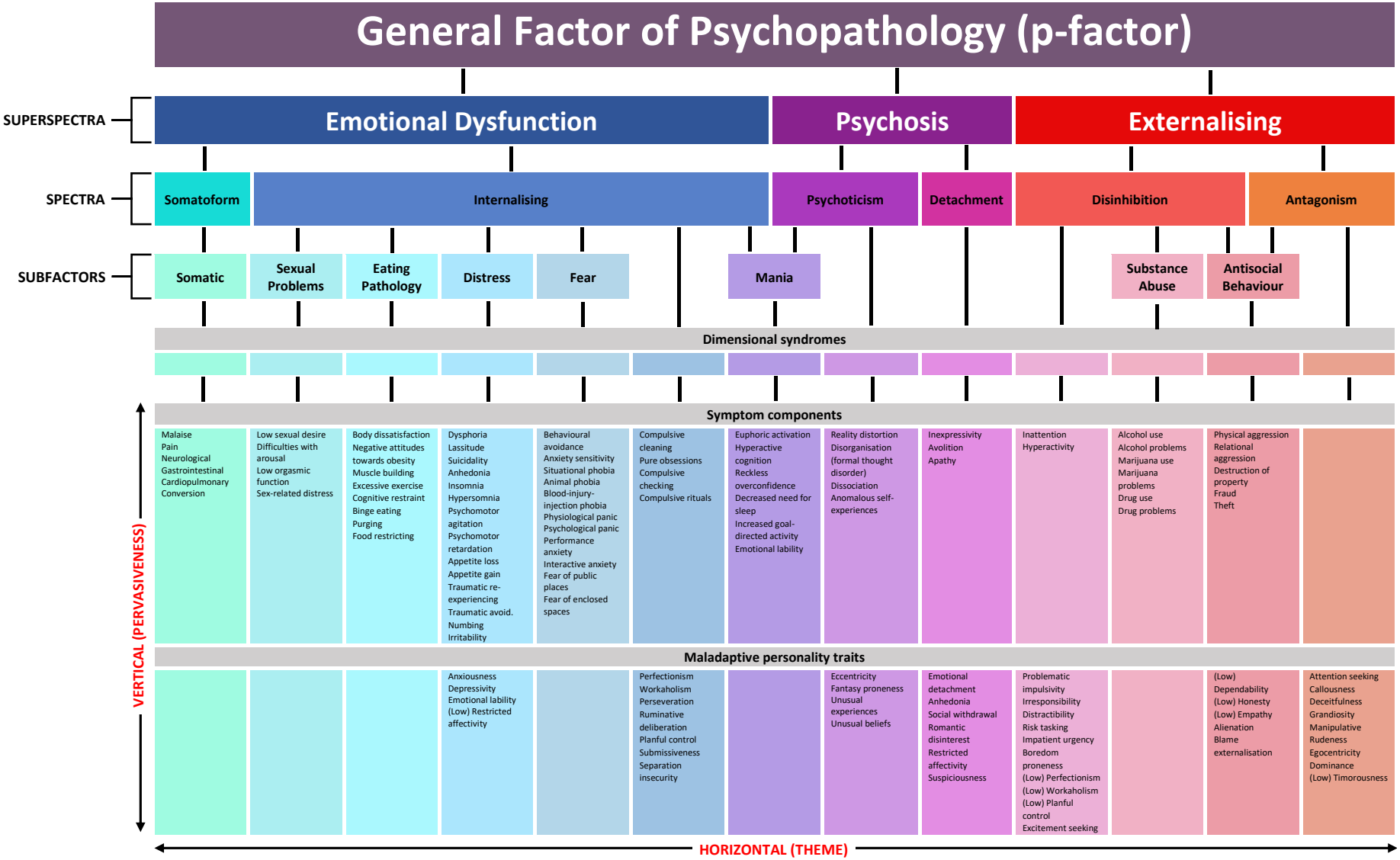
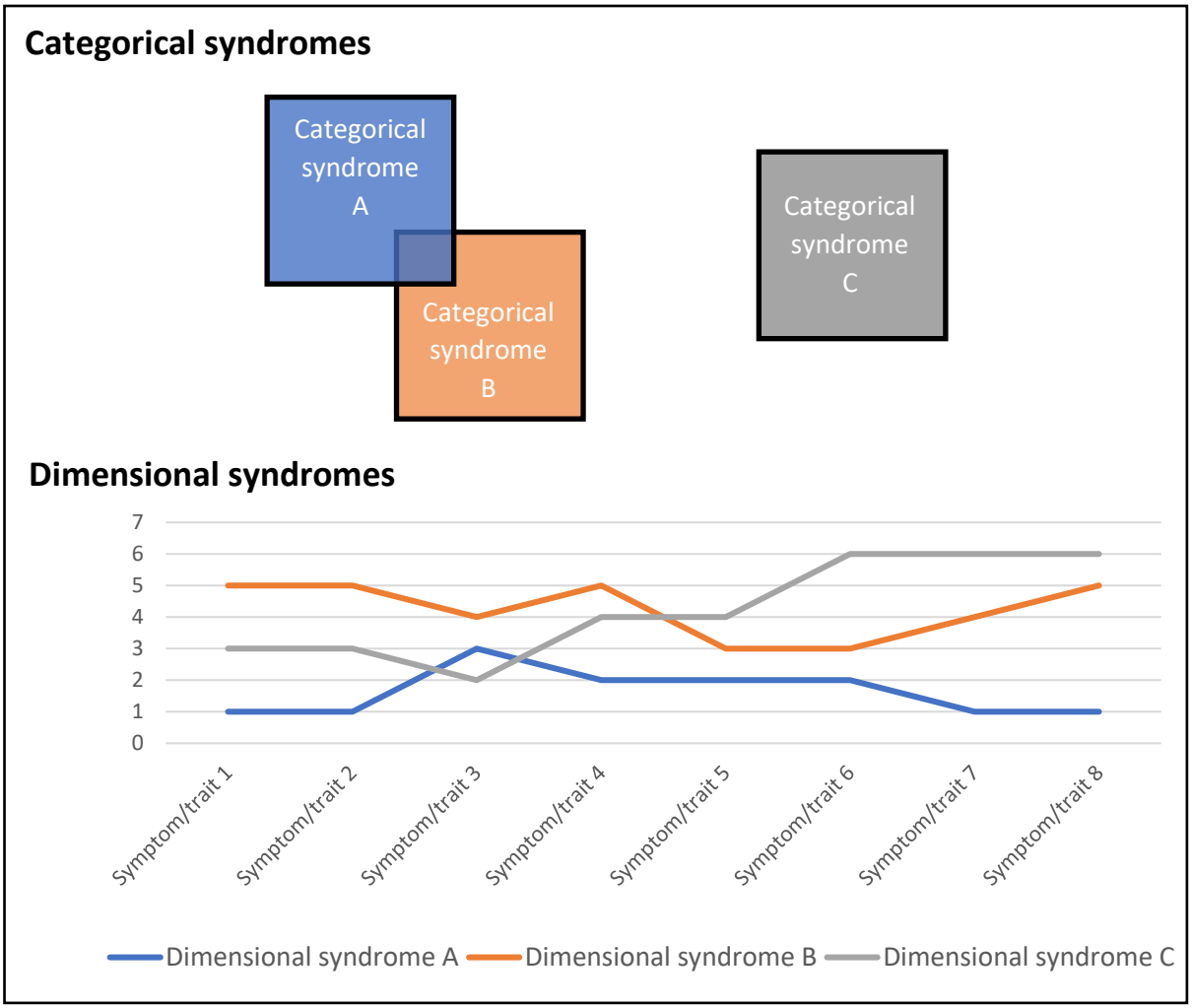


Figure 2a

Categorical vs. Dimensional Syndromes.



Note. Categorical syndromes are discrete experiences representing psychopathology as a cohesive set of symptoms/traits, despite their tendency to overlap. Consider categorical syndromes A and B, which could represent the overlap between an anxiety disorder and a depressive disorder. If an individual's clinical presentation was complex or exceeds the diagnostic criteria of either anxiety or depressive disorder, then they could possibly receive a diagnosis of an *unspecified* anxiety or depressive disorder (i.e., categorical syndrome C). Dimensional syndromes, however, are based on a standardised set of symptoms/traits, which allows for the plotting of multiple profiles. A dimensional alternative to categorical syndrome C (i.e., an unspecified disorder) would then provide a higher level of descriptive ability and specificity, thereby aiding in holistic clinical assessments and tailored support needs or treatments.

Emotional Dysfunction refers to extreme psychological manifestations of emotional and physical distress, which accounts for two resulting spectra (Watson et al., 2022a). The first is *Somatoform*, which represents bodily distress and physical sensations associated with emotional dysfunctions (e.g., somatic symptom disorder). The second is *Internalising*, representing the disorders and experiences of the emotions themselves (e.g., major depressive disorder, generalised anxiety disorder). Internalising can then be separated into five subfactors: *Distress* – extensive negative emotionality (e.g., depression); *Fear* – situation-specific forms of anxiety and behavioural avoidance (e.g., agoraphobia); *Eating Pathology* – disordered behaviours and fears surrounding eating (e.g., restricting); *Sexual Problems* – difficulties engaging in sexual activity (e.g., low sexual desire); and *Mania* – hyperactivation of positive emotionality and cognition (e.g., reckless overconfidence). Additionally, a sixth subfactor may exist under Internalising, pending further research: "*Obsessive-compulsivity"* – a pattern of obsessive intrusions of thought and anxiety-neutralising behaviours (e.g., obsessive checking; Watson et al., 2022a).

Psychosis refers to a disruption in cognition of oneself and one's surrounding environment, and accounts for an additional two spectra (Kotov et al., 2020). The first is *Psychoticism*, which constitutes disorders of thought and interpretation of reality (e.g., schizophrenia, schizoaffective disorder). The second is *Detachment*, concerning disengagement with social interactions and appropriate social responses (e.g., schizoid personality disorder). There are currently no documented subfactors of either Psychoticism or Detachment (Kotov et al., 2020).

Externalising refers to problematic patterns of behaviour and social opposition, which can be further differentiated into two spectra (Krueger et al., 2021). The first is *Disinhibition*, referring to dysregulation of impulse-control, which can then be separated into two additional subfactors: *Substance Abuse* – the inappropriate use of drugs and alcohol (e.g., alcohol

problems); and *Antisocial Behaviour* – disregard for the rights of others (e.g., relational aggression, which is dually accounted for by Antagonism, alongside Disinhibition). The second spectra, *Antagonism*, refers to patterns of interpersonal hostility (Krueger et al., 2021).

Issues surrounding categorical frameworks

The issue of diagnostic overlap and disorder co-occurrence

Within the diagnostic criteria of the DSM-5-TR, it is routinely stated that when making diagnostic decisions, the disturbance of a specific mental disorder should not be better explained by another mental disorder (APA, 2022). As such, there is a discrete relationship between categorical mental disorders, meaning that symptoms that are shared between two or more conditions are instead suggested to be constrained to differing diagnoses. This in turn may leave clinicians with a somewhat ambiguous situation where they must decide upon an individual's diagnosis based on a symptom(s) as either singular to one condition or overlapping with two or more conditions, complicating the diagnostic process (Kotov et al., 2022). For example, major depressive disorder (MDD) and posttraumatic stress disorder (PTSD) both feature depressed mood as a core symptom (APA, 2022). As a result of this diagnostic overlap, rates of disorder co-occurrence are likely to increase (Forbes, 2023), as 52% of people with PTSD also had co-occurring MDD (Rytwinski et al., 2013). This co-occurrence may instead represent the true manifestation of psychopathology; as complex, overlapping, and as the "rule rather than the exception" (Flory & Yehuda, 2015), which is representative of most categorical mental disorders (Kotov et al., 2021).

Moreover, the example of depressed mood is not unique to the case of MDD and PTSD, as the symptom appears across 15 different diagnoses, across 6 chapters of the DSM-5 (Forbes et al., 2023). In fact, of the 628 distinct symptoms in the DSM-5, 387 of these symptoms (63.2%) are unique to a specific diagnosis, but 231 symptoms (36.8%) were found to repeat across different diagnoses, with the most frequent being insomnia (repeating across

22 diagnoses; Forbes et al., 2023). As a result, 90-100% of diagnosis outlined in *Depressive, Substance-Related and Addictive, Bipolar and Related, Trauma- and Stressor Related, Dissociative, Neurocognitive,* and *Personality Disorder* diagnoses have at least one symptom that is shared in another diagnosis (Forbes et al., 2023), therefore raising questions regarding the validity of each diagnosis within clinical practice.

The issue of disorder heterogeneity

Disorder heterogeneity refers to the variation of symptoms within a single diagnosis, such that there can be a single diagnosis given to multiple people that do not share the same set of symptoms (Cavelti et al., 2021). Consider the example of borderline personality disorder (BPD), a personality disorder characterised by five or more of the following nine symptoms: (1) fear of abandonment; (2) unstable interpersonal relationships; (3) identity disturbance; (4) impulsivity; (5) recurrent suicidal behaviour; (6) affective instability; (7) chronic feelings of emptiness; (8) intense anger; and (9) paranoid ideation/dissociation. In line with this criteria, one individual may receive a diagnosis of BPD having symptoms 1-5, and another individual may receive the same diagnosis having symptoms 5-9 (Cavelti et al., 2021). Therefore, these individuals share the same diagnosis whilst having only one symptom in common. Although the nosology of BPD states that this diagnosis is valid for both individuals, phenomenologically, they express two substantially different patterns of behaviour. In fact, there are 256 possible combinations of a diagnosis of BPD (Cavelti et al., 2021). Another example, even more substantial, is the 636,120 possible ways to meet the criteria for PTSD (Galatzer-Levy & Bryant, 2013).

The issue of disorder reliability

The interrater reliability (i.e., the diagnostic agreement between clinicians) of categorical DSM-5-TR disorders that fall under the Emotional Dysfunction, Psychosis, and Externalising HiTOP superspectra have been deemed as fair to moderate (i.e., Kappa

coefficient *[K]* = .20-.67; Kotov et al., 2020; Krueger et al., 2021; Watson et al., 2022a). However, when considering these disorders as dimensions of Negative Affect (i.e., Internalising), Psychoticism, Detachment, Disinhibition, and Antagonism, the interrater agreement is excellent across all five spectra (Intraclass Coefficient [ICC] = .83-.90; Garcia et al., 2018). Moreover, the test-retest reliability of specific DSM-5-TR disorders are roughly fair to moderate (Grant et al., 2015; Kotov et al., 2020), but when representing these psychopathologies as dimensions, there is an improvement in test-retest reliability to an acceptable to good level (Kotov et al., 2020; Watson et al., 2022a; Wright et al., 2015). Additionally, the meta-analytic reliability of these dimensional counterparts ranges from acceptable to good (Kotov et al., 2020; Krueger et al., 2021; Watson et al., 2022a). As such, various reliability estimates increase when dimensionally expressing psychopathology, as opposed to categorical, which has previously been stated to increase by 15% overall (Markon et al., 2011).

The issue of subthreshold conceptualisation

A common consequence of categorical classifications are incidences where an individual may fall short of diagnostic criteria for any disorder. As a result, one may receive no diagnosis, or a diagnosis of "other specified/unspecified mental disorder", which possesses little utility regarding specific psychopathology (Kotov et al., 2021). To remedy this issue, a dimensional framework allows for a meaningful assessment of an individual's personality traits and symptoms, regardless of if they are at the clinical level or not. This alternative sees that the reliability of psychopathology improves substantially when considering them as continuous in nonclinical samples, therefore bridging the gap between psychopathology and "subthreshold" psychopathology (Markon et al., 2011).

The status of neurodevelopmental disorders within the HiTOP

The HiTOP accounts for a range of DSM-5-TR disorders. According to a consensus of evidence, *Substance-related*, *Impulse-control*, *Depressive*, *Anxiety*, *Personality*, and *Schizophrenia Spectrum* disorders all have strong levels of structural evidence in relation to the HiTOP, with most having strong levels of validation (Kotov et al., 2021). Additionally, *Bipolar and Related, Sexual Dysfunctions, Obsessive-compulsive and Related, Eating*, and *Neurodevelopmental* disorders have moderate levels of structural evidence with corresponding moderate to limited validation (Kotov et al., 2021).

Neurodevelopmental disorders are particularly important to expand upon, as they represent early-life manifestations of psychopathology. According to the DSM-5-TR, *neurodevelopmental disorders* (NDDs) are a set of conditions with an onset within the early developmental period, such as infancy or toddlerhood, and primarily affect fundamental processes of cognition, behaviour, and emotion (APA, 2022). As such, NDDs are found to affect intelligence, communication, executive functioning, learning, and motor skills (APA, 2022). See Table 1a for a full list of DSM-5-TR NDDs and associated specifiers. Despite covering a broad spectrum of affected areas, to date, NDDs have only been accounted for in the HiTOP via the investigation of attention-deficit/hyperactivity disorder (ADHD), which sees it placed within the Disinhibition spectrum with moderate levels of structural evidence and strong validation (Kotov et al., 2021). Some evidence has also highlighted the position of autism spectrum disorder (ASD) within the Detachment spectrum via factor analysis, but these findings are preliminary (Zimmermann et al., 2022). Therefore, NDDs require further investigation into their HiTOP position, so that dimensions and resulting dimensional syndromes can be identified. In turn, this may resolve issues such as diagnostic overlap, extensive co-occurrence, heterogeneity, low reliability, and subthreshold classification.

Issues of categorical neurodevelopmental disorders

The inter-rater reliability of ASD (K = 0.69) and ADHD (K = 0.61) in childhood is generally substantial (Freedman et al., 2013). This may be due to the limited repetition of symptoms (6.3%) within the chapter of *Neurodevelopmental Disorders* (except for the shared symptoms amongst *Motor Disorders*; Forbes et al., 2023), which could allow for a clearer indication of which NDD diagnosis is warranted. Still, the issue of co-occurrence is not uncommon amongst NDDs. In one sample of children with ASD, 61% had at least one co-occurring NDD – 42% had a language delay, 36% had a cognitive delay, and 4% had ADHD (Zauche et al., 2017). In another sample, 71% of children and adolescents with ASD met criteria for ADHD, and had co-occurring depression (29%), anxiety (34%), obsessive-compulsive disorder (11%) and oppositional defiant disorder (40%; Mosner et al., 2019). This is similarly true for young adults, but with higher co-occurrences of internalising disorders, as opposed to externalising disorders (Mosner et al., 2019). For ADHD, it is more likely to have at least one co-occurring DSM-5 condition than to have ADHD-alone (Jogia et al., 2022). In terms of co-occurring NDDs alongside ADHD, 25% had ASD, 9% had an intellectual disability, 19% had a language disorder, 21% had a learning disorder, and 3% had a tic disorder, amongst other internalising and externalising conditions (Jogia et al., 2022). In a twin-study of those with dyslexia (i.e., specific learning disorder), 38% had at least one other NDD – 21% had ADHD, 12% had ASD, 15% had developmental coordination disorder, and 19% with atypical sensory perception (Brimo et al., 2021). And in a review of those with Tourette syndrome, 3-20% had co-occurring ASD, 6-27% had a learning disorder, and 17-68% had ADHD (Cravedi et al., 2017).

Even though repetition of symptoms within NDDs is relatively low, 12 of the 15 observed NDD diagnoses (i.e., 80%) have at least one symptom that is found to repeat in other diagnoses of the DSM-5, with only the remaining 3 of the 15 NDD diagnoses (i.e.,

20%) having symptoms with no repetitions (i.e., not shared amongst other DSM-5 diagnoses; Forbes et al., 2023). Approximately 30% of all the distinct symptoms outlined in NDDs appear in other disorder chapters in the DSM-5 (Forbes et al., 2023), with the top six being: restlessness, stupor, stereotypy, echolalia, agitation, and mutism. For example, restlessness (as found in a diagnosis of ADHD) is also found in *Substance-related, Bipolar and Related, Neurocognitive, Depressive, Trauma- and Stressor-related,* and *Anxiety* disorders (Forbes et al., 2023). Additionally, stupor (as found in ASD with catatonia) is also found in the above disorder clusters with the addition of *Dissociative* and *Schizophrenia Spectrum* disorders (Forbes et al., 2023).

Table 1a

DSM-5-TR Neurodevelopmental Disorders and Associated Specifiers.

DSM-5 Sub-domain	Disorder	Disorder Specifier
Intellectual disabilities	1) Intellectual disability	-
	2) Global developmental delay	-
Communication disorders	3) Language disorder	-
	4) Speech sound disorder	-
	5) Childhood-onset fluency disorder (stuttering)	-
	6) Social (pragmatic) communication disorder	-
Autism spectrum disorder	7) Autism spectrum disorder	7.1) With/without accompanying intellectual impairment 7.2) With/without accompanying language impairment 7.3) Associated with a known medical condition or genetic condition or environmental factor 7.4) Associated with another neurodevelopmental, mental, or behavioural disorder 7.5) With catatonia
Attention-deficit/hyperactivity disorder	8) Attention-deficit/hyperactivity disorder	8.1) Combined presentation 8.2) Predominantly inattentive presentation 8.3) Predominantly hyperactive/impulsive presentation
Specific learning disorder	9) Specific learning disorder	9.1) With impairment in reading (dyslexia) 9.2) With impairment in written expression (dysgraphia) 9.3) With impairment in mathematics (dyscalculia)
Motor disorders	10) Developmental coordination disorder	-
	11) Stereotypic movement disorder	11.1) With self-injurious behaviour 11.2) Without self-injurious behaviour 11.3) Associated with a known medical or genetic condition, neurodevelopmental disorder, or environmental factor
	12) Tourette's disorder	-
	13) Persistent (chronic) motor or vocal tic disorder	13.1) With motor tics only 13.2) With vocal tics only
	14) Provisional tic disorder	-

Note. Tourette's disorder, persistent (chronic) motor or vocal tic disorder, and provisional tic disorder form a conglomerate category called *Tic Disorders*.

There have also been attempts to accommodate the heterogeneity of NDDs. For example, the implementation of a spectrum-based understanding of ASD has allowed for the consolidation of multiple conditions into a broad umbrella with specifiers (e.g., with/without presence of intellectual impairment) to account for, and label, various symptom combinations (Jacob et al., 2019). However, we make the argument that certain specifiers are lacking within a diagnosis of ASD. For instance, unlike a diagnosis of ADHD, which allows for the nuance in the presentation of inattention and hyperactivity-impulsivity, a diagnosis of ASD requires *both* criterion A (i.e., social-communication difficulties) and criterion B (i.e., restricted and repetitive behaviours; APA, 2022). A misdiagnosis of another NDD (that has different levels of public awareness and acceptance) and disregard for associated support may result if there are those that meet criterion A but not B, or vice-versa. For example, criterion A of ASD is largely shared with social communication disorder (Flax et al., 2019), and aspects of criterion B are similarly shared with stereotypic movement disorder (Freeman et al., 2010). As such, a diagnosis of either condition may occur when a diagnosis of ASD is warranted. What is more, social communication disorder has been suggested to exist on a continuum with ASD (Georgiou & Spanoudis, 2021), and mirrors the broader autistic phenotype (i.e., features that "border" autism), leading to questions surrounding its clinical usefulness in providing appropriate support needs (Flax et al., 2019). The need for such differential diagnoses is challenged when instead allowing for these nuances on a set of spectra, as a dimensional model would provide. Furthermore, a dimensional model would discourage the use of clinical diagnoses that have limited descriptive utility (e.g., other specified/unspecified neurodevelopmental disorder), as well as diagnoses that don't consider subthreshold conceptualisation and complex symptom presentations (Reiersen, 2017).

Thesis objectives

Considering that the HiTOP does not currently explore NDDs in much depth, in this thesis, across two studies, I will focus on using this dimensional model to map various neurodevelopmental traits more comprehensively. Outside of NDDs, exploratory methods such as factor analysis and latent class/profile analysis have commonly been used to empirically identify: (1) *individual components of psychopathology*; and (2) *dimensional syndromes*, respectively (Wardenaar & de Jonge, 2013). I will utilise these methods throughout both studies in this thesis. However, these methods can be subjected to restrictive strategies such as sampling based primarily on community demographics (e.g., clinical inpatient participants; Bornovalova et al., 2010; Cavelti et al., 2021) where certain behavioural characteristics are frequent. If clinical samples are solely used (i.e., individuals with categorical disorder X), then the traits and syndromes that are identified are constrained, as this approach would essentially fit different subtypes via latent profile analysis to these categorical disorders. Instead, I will recruit participants from the general population, by considering those with "non-clinical" and "clinical" experiences, arguably allowing for a fuller range of neurodevelopmental aspects to be captured from normality to psychopathology. This also allows for the empirical exploration and identification of symptoms and/or traits that would be considered "subthreshold" within a categorical framework.

Presented in **Chapter 2**, *What are the Factors Underlying Dimensional Traits of Autism and Schizotypy in the General Population?* is study one of this thesis. Of the two studies in this thesis, study one had a narrower approach, with an aim of investigating the conceptual overlap between traits of autism and schizotypy, specifically. Presented in **Chapter 3**, *Mapping Neurodevelopmental Disorder and Related Traits within the Hierarchical Taxonomy of Psychopathology* (HiTOP) was study two within this thesis. Study

two had a broader approach, with the aim of elucidating the HiTOP position of four NDDs (i.e., ASD, ADHD, specific learning disorder, and tic disorders). We also considered three NDD-related experiences (i.e., extreme demand avoidance, sluggish cognitive tempo, and emotional dysregulation), commonly reported within neurodevelopmental literature, that may act as extensions or closely related manifestations of the above four NDDs. Following these two studies, in **Chapter 4,** I then provide a general discussion of the integration of studies one and two. We consider the components of psychopathology by commenting on the HiTOP positions of specific NDDs and NDD-related experiences, as well as the dimensional syndromes that arise. Ultimately, across this thesis, we suggest updates to HiTOP that may be able to integrate NDDs more fully within its dimensional framework, and in so doing advance understanding of NDDs.

Chapter 2

Study One

What are the Factors Underlying Dimensional Traits of Autism and Schizotypy in the General Population?

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Abstract

Introduction: Autism and schizotypy are currently understood as separate experiences. However, research shows a large, shared factor between these two constructs, with only a smaller set of unique factors differentiating them in the general population. Yet, these findings are preliminary and may be impacted by limitations with measure psychometrics. Whilst attending to these issues, we aimed to reassess the factors underlying dimensional traits of autism and schizotypy within the general population, along with delineating any latent classes that would emerge from these factors. *Method:* Our study had a cross-sectional, correlational design. We recruited 669 adult participants from the broader community and Curtin University (M_{age} = 29, 52% Female) to complete an online survey of autism, schizotypy, and schizoid trait measures. *Results:* In an exploratory factor analysis, six factors emerged between dimensions of autism and schizotypy (Social Discomfort, Expressive Difficulty, Cue Interpretation, Eccentricity, Derailed Speech, and Suspiciousness) that were components of two higher-order factors of Detachment and Psychoticism, where Detachment strongly reflected the schizoid personality. Seven dimensional syndromes also emerged within a latent profile analysis, representing different combinations of these factors, with combined autistic-schizotypal phenotypes being the most common. *Conclusions:* Our findings show that traits of autism and schizotypy substantially overlap, and validate the relevance and positioning of autism and schizotypy within the Hierarchical Taxonomy of Psychopathology (HiTOP).

What are the Factors Underlying Dimensional Traits of Autism and Schizotypy in the General Population?

Introduction

The *Diagnostic and Statistical Manual of Mental Disorders – 5th Edition – Text Revised* (DSM-5-TR) outlines diagnoses via discreet categories of symptoms (APA, 2022), leading to various issues such as disorder co-occurrence (Kotov et al., 2021). The *Hierarchical Taxonomy of Psychopathology* (HiTOP) has recently been established as an alternative to DSM-5-TR psychiatric classification, providing a framework where mental disorders are expressed as continuous dimensions (Caspi & Moffitt, 2018; Keyes et al., 2013; Kotov et al., 2021; Lahey et al., 2017; Ruggero et al., 2019). The HiTOP is generally differentiated into three higher-order factors: (1) *Emotional Dysfunction* – the tendency to experience anxiety and mood disturbances, along with somatic symptoms; (2) *Psychosis* – the presence of cognitive aberrations (e.g., paranoia) as well as social detachment; and (3) *Externalising* – patterns of disinhibited behaviours and antagonism (Kotov et al., 2021). However, the HiTOP does not currently consider the position of neurodevelopmental disorders in much depth, except for attention-deficit/hyperactivity disorder (ADHD; Kotov et al., 2021). Consequently, there is a growing interest in the HiTOP position of autism (Zimmermann et al., 2022), considering that autism and ADHD have been found to form an *Attention and Communication Difficulties* factor that is separate from the standard five-factor model of personality (Stanton et al., 2021), akin to the domains of the HiTOP. However, overlap at the conceptual level (i.e., via diagnostic criteria) is prominent between that of autism and schizotypy (Dinsdale et al., 2013; Ford et al., 2017; Ford & Crewther, 2014; Zhou et al., 2019), with genetic similarities underpinning the relationship between autism and schizophrenia spectra (Rees et al., 2021).

Autism spectrum disorder (ASD) is a neurodevelopmental disorder, characterised by social-communication difficulties, as well as restrictive and repetitive behaviours (APA, 2022). Likewise, schizotypy is clinically recognised as *schizotypal personality disorde*r; characterised by long-standing patterns of eccentricity and cognitive-perceptual abnormalities (APA, 2022). These disorders are currently classed as separate phenomena, hence their distinction via exclusion criteria (King & Lord, 2010) and placement in different sections of the DSM-5-TR. However, both autism (von dem Hagen et al., 2011; Wheelwright et al., 2010) and schizotypy (Polner et al., 2019) are dispersed throughout the general population, with the two displaying substantial overlap through factor analysis (Dinsdale et al., 2013; Ford et al., 2017; Ford & Crewther, 2014; Zhou et al., 2019). Thus, the argument that the two constructs reflect overlapping dimensions, as opposed to discreet categories, supports the use of the HiTOP to dimensionally map these traits.

Although arguments can be made for either framework (i.e., discreet vs. continuous; Shorter & van Praag, 2010), criticisms of discreet psychiatric classification highlight substantial diagnostic overlap, symptom heterogeneity, and limited diagnostic agreement between health professionals (Demazeux & Singy, 2015; Regier et al., 2011). In lieu of these issues, improving diagnostic utility and inter-rater reliability in research is key for providing tailored support needs (Regier et al., 2011), which is why the HiTOP is a promising avenue. But before clinical research is conducted, a solid foundation of research assessing the relationship between autistic and schizotypal traits within the general population is needed.

Overlapping and Diametric Relationships Between Autistic and Schizotypal Traits

There are strong positive associations between traits of autism and schizotypy within the general population (Kondo & Lin, 2020; Russell-Smith et al., 2011). Furthermore, a large, overlapping factor called *Social Disorganisation* emerges between

them (Ford & Crewther, 2014), characterised by difficulties with social-communication (e.g., cue interpretation), social anxiety, and relationship disinterest (Ford et al., 2017). Moreover, mixed findings on the role of cognitive and emotional empathy in both autism and schizotypy (Nahal et al., 2021; Wang et al., 2015) also suggests a common difficulty in social-communication. Social Disorganisation has also been found to reflect the phenotype of the schizoid personality (Ford et al., 2017; Ford & Crewther, 2014), which is clinically recognised as *schizoid personality disorder*; characterised by a long-term pattern of social anhedonia (i.e., lack of social enjoyment; Russell-Smith et al., 2013) and absence of intimate relationships (APA, 2022). Schizoid personality disorder and schizotypal personality disorder are both considered cluster A personality disorders (i.e., they share odd/eccentric features; APA, 2022), but they differ in that the schizoid personality primarily is defined by the presence of negative psychotic-like features only (e.g., social anhedonia), whereas the schizotypal personality is defined by the presence of both negative and positive psychotic-like features (e.g., social anhedonia and magical thinking; APA, 2022). Given that the schizoid personality primarily accounts for negative-psychotic traits, and thus a distinguishing trait of HiTOP Detachment (i.e., defined by pervasive difficulties in social engagement; Zimmermann et al., 2022), it could be posited that the overlap between autism and schizotypy (i.e., Social Disorganisation) is accounted for by the Detachment spectrum.

Still, smaller factors have emerged in recent works that differentiated autism and schizotypy. Firstly, *Perceptual Oddities*, referring to differences in perception and cognition, theoretically aligned with the conceptualisation of positive schizotypy (e.g., paranoia, belief in telepathy; Ford et al., 2017), where overlap with autistic traits is less pronounced (Larson et al., 2020; Nenadić et al., 2021). Secondly, *Social Rigidity*, the inflexibility and attention to detail, aligned more with the typical construct of autism,

particularly restricted and repetitive behaviours (Ford et al., 2017). The divergence of these factors may suggest a diametric (i.e., opposing axis) set of symptoms that occur alongside the overlapping factor. The diametric relationship is hypothesised to represent fluidity to rigidity of thought (Hurst et al., 2007), where global processing (i.e., holistic thinking) is positively associated with schizotypy, and local processing (i.e., attention to fine details) is positively associated with autism (Russell-Smith et al., 2010). Further research supports this notion that an overlapping and diametric autism-schizotypy spectrum exists within the general population (Dinsdale et al., 2013; Russell-Smith et al., 2011; Zhou et al., 2019), with the support of neuroimaging (Ciaramidaro et al., 2015; Stanfield et al., 2017).

When using the lower-order seven-factor solution that emerged between autism and schizotypy in past work (i.e., Fixation with Details, Cue Interpretation, Relationship Disinterest, Social and Communication Discomfort, Odd Behaviour, Hallucination/Delusional Experiences, and Paranoia/Suspiciousness; Ford et al., 2017), eight clusters of participants then emerged (Ford et al., 2018), representing the dimensional syndromes (i.e., the symptom combinations). Classes that were comprised of participants' equal scoring on all the factors were the most common, but smaller groups also appeared that were primarily autistic and/or schizotypal (Ford et al., 2018). This may suggest that the occurrence of schizotypal traits without autistic traits (and vice versa) is more of a rarity, however, this finding has only been demonstrated once.

Assessing Autistic and Schizotypal Traits

Research assessing these two constructs often use the 50-item Autism Quotient (Baron-Cohen et al., 2001) alongside the Schizotypal Personality Questionnaire (Cohen et al., 2010; Raine, 1991) within factor analysis, and without consideration of alternate measures (Dinsdale et al., 2013; Ford et al., 2017; Ford & Crewther, 2014; Zhou et al., 2019). Although the Autism Quotient is descriptive of autistic traits in the general

population (Jia et al., 2019; Ruzich et al., 2015), Cronbach's alpha (α) of the total scale and subscale score have sometimes been below the .70 threshold when used in this broader context (Baron-Cohen et al., 2001; Zhou et al., 2019). Subsequent validation of the Autism Quotient in the general population also found its five-factor solution to be non-parsimonious (Hoekstra et al., 2011; Jia et al., 2019; Lundqvist & Lindner, 2017), as reducing the number of items from 50 to 28 provided a streamlined solution that theoretically aligned with DSM-5 conceptualisation of ASD (Hoekstra et al., 2011). Furthermore, violations in item-convergent and item-discriminant validity have been noted in some work with the Autism Quotient (Nishiyama et al., 2014). Therefore, work on autism and schizotypy that uses alternative, more recent measures with stronger psychometrics, may then usefully advance existing work.

Several autistic measures have alternatively been used, but the 24-item Subthreshold Autism Trait Questionnaire (SATQ; Kanne et al., 2012), and 36-item Broader Autism Phenotype Questionnaire (Hurley et al., 2007) excel above others in terms of item-convergent and item-discriminant validity (Nishiyama et al., 2014). Although both questionnaires are good candidates due to their strong convergence with the Autism Quotient (Skylark & Baron-Cohen, 2017), the SATQ has been found to have a better discriminating ability when identifying cases vs controls (Nishiyama et al., 2014) and was parsimonious given its brevity. We therefore planned to use the SATQ as an alternative to the Autism Quotient, alongside the Schizotypal Personality Questionnaire. The Schizotypal Personality Questionnaire will remain the measure of schizotypy in this study given its revised structure and good psychometrics (Davidson et al., 2016), as well as its broader content coverage compared to the Community Assessment of Psychic Experience and Oxford-Liverpool Inventory of Feelings and Experiences (Mason, 2015).

Objectives and Rationale for the Current Study

Our aim was to explore the overlap between dimensions of autism and schizotypy using a factor analytic approach, and then compare this overlap to the schizoid personality. We also compared our factor solution to the seven-factor solution proposed by Ford et al. (2017) as well as the spectra outlined by the HiTOP (Kotov et al., 2021). Additionally, we aimed to identify the factor combinations (i.e., the dimensional syndromes of autism and schizotypy) with latent profile analysis (LPA) and compare our results to the cluster solution by Ford et al. (2018). We believe the current study is necessary to further validate the HiTOP and previous factor analytic findings between autism and schizotypy (Dinsdale et al., 2013; Ford et al., 2017; Ford & Crewther, 2014). Linking autistic and schizotypal traits may then help inform the accommodations needed to counter functional impairments in schizotypy (Chabrol & Raynal, 2018; Jahshan & Sergi, 2006).

Method

Design, Participants, and Recruitment Procedures

A cross-sectional, correlational design was used. Recruitment was made via convenience and snowball sampling, where participants over the age of 18 were included and sourced from the general population that were predominantly English-speaking. Curtin University students completing the survey as part of a course requirement could be 17 or over. The study was advertised on the Curtin University SONA webpage, professional social media accounts, and internet forums (e.g., Reddit). Curtin University psychology students were awarded two SONA points upon completion. Ethical approval was granted for our study by the Research Office at Curtin University (HRE2021-0352-05).

Our final sample size was 669 (ages 18 to 79; M_{age} = 28.86 years; SD_{age} = 12.08,). Fifty two percent were female, 39% were male, and 9% were non-binary/third gender or gender-diverse participants. Most were employed (including caring for another/children) or

studying, with most also being a high school graduate or having a university degree as their highest level of education. Many participants resided in Australia, but a substantial number was also from the United States and the United Kingdom. See Table 1b for demographic descriptives.

Measures

Participants completed a 15 to 30-minute online Qualtrics survey which consisted of demographic questions and questionnaires measuring autism, schizotypy, and schizoid traits. Three attention checks were included throughout the survey (e.g., "To make sure you are paying attention, please choose 'strongly agree'"). The psychometrics for each measure below were calculated for the current study using McDonald's omega [ω] and α.

Table 1b

Sociodemographic Descriptives and Frequencies of Participants.

Variable	*n*	%
Gender		
Female	347	52
Male	263	39
Non-binary/third gender or gender-diverse	57	9
Prefer not to say	2	0
Occupation		
Employed or caring for another/children	439	66
Unemployed or unable to work due to disability	75	11
Studying	319	48
Highest level of education		
Less than high school	45	7
High school graduate	249	37
Vocational training or other form of education	72	11
Undergraduate or postgraduate degree	303	45
Country		
Australia	386	58
United States of America	99	15
United Kingdom	78	12
Other	103	15
Survey-type		
Broader community	558	83
SONA	111	17

Note. N = 669. Participants were on average 28.9 years old (SD = 12.1).

Subthreshold Autism Trait Questionnaire (SATQ)

The SATQ is a 24-item questionnaire designed to measure subthreshold traits of autism in the general population (Kanne et al., 2012) using a four-point Likert scale (i.e., 1. "Strongly disagree" to 4. "Strongly agree"). The measure has five subscales: *Social*

Interaction and Enjoyment (α = .87, ω = .87); *Oddness* (α = .77, ω = .78); *Reading Facial Expressions* (α = .79, ω = .78); *Expressive Language* (α = .65, ω = .70); and *Rigidity* (α = .69, ω = .68). For the SATQ total scale score, both α and ω were .90. An example item is "I make eye contact when talking with others". Moreover, the SATQ demonstrates convergent validity with the Autism Quotient and Broader Autism Phenotype Questionnaire (Nishiyama et al., 2014; Skylark & Baron-Cohen, 2017). Eight items were originally excluded by Kanne et al. (2012), but they remained in the dataset when conducting EFA on the combined SATQ and SPQ-BR to examine their utility.

Schizotypal Personality Questionnaire - Brief Revised (SPQ-BR)

The SPQ-BR has 32 items and assesses various aspects of schizotypy in the general population (Davidson et al., 2016) using a four-point Likert scale (i.e., 1. "Strongly disagree" to 4. "Strongly agree") akin to the SATQ, as opposed to the traditional binary response format of the SPQ (i.e., yes/no). This is to encourage a dimensional assessment of schizotypy instead of a categorical one. The measure has nine subscales*: Ideas of Reference* (α = .82; ω = .83); *Suspiciousness* (α = .76; ω = .77); *No Close Friends* (α = .85; ω = .85); *Constricted Affect* (α = .70; ω = .71); *Eccentric Behaviour* (α = .88; ω = .89); *Social Anxiety* (α = .89; ω = .89); *Magical Thinking* (α = .85; ω = .85); *Odd Speech* (α = .81; ω = .81); and *Unusual Perceptions* (α = .68; ω = .68). Additionally, three higher-order factors of schizotypy were present: *Cognitive-Perceptual* (α = .88; ω = .87); *Interpersonal* (α = .89; ω = .89); and *Disorganised* (α = .87; ω = .86; Davidson et al., 2016). Both α and ω for the SPQ-BR total scale score were .93. An example item is "I often feel that others have it in for me". Convergent validity has been established with similar trait-schizotypy measures (e.g., Oxford-Liverpool Inventory of Thoughts and Experiences; Mason et al., 1995).

Coolidge Axis II Inventory 260: Schizoid Subscale (CATI-Sd)

The CATI-Sd (Coolidge, n.d.) is based on the diagnostic criteria of schizoid personality disorder. Having nine items[1] comprising a single factor (e.g., "I think of myself as a loner"), the measure has a four-point Likert scale (i.e., 1. "Strongly disagree" to 4. "Strongly agree"). The measure was used to validate resultant factors in our study. Internal consistency for the CATI-Sd total score was good (α = .86, ω = .87). Convergent validity has been established between this subscale and the Autism Quotient and Schizotypal Personality Questionnaire (Ford et al., 2017).

Analytic Strategy

Within RStudio (RStudio Team, 2020), we used the lavaan package (Rosseel, 2012) to conduct confirmatory factor analysis (CFA) with robust maximum likelihood estimation to first assess the structural integrity of the measures, and then the tidyLPA package (Rosenberg et al., 2022) to conduct LPA. Exploratory factor analysis (EFA), correlations, and Chi-square (χ^2) test of contingencies were conducted using SPSS (v28; IBM Corp., 2023). Parallel analysis was conducted using Patil et al.'s (2017) software.

Correlational Analysis and Exploratory Factor Analysis

Participants completed a randomised, combined questionnaire of autistic and schizotypal traits as per Ford et al.'s (2017) protocol. Pearson's correlations were then run between each of the subscales in all measures, with $r \geq .50$ indicating a strong correlation. The items from this questionnaire were used in a lower-order EFA to find a unique factor

[1] CATI-Sd item 6 ("neither praise nor criticism bother me") had a low item-total correlation, which increased α and ω if deleted. This item was *not* included in analysis as we do not need to reassess the multidimensional structural validity of the measure, given its one-dimensionality. Therefore, eight items remained in the CATI-Sd, with an α of .88 and ω of .89.

solution, with item loadings ≥ .40 being retained within a factor as recommend by Matsunaga (2010). However, items with loadings less than (but close to) .40 were retained if there was theoretical sense to do so. The number of factors to keep was aided by Horn's (1965) parallel analysis, given its superior discriminant ability than the traditional eigenvalue (i.e., ≥ 1) retention method (Matsunaga, 2010). However, if there was a theoretical reason to retain a factor, where parallel analysis suggested otherwise, the interpretability and implications of this decision was also considered. We then conducted higher-order EFA using the mean scores of the resultant factors as parameters, and then ran Pearson's correlations between all resultant factors as well as the schizoid subscale for validation.

Latent Profile Analysis

Each factor was then used as a variable in an LPA to highlight meaningful profiles of participants (Spurk et al., 2020). We set out to estimate one to nine profiles in four different model types (i.e., [1] equal variances/zero covariances, [2] varying variances/zero covariances, [3] equal variances/equal covariances, and [6] varying variances/varying covariances; Rosenberg et al., 2022)[2]. Each model type was compared against each other according to the lowest value of fit indices (i.e., Akaike's information criterion [AIC], Bayesian information criterion [BIC], classification likelihood criterion [CLC], Kullback information criterion [KIC], and approximate weight of evidence [AWE]; Akogul & Erisoglu, 2017), using analytic hierarchy processing (Akogul & Erisoglu, 2017), alongside the clinical meaningfulness of each solution. We additionally considered Entropy ≥ .80 for each solution, indicating an acceptable level of certainty when allocating participants into a certain profile (Tein et al., 2013). We also specified the minimum and maximum

[2] Models 4 (varying variances/equal covariances) and 5 (equal variances/varying covariances) in tidyLPA were not assessed, as they are not compatible with the "mclust" package (Rosenberg et al., 2022).

probability of being assigned to a profile (i.e., modal assignment; Spurk et al., 2020), and the percentage of profile sizes relative to the total sample size (i.e., a profile should comprise at least 3% of the total sample; Spurk et al., 2020).

Chi-square Test of Contingencies

Chi-square *(χ^2)* test of contingencies was then used to highlight any differences of demographics between each profile from the best LPA solution. Cramer's V (ϕ_c) was used as the effect size (Rea & Parker, 2014). To compare all profiles on these variables, we then calculated the adjusted residual statistics (z) for each profile to determine individual χ^2 values and Bonferroni-corrected significance levels ($df = 1$; Beasley & Schumacker, 1995; García-pérez & Núñez-antón, 2003).

Results

Eighty-one participants had more than 30% missing data across the questionnaires, which were then deleted along with those who did not answer at least one attention check. A missing values analysis found 27 empty responses across items on all measures, but they were missing completely at random (MCAR) according to Little's MCAR test, χ^2 (1664) = 324.00, $p = 1.000$. Expectation maximisation was then used to impute missing values. Univariate and multivariate outliers were found but not considered influential (i.e., Cook's distance < 1), so they remained in the final dataset. The four measures were deemed as having good fit and were acceptable using CFA (see Supplementary Material F1).

Bivariate Correlations

See Table 2b for scale means. Zero-order Pearson's correlation between variables were mostly moderate to large and statistically significant (see Table 3b).

Table 2b

Means (M) and Standard Deviations (SD) for Each Scale Variable.

Variable	Total		Males		Females		Non-binary	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
SATQ total score	54.51	11.24	55.57	11.00	52.25	10.86	63.30	9.65
Social Interaction and Enjoyment	21.88	5.61	22.59	5.73	20.84	5.36	24.84	5.14
Oddness	11.96	3.29	12.41	3.18	11.14	3.19	14.81	2.39
Reading Facial Expressions	8.39	2.57	8.53	2.48	7.97	2.49	10.25	2.69
Expressive Language	8.45	2.28	8.48	2.33	8.29	2.20	9.26	2.39
Rigidity	12.19	2.86	11.98	2.91	12.06	2.76	13.88	2.75
SPQ-BR total score	77.21	16.19	76.56	16.27	75.19	15.17	92.13	14.19
Ideas of Reference	7.39	2.35	7.19	2.20	7.29	2.34	8.89	2.60
Suspiciousness	7.00	2.18	6.91	2.16	6.81	2.07	8.47	2.39
Magical Thinking	6.93	2.99	6.22	2.71	7.12	2.88	9.02	3.70
Unusual Perceptions	8.37	2.67	8.43	2.69	8.04	2.55	10.01	2.78
No Close Friends	7.43	2.58	7.71	2.67	6.99	2.46	8.74	2.31
Constricted Affect	7.10	2.06	7.65	2.11	6.56	1.90	7.86	1.88
Social Anxiety	11.51	3.24	11.25	3.27	11.38	3.18	13.39	2.85
Eccentric Behaviour	10.24	3.02	10.48	2.95	9.63	2.97	12.93	1.93
Odd Speech	11.25	2.71	10.73	2.58	11.37	2.70	12.82	2.69
Cognitive-Perceptual	29.67	7.90	28.75	7.36	29.26	7.48	36.40	9.61
Interpersonal	26.02	6.65	26.60	7.01	24.93	6.21	29.98	5.71
Disorganised	21.49	5.01	21.21	4.92	21.00	4.96	25.75	3.54
CATI-Sd total score[a]	17.33	5.48	18.10	5.79	16.23	4.98	20.49	5.18

Note. $N = 669$. Variables that are higher-order factors are italised.

[a] Mean value of eight out of nine items (i.e., item 6 excluded). When including all nine items (i.e., item 6 included), $M = 19.20$, and $SD = 5.66$.

Table 3b

Zero-Order Pearson's Correlations.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Social Interaction & Enjoyment																			
2	Oddness	.44**																		
3	Reading Facial Expressions	.75**	.51**																	
4	Expressive Language	.56**	.44**	.60**																
5	Rigidity	.65**	.50**	.62**	.47**															
6	SATQ total	.88**	.73**	.84**	.71**	.80**														
7	Ideas of Reference	.30**	.49**	.27**	.40**	.41**	.46**													
8	Suspiciousness	.33**	.54**	.29**	.38**	.40**	.48**	.62**												
9	Magical Thinking	-.02	.28**	.04	.10**	.11**	.12**	.37**	.36**											
10	Unusual Perceptions	.25**	.52**	.28**	.29**	.33**	.41**	.55**	.53**	.42**										
11	No Close Friends	.66**	.52**	.53**	.47**	.48**	.69**	.38**	.45**	.08*	.35**									
12	Constricted Affect	.63**	.50**	.51**	.55**	.44**	.68**	.35**	.39**	.07	.35**	.70**								
13	Social Anxiety	.64**	.42**	.50**	.51**	.59**	.67**	.47**	.41**	.10*	.36**	.55**	.46**							
14	Eccentric Behaviour	.45**	.81**	.48**	.36**	.47**	.66**	.46**	.49**	.21**	.44**	.53**	.47**	.47**						
15	Odd Speech	.18**	.53**	.30**	.35**	.40**	.41**	.48**	.41**	.21**	.44**	.31**	.24**	.39**	.52**					
16	*Cognitive-Perceptual*	.26**	.57**	.27**	.36**	.38**	.45**	.79**	.78**	.73**	.81**	.39**	.36**	.41**	.50**	.49**				
17	*Interpersonal*	.76**	.56**	.61**	.60**	.61**	.80**	.49**	.49**	.10**	.42**	.87**	.81**	.84**	.58**	.38**	.46**			
18	*Disorganised*	.37**	.78**	.45**	.41**	.50**	.62**	.54**	.52**	.24**	.51**	.49**	.42**	.49**	.89**	.86**	.57**	.56**		
19	SPQ-BR total	.55**	.75**	.52**	.55**	.59**	.74**	.75**	.74**	.47**	.72**	.70**	.63**	.70**	.76**	.66**	.85**	.81**	.81**	
20	CATI-Sd total	.75**	.53**	.53**	.47**	.52**	.74**	.43**	.49**	.10**	.37**	.79**	.71**	.62**	.56**	.29**	.43**	.83**	.49**	.70**

Note. $N = 669$. Variables that are higher-order factors are italised.

$^{*}p < .05$. $^{**}p < .01$ (two-tailed).

Exploratory Factor Analysis

All 64 items on the combined SATQ and SPQ-BR had an α of .96. However, SATQ 8 (i.e., "I use gestures") and 19 (i.e., "I have a good imagination"), as well as SPQ-BR 7 (i.e., "I believe in telepathy") and 8 (i.e., "I believe in clairvoyance") had a corrected item-total correlation below .03 and were thus removed in order to streamline the set of items prior to EFA. Principal axis factoring with promax rotation on the remaining 60 items had a Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) of .96, and Bartlett's test of sphericity was significant, χ^2 (1770) = 22673.18, $p < .001$, supporting the data's factorability. Parallel analysis instead suggested six factors, and items with low loadings and two or more cross-loadings were removed. Items with low extracted communalities (i.e., below .40) were also removed, unless they were theoretically necessary to maintain. This was the case for some items measuring rigidity in the SATQ, as restricted behaviours are a central criterion for ASD (APA, 2022), although most items assessing this criterion did not perform well in the EFA and were subsequently removed.

The final solution had six factors with 23 items, explaining 55.85% of the variance in the data (see Table 4b). We called Factor 1 *Eccentricity*, capturing behaviours that are incongruent with social expectations. This factor also captured some restrictive behaviours as well as sensory sensitivities found in autism. Factor 2 we called *Suspiciousness*, detailing paranoia-like cognitions, Factor 3 reflected *Social Discomfort,* referring to anxiety and avoidance of social situations, and Factor 4 we called *Derailed Speech*, relating to tangential patterns of speech. We called Factor 5 *Cue Interpretation*, capturing difficulties in recognising body language of others, and Factor 6 was called *Expressive Difficulty* of emotions and thoughts. There were no cross loadings and most items had loadings over .40, except for SATQ 28 (i.e., sensory sensitivities) which had a loading of .39. The higher-order EFA found a single factor which we called *General Neurotype*,

explaining 40.88% of the variance in the data (see Table 5b). However, we favoured a manually tested two-factor solution which explained a larger 50.42% of the total variance and reflected the two HiTOP spectra of: (1) *Detachment*; and (2) *Psychoticism*, explaining 42.32% and 8.10% of the variance in the data, respectively (see Table 6b). Internal consistency for each factor was deemed as acceptable to good (see Table 7b).

Table 4b

Six Factor Solution from an EFA of the Combined SATQ and SPQ-BR.

Original Item	Item	Factor					
		1	2	3	4	5	6
SPQ-BR 26	I am an odd, unusual person.	**.84**	.00	.00	.02	.01	-.05
SATQ 10	I have some behaviours that others consider strange or odd.	**.83**	.05	-.03	-.06	-.02	.06
SATQ 9	Others think I am strange or bizarre.	**.82**	.07	-.07	-.04	.03	.05
SPQ-BR 27	I have some eccentric (odd) habits.	**.77**	.00	-.03	.04	-.04	.03
SATQ 25	I have interests that occupy much of my time and thoughts (more so than most of my peers).	**.46**	-.09	.09	.14	.08	-.05
SATQ 28	I am unusually sensitive to textures, sights, smells, tastes or sounds.	.39	.06	.19	.14	.04	-.04
SPQ-BR 2	I sometimes feel that other people are watching me.	-.10	**.77**	.02	.05	-.01	.05
SPQ-BR 4	I often feel that others have it in for me.	.09	**.74**	-.08	-.09	.07	-.01
SPQ-BR 3	When shopping, I get the feeling that other people are taking notice of me.	-.01	**.72**	.05	.05	-.05	-.03
SPQ-BR 5	I sometimes get concerned that friends or co-workers are not really loyal or trustworthy.	.11	**.63**	.01	-.07	-.05	.00
SATQ 2	I enjoy social situations where I can meet new people and chat (i.e., parties, dances, sports, games) (R).	.04	-.05	**.93**	-.08	-.04	-.01
SATQ 3	I seek out and approach others for social interactions (R).	.02	-.07	**.69**	-.03	.00	.11
SATQ 20	I am comfortable with spontaneity, such as going to new places and trying new things (R).	-.05	.08	**.60**	-.05	.18	-.06
SPQ-BR 22	I get anxious when meeting people for the first time.	-.05	.11	**.56**	.17	-.09	.05
SPQ-BR 29	I sometimes jump quickly from one topic to another when speaking.	-.01	-.06	-.09	**.86**	-.02	.05
SPQ-BR 30	I tend to wander off the topic when having a conversation.	.04	-.03	.00	**.76**	-.02	.05
SPQ-BR 31	I often ramble on too much when speaking.	.12	.09	.05	**.62**	.01	-.17
SATQ 14	I am good at knowing what others are feeling by watching their facial expressions or listening to the tone of their voice (R).	-.05	.00	-.02	-.02	**.92**	.01
SATQ 15	I can sense that someone is not interested in what I'm saying by reading their facial expression (R).	.09	-.05	.04	-.01	**.73**	-.08
SATQ 6	I respond appropriately to other people's emotions (for example, comforting someone who is upset) (R).	.05	.02	.08	.02	**.43**	.20
SPQ-BR 18	I tend to keep my feelings to myself.	.07	-.05	.10	-.14	-.12	**.75**
SPQ-BR 20	I am not good at expressing my true feelings by the way I talk and look.	.11	-.03	-.05	.08	.05	**.70**
SATQ 17	I am good at using words to express my thoughts and ideas (R).	-.18	.14	.01	.11	.12	**.55**
Variance Explained by Factors (%)		32.59	8.54	5.17	3.73	3.24	2.68
Total Variance Explained (%)		55.85					

Note. $N = 669$. The extraction method was principal axis factoring with a 'promax' rotation. Factor loadings above .4 are highlighted in bold text. Reverse-coded items are indicated with an (R). Factor 1: *Eccentricity*; Factor 2: *Suspiciousness*; Factor 3: *Social Discomfort*; Factor 4: *Derailed Speech*; Factor 5: *Cue Interpretation*; Factor 6: *Expressive Difficulty*.

Table 5b

One Higher-Order Factor EFA Solution of the Combined SATQ and SPQ-BR.

Factor	Higher-order factor
	1
Eccentricity	**.79**
Expressive Difficulty	**.65**
Social Discomfort	**.65**
Cue Interpretation	**.59**
Suspiciousness	**.59**
Derailed Speech	**.53**
Total Variance Explained (%)	40.88

Note. N = 669. The extraction method was principal axis factoring with a 'promax' rotation. Factor loadings above .4 are highlighted in bold text. Higher-order Factor 1: *General Neurotype.*

Table 6b

Two Higher-Order Factor EFA Solution of the Combined SATQ and SPQ-BR.

Factor	Higher-order factor	
	1	2
Social Discomfort	**.72**	.00
Expressive Difficulty	**.71**	-.06
Cue Interpretation	**.68**	.03
Eccentricity	-.16	**.79**
Derailed Speech	.23	**.65**
Suspiciousness	.09	**.57**
Variance Explained by Factors (%)	42.32	8.10
Total Variance Explained (%)	50.42	

Note. N = 669. The extraction method was principal axis factoring with a 'promax' rotation. Factor loadings above .4 are highlighted in bold text. Higher-order Factor 1: *Detachment;* Higher-order Factor 2: *Psychoticism.*

Table 7b

Means (M), Standard Deviations (SD) and Reliability for Each Factor.

#	Factor	*M*	*SD*	α	ω
1	Eccentricity	15.63	4.25	.87	.88
2	Expressive Difficulty	7.61	2.15	.73	.74
3	Social Discomfort	10.39	2.88	.81	.82
4	Cue Interpretation	6.26	2.05	.78	.79
5	Suspiciousness	9.43	2.89	.81	.80
6	Derailed Speech	8.31	2.21	.80	.80
H1	*Detachment*	24.26	5.77	.86	.86
H2	*Psychoticism*	33.37	7.70	.89	.86
G1	*General Neurotype*	57.63	11.88	.91	.89

Note. N = 669. Variables that are higher-order factors are italised. α = Cronbach's alpha; ω = McDonald's omega. *H1* = higher-order factor 1; *H2* = higher-order factor 2; *G1* = general factor.

Validation of our higher-order *Detachment* factor was aided by the strong association with schizoid traits (r = .74, p < .01), a hallmark of HiTOP Detachment (Kotov et al., 2020). Likewise, *Psychoticism* was strongly associated with total schizotypal traits (r = .91, p < .01, a hallmark of HiTOP Psychoticism (Kotov et al., 2020). The *General Neurotype* was strongly associated with autism, schizotypy, and schizoid traits, possibly reflecting the Psychosis superspectrum of the HiTOP (Kotov et al., 2020)

At the lower-order level, autism was strongly associated with *Eccentricity, Expressive Difficulty, Social Discomfort*, *Cue Interpretation*, and *Suspiciousness* (although the correlation was just above .50 for the latter). At the higher-order level, autism was strongly associated with both *Detachment* and *Psychoticism*, but more so with *Detachmen*t (r = .91, p < .01). Schizotypal personality was strongly associated with *Eccentricity, Expressive Difficulty, Social Discomfort, Suspiciousness*, and *Derailed Speech*, at the lower-order level. And inversely to autism, schizotypal personality was strongly associated with both *Detachment* and *Psychoticism*, at the higher-order level, but more so with *Psychoticism* (r = .91, p < .01; see Table 8b).

Table 8b

Zero-Order Pearson's Correlations Between Factors and Primary Variables.

#	Variable	1	2	3	4	5	6	*H1*	*H2*	SATQ total	SPQ-BR total	CATI-Sd
1	Eccentricity									.71**	.77**	.59**
2	Expressive Difficulty	.44**								.67**	.61**	.60**
3	Social Discomfort	.46**	.50**							.77**	.58**	.69**
4	Cue Interpretation	.46**	.47**	.48**						.77**	.43**	.48**
5	Suspiciousness	.51**	.38**	.36**	.23**					.50**	.80**	.51**
6	Derailed Speech	.54**	.26**	.25**	.24**	.42**				.39**	.62**	.27**
H1	*Detachment*	.56**	.79**	.86**	.77**	.40**	.31**			.91**	.67**	.74**
H2	*Psychoticism*	.90**	.46**	.46**	.41**	.78**	.74**	.55**		.69**	.91**	.59**
G1	*General Neurotype*	.85**	.68**	.72**	.64**	.70**	.63**	.84**	.91**	.89**	.91**	.74**

Note. N = 669. Variables that are higher-order factors are italised. SATQ = Subthreshold Autism Trait Questionnaire; SPQ-BR = Schizotypal Personality Questionnaire-Brief Revised: Adapted; CATI-Sd = Coolidge Axis II Inventory 260: Schizoid subscale. *H1* = higher-order factor 1; *H2* = higher-order factor 2; *G1* = general factor.

*p < .05. **p < .01 (two-tailed).

Latent Profile Analysis

Akogul and Erisoglu's (2017) method suggested that model six (i.e., varying variances, varying covariances) with four profiles was the best solution (AIC = 8977.80, BIC = 9477.94, CLC = 8757.41, KIC = 9091.80, AWE = 10531.47, Entropy = .81). This model reflected varying levels in autistic and schizotypal traits but did not highlight any nuances in factor patterns (e.g., high *Detachment*, but low *Psychoticism*), raising risks of heterogenous groupings. Instead, we chose model one (i.e., equal variance, zero covariance) with seven profiles (AIC = 9454.37, BIC = 9697.68, CLC = 9348.02, KIC = 9511.37, AWE = 10209.35, Entropy = .82), given that model one is the default setting (Rosenberg et al., 2022) and produced visually distinct profiles with Entropy greater than .80 (see Table 9b).

The original four-profile solution still emerged in this seven-profile solution, but with three "uneven" profiles (i.e., profiles 2, 4, and 6), in addition to four "flat" profiles (i.e., profiles 1, 3, 5, and 7; see Figure 1b). An "uneven" profile is characterised by greater intensity of one higher-order factor and less of the other, and a "flat" profile is characterised by relatively equal intensities across each higher-order factor. Furthermore, the profiles can be differentiated by a low, mild, moderate, and high pattern of psychopathological intensity. Profile 1 (n = 67) had the highest intensity of psychopathology out of the solution (i.e., high *Detachment-Psychoticism*), profile 2 (n = 78) was characterised by mild *Detachment* and high *Psychoticism*, profile 3 (n = 138) had moderate *Detachment-Psychoticism*, profile 4 (n = 30) was characterised by low *Detachment* and moderate *Psychoticism*, profile 5 (n = 231) was the largest group characterised by mild *Detachment-Psychoticism*, profile 6 (n = 21) was the smallest group, having mild *Detachment* and low *Psychoticism*, and profile 7 (n = 104) had the lowest psychopathological intensity (i.e., low *Detachment-Psychoticism*).

Table 9b

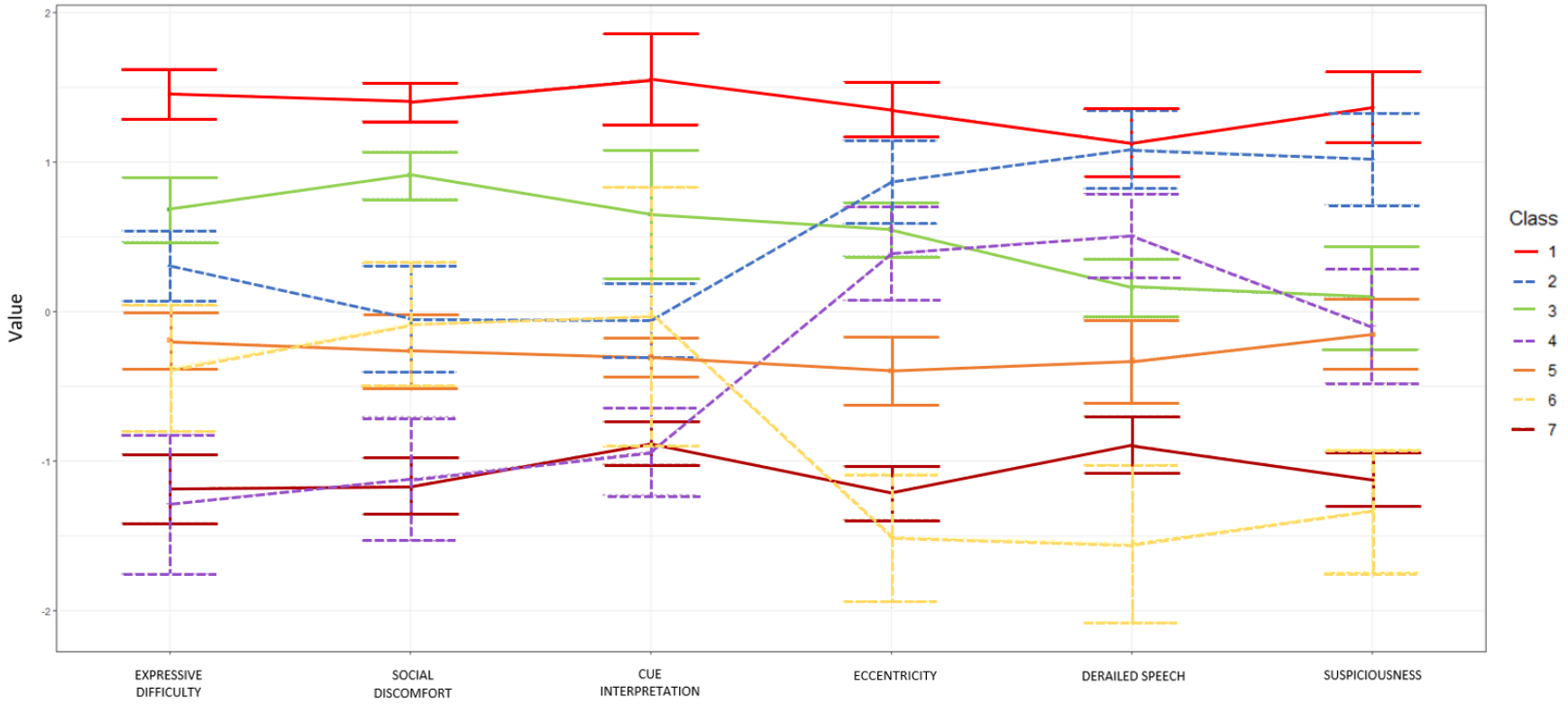
Latent Profile Analysis Model Comparison.

Solution	AIC	BIC	CLC	KIC	AWE	Entropy	Modal membership		*n/N* (%)	
							min	max	min	max
Model one (equal variances, zero covariances)										
Seven profile	9454.37	9697.68	9348.02	9511.37	10209.35	.82	.75	.90	3.1%	34.5%
Model six (varying variances, varying covariances)										
Four profile	8977.80	9477.94	8757.41	9091.80	10531.47	.81	.74	.97	17.8%	38.6%

Note. $N = 669$. AIC = Akaike's information criterion; BIC = Bayesian information criterion, CLC = Classification likelihood criterion; KIC = Kullback information criterion; AWE = Approximate Weight of Evidence; *n* = number of participants within a profile.

Figure 1b

Seven-profile Solution Using Latent Profile Analysis.



Note. 95% confidence intervals are displayed for each factor in every profile. Profile 1 = high Detachment-Psychoticism; Profile 2 = mild Detachment, high Psychoticism; Profile 3 = moderate Detachment-Psychoticism; Profile 4 = low Detachment, moderate Psychoticism; Profile 5 = mild Detachment-Psychoticism; Profile 6 = mild Detachment, low Psychoticism; Profile 7 = low Detachment-Psychoticism. The profiles were extracted using model one (i.e., equal variances/zero covariances). Bold lines are "flat" profiles, and dotted lines are "uneven" profiles.

Chi-square Test of Contingencies

Statistically significant associations were found between profile membership and gender identity, as well as highest level of education, current employment or caring for another/children, and unemployment or unemployment due to disability, with the latter having the strongest association with the profiles, overall (ϕ_c = .33). There were non-significant differences between profile membership and studying as a current occupation (see Table 10b).

The proportion of non-binary or gender-diverse individuals were significantly higher in profiles 1 and 2, and lower in profiles 5 and 7 than males or females. Females were also proportionally lower than males or non-binary participants in profile 3. The proportion of participants with a university degree as their highest level of education was also lower than all other forms of education in profile 1. The proportion of participants having current employment (or caring for another/children) was significantly lower than those without current employment in profiles 1 and 3. Likewise, the proportion of participants who are unemployed or who are not able to work due to disability was significantly higher in profiles 1 and 3.

Table 10b

Participant Frequencies and Chi-square Test of Contingencies for Each Profile.

Variable	Profile 1		Profile 2		Profile 3		Profile 4		Profile 5		Profile 6		Profile 7		Chi-square test		
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	χ^2	*df*	ϕ_c
Total Size	67	*10*[a]	78	*12*[a]	138	*21*[a]	30	*5*[a]	231	*35*[a]	21	*3*[a]	104	*16*[a]			
Gender[b]															75.35***	12	.24
Male	24	*36*	28	*36*	68	*49*	10	*33*	86	*37*	10	*48*	37	*36*			
Female	25	*37*	35	*45*	54	*39*	19	*63*	136	*59*	11	*52*	67	*64*			
Non-binary or gender-diverse	18	*27*	15	*19*	15	*11*	1	*3*	9	*4*	0	*0*	0	*0*			
Prefer not to say	0	*0*	0	*0*	1	*1*	0	*0*	1	*0*	0	*0*	1	*0*			
Education level															30.73*	18	.12
Less than high school	9	*13*	8	*10*	10	*7*	2	*7*	12	*5*	2	*10*	2	*2*			
High school graduate	30	*45*	28	*36*	58	*42*	9	*30*	84	*36*	7	*33*	33	*32*			
Vocational training	10	*15*	11	*14*	15	*11*	2	*7*	25	*11*	0	*0*	9	*9*			
Undergraduate or postgraduate university	18	*27*	31	*40*	55	*40*	17	*57*	110	*48*	12	*57*	60	*58*			
Occupation																	
Employed or caring for another															40.08***	6	.25
No	39	*58*	26	*33*	64	*46*	6	*20*	68	*29*	4	*19*	23	*22*			
Yes	28	*42*	52	*67*	74	*54*	24	*80*	163	*71*	17	*81*	81	*78*			
Unemployed or unable to work due to disability															73.62***	6	.33
No	43	*64*	70	*90*	110	*80*	28	*93*	222	*96*	21	*100*	100	*96*			
Yes	24	*36*	8	*10*	28	*20*	2	*7*	9	*4*	0	*0*	4	*4*			
Studying															7.08	6	.10
No	38	*57*	38	*49*	79	*57*	16	*53*	115	*50*	15	*71*	49	*47*			
Yes	29	*43*	40	*51*	59	*43*	14	*47*	116	*50*	6	*29*	55	*53*			

Note. $N = 669$. Red highlighting denotes a proportion of a demographic that is significantly lower in a profile. Green denotes a proportion of a demographic that is significantly higher in a profile. χ^2 = chi-square test; *df* = degrees of freedom; ϕ_c = Cramer's *V*.

Magnitude of ϕ_c is aided by the following parameters (negligible = $.00 \leq \phi_c < .10$; weak = $.10 \leq \phi_c < .20$; moderate = $.20 \leq \phi_c < .40$; relatively strong = $.40 \leq \phi_c < .60$; strong = $.60 \leq \phi_c < .80$; and very strong = $.80 \leq \phi_c \leq 1.00$; Rea & Parker, 2014).

[a] Percentage based on total number of participants.

[b] Chi-square test based on groups: Male, Female, and Non-binary or gender-diverse; $N = 667$.

* $p < .05$. ** $p < .001$. *** $p < .001$ (two-sided).

Discussion

Operating within the framework of the HiTOP (Kotov et al., 2021), the aim of the current study was to highlight factors underpinning traits of autism and schizotypy within the general population. Within our data, a lower-order six-factor solution appeared (*Social Discomfort, Expressive Difficulty, Cue Interpretation, Eccentricity, Derailed Speech,* and *Suspiciousness*), with key similarities to past findings by Ford et al.'s (2017) lower-order structure. However, the three factor higher-order structure they documented (i.e., Social Rigidity, Social Disorganisation, and Perceptual Oddities; Ford et al., 2017; Ford & Crewther, 2014) was not replicated. We instead found two higher-order factors of *Detachment* and *Psychoticism* of the HiTOP (Kotov et al., 2020, 2021), which theoretically aligned more with the factor structure of autism and schizotypy by Zhou et al. (2019). Traits of autism, in our study, were mainly captured by *Eccentricity, Expressive Difficulty, Social Discomfort, Cue Interpretation,* as well as higher-order *Detachment*. Likewise, schizotypal traits were primarily captured by *Eccentricity, Expressive Difficulty, Social Discomfort, Suspiciousness, Derailed Speech,* as well as higher-order *Psychoticism*. The lower-order factor solution also yielded seven meaningful profiles of participants, four of which had relatively equal scoring/intensities across all factors, two being primarily characterised by *Psychoticism*, and one primarily characterised by *Detachment*.

Detachment Spectrum

Structurally, the higher-order *Detachment* factor accounts for *Social Discomfort, Expressive Difficulty*, and *Cue Interpretation* in this study. Conceptually, *Social Discomfort* relates somewhat to previous HiTOP validation of "social anxiety" as a symptom which falls under the Distress subfactor of the Internalising spectrum (Watson et al., 2022b). However, the contents of *Social Discomfort* in our study suggest an added aspect of the personality trait "social withdrawal" found within Detachment (Zimmermann et al., 2022). This is supported

by a HiTOP meta-analysis which sees that social anxiety/phobia is dually accounted for by Detachment and Internalising (Ringwald et al., 2021). Additionally, our finding of *Expressive Difficulty* is conceptually close to "inexpressivity" as a symptom of Detachment (Cicero et al., 2022; Kotov et al., 2020).

The emergence of *Cue Interpretation* is a relatively novel contribution of our study and Ford et al.'s (2017) study, as Detachment, or any other HiTOP spectra does not consider a specific factor with issues recognising social cues. Zimmermann et al. (2022) included items of ASD-related social-communication difficulty in the development of their Detachment scale, but most of these items were later subsumed under their social withdrawal subscale. However, only one conceptually relevant item ("I have trouble understanding how others are feeling") fell under their other subscale of "restricted affectivity", a personality trait. As such, future research might further expand on the nature of *Cue Interpretation* and its relationship to pre-existing HiTOP symptoms and traits.

Psychoticism Spectrum

The higher-order *Psychoticism* factor accounts for *Eccentricity, Suspiciousness*, and *Derailed Speech* in our study. *Eccentricity* is essentially identical to the personality trait of "eccentricity/peculiarity", conceptually, which has previously been validated within the Psychoticism spectrum of the HiTOP (Cicero et al., 2022; Kotov et al., 2020). Similarly, *Suspiciousness* closely mirrors the personality trait of "suspiciousness" outlined by the HiTOP, but previous mappings of this trait alternates between Detachment and Psychoticism (Cicero et al., 2022). And lastly, we identified *Derailed Speech*, resembling HiTOP conceptualisation of the symptom of "disorganisation" (i.e., a formal disorder of thought; Cicero et al., 2022; Kotov et al., 2020), however, our factor was solely composed of items relating to speech patterns, instead of cognition in general. That said, the emergence of *Derailed Speech* is supported by the increased prevalence of formal thought disorder (as

indicated by derailments of speech) in people with a diagnosis of ASD (Ziermans et al., 2017).

Additionally, related aspects of magical thinking, typically understood within the context of schizotypy (Davidson et al., 2016), did not perform well within the final EFA result, as this may partially represent other clinical symptomatology not considered in our study (e.g., thought broadcasting in schizophrenia or thought-action fusion within obsessive-compulsivity; Raynal et al., 2016). Furthermore, items of hallucinatory experiences/unusual perceptions did not load strongly onto any factor in our final factor solution, suggesting that positive psychotic symptoms (e.g., "I often hear a voice speaking my thoughts aloud") may instead represent clinical syndromes such as schizophrenia or attenuated psychosis syndrome (i.e., positive psychotic symptoms present for at least one month; APA, 2022), which has been found to commonly occur alongside ASD at the clinical level (Vaquerizo-Serrano et al., 2021).

General Neurotype

We can alternatively express the six lower-order factors onto a single factor, alongside the two-factor higher-order structure of *Detachment* and *Psychoticism* in our study. We called this single factor the *General Neurotype*, indicating the convergence of these experiences into a unitary dimension, akin to conceptualisation of the Psychosis superspectrum or the General "p" Factor of Psychopathology of the HiTOP (Kotov et al., 2021). As such, there appears to be a strong link between the neurodevelopmental domain (specifically the autism spectrum) and schizophrenia spectrum, as per previous research (Rees et al., 2021). We therefore posit that the discreet separation of autism and schizotypy is not empirically supported, given this association and large degree of conceptual overlap. However, a dissociation may occur when considering the influence of a diathesis stress model, as *Detachment* could remain stable throughout an individual's lifespan, evidenced by

the early-life onset of ASD (APA, 2022), but environmental factors may interact with this predisposition to elicit subsequent positive schizotypal symptoms (i.e., *Psychoticism*; De Crescenzo et al., 2019; Sporn et al., 2004).

Dimensional Syndromes of Autism and Schizotypy

Our seven-profile solution closely coincides with Ford et al.'s (2018) eight-class solution, supporting the emergence of these varying phenotypic expressions. The combined phenotypes (i.e., equal levels of *Detachment* and *Psychoticism*) were most frequent in our study, corresponding to a unitary expression akin to the *General Neurotype*. Additionally, there was a four-tiered expression (i.e., low, mild, moderate, and high) in the psychopathological intensity of these syndromes, supporting the notion of broader, medium, and narrow autism phenotypes (Wheelwright et al., 2010). Our study highlights that the proportion of non-binary or gender-diverse participants is increased within elevated profiles (e.g., profile 1), consistent with previous findings of elevated autistic traits within non-binary or gender-diverse people (Walsh et al., 2018). We also found that the rates of unemployment due to disability (or otherwise) increased, and rates of employment decreased within elevated profiles. Therefore, people experiencing these elevated profiles may require higher support needs, similarly specified within an ASD diagnosis (APA, 2022).

What is perhaps most noteworthy, however, is the relatively low frequency of participants in profiles 4 and 6. These profiles are "uneven", suggesting that higher levels of *Psychoticism* with low *Detachment* (and vice versa) is phenomenologically rarer. In fact, those with ASD are 3.6 times more likely to experience schizophrenia than control groups (Zheng et al., 2018). As such, implications for the current isolated assessment of ASD then arise, given that our results show that autistic traits are less likely to occur in isolation of schizotypal traits. A dimensional assessment of these traits framed within the HiTOP may

then allow for a richer clinical description, based upon an individual's genuine symptom/trait presentation.

Limitations and Future Research

Our cross-sectional design limits our understanding of the age-of-onset of these traits, particularly since schizotypal and schizoid personality disorders have a minimum diagnostic age of 18, whereas ASD can be diagnosed very early on in childhood (APA, 2022). Yet, Jones et al. (2015) developed a measure that captures schizotypy/schizotypal personality disorder in children between ages five and 12, where an emergent *Social/Pragmatic Deficit* factor strongly related to ASD, and a *Positive Schizotypy Symptoms* factor distinguished the two conditions. This may suggest that the overlap between autism and schizotypy is also present in childhood with a nuanced expression of psychotic traits. However, longitudinal studies using these emergent factors may help clarify the prognostic trajectory starting from early childhood.

Although our sample size was modest enough to elicit seven profiles, a larger sample may highlight additional profiles via LPA, as the eight-class solution by Ford et al. (2018) may not have been replicated due to our comparatively lower sample size. Moreover, our use of an alternate, and arguably more reliable, autism measure (i.e., the SATQ, as opposed to the Autism Quotient) and a brief schizotypy measure (i.e., the SPQ-BR) may have elicited a more parsimonious solution. Additionally, direct accounts of ASD, schizotypal personality disorder, or any other formal diagnosis were not considered, therefore limiting the generalisability of our findings to clinical samples. We suggest future research consider a broader range of traits surrounding the autistic-schizotypal phenotype, as well as other NDDs (e.g., ADHD), considering that NDDs tend to cluster together in a way that is separate from pre-existing dimensions of the HiTOP (Grotzinger et al., 2020; Lu et al., 2021; Waldman et al., 2020; Yang et al., 2021). English et al. (2021) have made such an advancement by

validating the NDD-related experience of social camouflage within the autism spectrum. *Social camouflage* refers to the intentional "masking" of autistic traits to align with social expectations (English et al., 2021). By considering social camouflage, sensitivity in detecting autistic traits may be increased (English et al., 2021), particularly within women or non-binary individuals given their increased tendency to mask (Cook et al., 2021). As these NDD-related experiences may constitute additional functional impairments, or compensation of these impairments in the case of social camouflage, future research may consider these experiences and their relationship to various HiTOP spectra.

Conclusion

We aimed to investigate the factors underlying traits of autism and schizotypy within the general population, and how they relate to pre-existing HiTOP domains. We found a large degree of overlap between these two constructs, opposing the notion that autism and schizotypy are separate, as defined by the DSM-5-TR. Six HiTOP-related factors emerged that were largely shared across autism and schizotypy (*Social Discomfort*, *Expressive Difficulty*, *Cue Interpretation*, *Eccentricity*, *Derailed Speech*, and *Suspiciousness*), which were accounted for by two high-order factors of HiTOP *Detachment* and *Psychoticism*, or a single dimension, which we called the *General Neurotype.* Additionally, the six factors elicited the emergence of seven unique dimensional syndromes that varied in terms of psychopathological intensity of *Detachment* and *Psychoticism*, although equal intensities of these factors were more common across these syndromes, reflecting the unitary construct of the *General Neurotype*. This study thereby provides support for the HiTOP to dimensionally map various traits of autism and schizotypy in an effort to better understand and describe an individual's specific clinical presentation.

Chapter 3

Study Two

Mapping Neurodevelopmental Disorder and Related Traits within the Hierarchical Taxonomy of Psychopathology (HiTOP).

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Abstract

Introduction: The HiTOP is a dimensional alternative to the categorical model of mapping mental disorders within the DSM-5-TR. However, neurodevelopmental disorders (NDDs) are currently largely not considered by the HiTOP, except for ADHD. We therefore aimed to identify the latent structure and relevant HiTOP position of four NDDs (i.e., autism spectrum disorder [ASD], ADHD, specific learning disorder, and tic disorders), as well as three NDD-related experiences (i.e., extreme demand avoidance, sluggish cognitive tempo, and emotional dysregulation). Additionally, we investigated associations between this structure and global disability, as well as the dimensional syndromes that emerged. *Method:* Our study had a cross-sectional, correlational design. We recruited 440 adult participants from the broader community and Curtin University (M_{age} = 28, 65% Female) to complete an online survey. We used exploratory factor analysis to identify the latent structure of NDDs, and latent profile analysis to identify the dimensional syndromes. *Results:* NDDs and related experiences loaded onto a six-factor solution, akin to HiTOP spectra, most of which significantly predicted global disability. ASD was characterised by Detachment, ADHD by Disinhibition, and both specific learning disorder and tic disorders by Psychoticism. NDD-related experiences were largely dispersed across the factors. A higher-order, General "*p*" Factor of Psychopathology also emerged, which closely corresponded to increasing levels of global disability. We identified a set of reliable dimensional syndromes (i.e., the combinations of these factors) that were associated with cases of DSM-5-TR NDDs and related experiences, and also differed according to global disability. *Conclusions:* We provide preliminary evidence highlighting dimensional expressions of NDDs via the pre-existing HiTOP structure, thereby encouraging a more holistic, standardised description of these conditions.

Mapping Neurodevelopmental Disorder and Related Traits within the Hierarchical Taxonomy of Psychopathology (HiTOP)

Introduction

Psychiatric nosology is commonly ordered according to the *Diagnostic and Statistical Manual of Mental Disorders – Version 5 – Text Revised* (DSM-5-TR; American Psychiatric Association [APA], 2022). The DSM-5-TR operates on a *categorical* model, expressing mental disorders via separate (i.e., discrete) diagnoses, though empirical data seems to support a dimensional model instead of a discrete separation (Kotov et al., 2021). This is due to various issues of the categorical model: (1) diagnostic overlap and disorder co-occurrence; (2) low disorder reliability (e.g., low diagnostic agreement); (3) high disorder heterogeneity; and (4) limited capacity for subthreshold conceptualisation (Kotov et al., 2021).

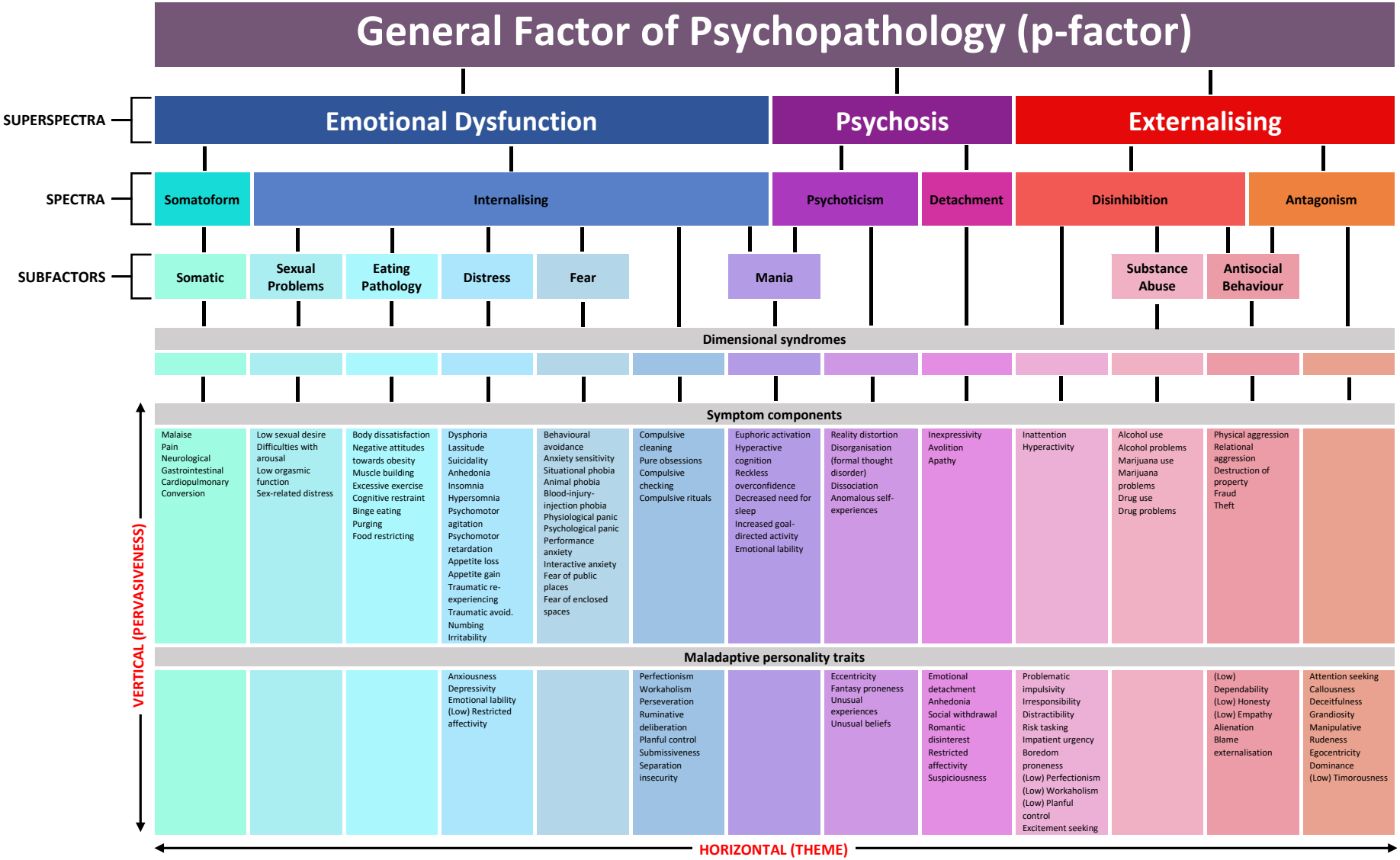
The Hierarchical Taxonomy of Psychopathology

Efforts to reconceptualise psychiatric nosology are advanced most prominently by the *Hierarchical Taxonomy of Psychopathology* (HiTOP; Caspi & Moffitt, 2018; Keyes et al., 2013; Kotov et al., 2020, 2021; Krueger et al., 2021; Watson et al., 2022a), a *dimensional* alternative to the DSM-5-TR. See Figure 1c for the current HiTOP model. Horizontally, the HiTOP can be grouped into three thematically differing superspectra. The first is *Emotional Dysfunction*, which can be further differentiated into *Somatoform* (i.e., somatic symptoms and bodily distress) and *Internalising* (i.e., depression, anxiety) spectra (Watson et al., 2022a). The second is termed *Psychosis*, further differentiated into *Psychoticism* (i.e., mania and reality distortion) and *Detachment* (i.e., social withdrawal and constricted emotions; Kotov et al., 2020). Lastly, *Externalising* refers to problematic behaviours characterised by *Disinhibition* (i.e., impulsivity and substance use) and *Antagonism* (i.e., aggression and narcissism; Krueger et al., 2021).

Vertically, the HiTOP considers two degrees of pervasiveness: (1) *symptom components,* representing current manifestations of a particular domain, which may be situation-dependent (e.g., social anxiety); and (2) *maladaptive personality traits*, representing more stable and higher-order pervasiveness of a particular domain (e.g., perfectionism; Kotov et al., 2021; see Figure 1c). It is with these symptoms and personality traits of psychopathology (i.e., the components) that a series of dimensional syndromes emerge, detailing an individual's specific clinical presentation within the HiTOP framework (Kotov et al., 2021).

Figure 1c

The Current HiTOP Model



Neurodevelopmental Disorders

According to a consensus of evidence, extensive work within the HiTOP sphere has found moderate to strong levels of structural evidence and validation accounting for a range of DSM-5-TR mental and personality disorder domains (Kotov et al., 2021). However, to date, certain disorder domains have structural evidence for only a few specific disorders that have been assessed, whilst overlooking other disorders (Kotov et al., 2021). One of these is the neurodevelopmental domain, as only attention-deficit/hyperactivity disorder (ADHD) is presently accounted for (by the Disinhibition spectrum), rendering other neurodevelopmental conditions unknown in terms of their HiTOP position.

Neurodevelopmental disorders (NDDs) are a set of conditions with an onset primarily within the early developmental period and are characterised by differences in one's core functioning (i.e., intellectual functioning, communication, executive functioning, learning, and motor execution; APA, 2022). Some research at the genetic level highlights that NDDs tend to cluster together onto a domain that is separate from pre-existing HiTOP domains of Internalising and Externalising (Grotzinger et al., 2020; Lu et al., 2021; Waldman et al., 2020; Yang et al., 2021). The genetic clustering of these conditions therefore raises the question of whether NDDs are horizontally or vertically inclined within the HiTOP model. If they are horizontally inclined, a separate neurodevelopmental spectrum may exist alongside pre-existing HiTOP spectra. However, if these conditions were vertically inclined, then NDDs could constitute an additional layer alongside Symptom Components or Personality Traits to account for their early-onset and higher degree of pervasiveness.

The following is a literature review defining and detailing our reasons for considering certain constructs in our study, alongside established HiTOP constructs. We considered four conditions listed in the DSM-5-TR chapter of NDDs: autism spectrum disorder (ASD), ADHD, specific learning disorder, and tic disorders. We also considered three constructs that

are not listed in the DSM-5-TR (i.e., extreme demand avoidance, sluggish cognitive tempo, and emotional dysregulation), but show close associations with NDDs, potentially reflecting extensions of these disorders or closely associated phenomena with unique functional impairments.

DSM-5-TR Neurodevelopmental Disorders

Autism Spectrum Disorder

ASD is characterised by social-communication differences (criterion A) as well as restricted and repetitive behaviours (criterion B; APA, 2022). Preliminary factor analytic exploration within the HiTOP highlights that social-communication differences may be accounted for by Detachment (Zimmermann et al., 2022). However, the HiTOP position of restricted and repetitive behaviours remains unknown, as Zimmermann et al. (2022) only assessed social-communication in their study; therefore further exploration into the position of restricted and repetitive behaviours of ASD is warranted. A dimensional framework such as the HiTOP is advantageous for NDD conceptualisation, as ASD co-occurs with ADHD 30-80% of the time, prompting some researchers to suggest that there is a larger ASD-ADHD condition at play (Pandolfi & Magyar, 2016). The notion that there is overlap between the two diagnoses is indicated by findings that ASD and ADHD are causative of one another in a genetic pathway analysis (Yang et al., 2021). They also mutually load onto a shared "Neurodevelopmental" factor (Grotzinger et al., 2020; Stanton et al., 2021; Waldman et al., 2020), along with Tourette's syndrome (Yang et al., 2021). Additionally, theory-of-mind deficits can occur in both ASD and ADHD (Dağdelen, 2021).

Attention-deficit/Hyperactivity Disorder

ADHD is characterised by inattention, hyperactivity, and impulsivity (APA, 2022). Theoretical explanations for ADHD are generally informed by the *trait-impulsivity etiological model* via dysfunctions in the mesolimbic reward system (Junghänel et al., 2020;

Lee et al., 2016). This model posits that impulsivity is the main driver of ADHD, and evidence for this has extensively been found within children and adolescents (Garner et al., 2017; Gomez et al., 2021; Leonard Burns et al., 2014; Rodenacker et al., 2018; Ullebø et al., 2012), as well as adults (Brevik et al., 2020; Gibbins et al., 2012). The trait-impulsivity model is a cornerstone of HiTOP Disinhibition, and as such, ADHD traits (i.e., inattention and hyperactivity-impulsivity) consistently fall under this spectrum (Krueger et al., 2021) with extensive validation to support this (Kotov et al., 2021). However, ADHD traits have not yet been investigated under the HiTOP framework alongside other NDDs. Considering the mutual loadings of ADHD and ASD onto a shared factor in other works (Grotzinger et al., 2020; Stanton et al., 2021; Waldman et al., 2020), we included ADHD traits in our assessment.

Specific Learning Disorder

Specific learning disorder is defined as impaired learning in reading (i.e., dyslexia), written expression (i.e., dysgraphia), and/or mathematics (i.e., dyscalculia; APA, 2022). Specific learning disorder has not previously been explored within the HiTOP, rendering its thematic position unknown. As such, we consider the co-occurrences of specific learning disorder, those primarily being ADHD (Altay & Görker, 2018; Margari et al., 2013; Sahoo et al., 2015; Visser et al., 2020). At the specifier level, impairment in spelling co-occurs with ADHD the most, followed by mathematics, then reading (Visser et al., 2020), suggesting shared executive dysfunction, which has previously been identified in both ADHD and specific learning disorder (Crisci et al., 2021). Other externalising conditions (e.g., oppositional defiant disorder and conduct disorder) are also common in children with specific learning disorder, as well as internalising conditions (e.g., major depressive disorder and anxiety disorders; Altay & Görker, 2018; Margari et al., 2013; Sahoo et al., 2015; Visser et al., 2020). These co-occurrences seem to suggest that the Disinhibition spectrum of the

HiTOP might account for specific learning disorder, given that associated ADHD traits and other externalising features fall under Disinhibition (Krueger et al., 2021). However, the co-occurrence of externalising and internalising features may also be a psychosocial consequence of academic difficulties associated with specific learning disorder in children (Donolato et al., 2022).

Tic Disorders

Tic disorders are a set of conditions with a common presence of *tics*, defined as sudden, and recurrent motor and/or vocal movements (APA, 2022). Tic disorders have also not yet been investigated within the HiTOP framework, so we again considered their co-occurrences. Tic disorders and *obsessive-compulsive disorder* (OCD; i.e., the presence of recurrent intrusive thoughts and anxiety-neutralising behaviours; APA, 2022) co-occur frequently (i.e., 35%; Eapen et al., 2016), with Tourette's syndrome (i.e., an expression of tic disorder) being genetically causative of OCD (Yang et al., 2021). That said, Tourette's syndrome has been found to load onto a shared factor with ASD and ADHD but *not* OCD, where ADHD was the strongest indicator (Yang et al., 2021). Therefore, a common *compulsive* mechanism may underpin tic disorders and OCD, which is predominantly accounted for by the Internalising spectrum of the HiTOP (Watson et al., 2022a, 2022b). Additionally, there may be an independent *impulsive* mechanism that underpins tic disorders, ASD, and ADHD, which theoretically aligns with HiTOP Disinhibition. As such, there may be a compulsive-impulsive understanding of tic disorders (Yang et al., 2021), suggesting a dual role of Internalising and Disinhibition.

Neurodevelopmental-related Experiences

Extreme Demand Avoidance

Extreme demand avoidance refers to social manipulation tactics to avoid everyday requests and demands, as well as a need for control (Kildahl et al., 2021). Despite arguments

that extreme demand avoidance is a distinct phenomenon, it is mostly reported within the context of ASD (Kildahl et al., 2021), with one in five autistic people also exhibiting a profile of extreme demand avoidance (Gillberg et al., 2015). Therefore, there may be a role of HiTOP Detachment within extreme demand avoidance, given prior assertions that aspects of ASD are accounted for by Detachment (Zimmermann et al., 2022). There have also been additional accounts of extreme demand avoidance found within ADHD and oppositional defiant disorder (Kildahl et al., 2021), with regression analyses highlighting that only ADHD traits, Emotional Instability, and Antagonism predicted extreme demand avoidance, where Detachment (i.e., ASD) was not a predictor (Egan et al., 2020). Furthermore, anxiety, commonly found within ASD, mediates intolerance of anxiety and extreme demand avoidance symptoms (Stuart et al., 2020). As such, we speculated that extreme demand avoidance may be attributable to Internalising, Disinhibition, and Antagonism spectra of the HiTOP.

Sluggish Cognitive Tempo

Sluggish cognitive tempo describes a pattern of decreased alertness, sluggish thought and behaviour, daydreaming, and confusion (Lee et al., 2016). Although sluggish cognitive tempo is strongly associated with the inattentive domain of ADHD (Fredrick et al., 2020; Reinvall et al., 2017), with a significant additive effect on social functioning in combination with ADHD and ASD (McFayden et al., 2022), sluggish cognitive tempo is not accounted for by the trait-impulsivity etiological model of ADHD and oppositional defiant disorder (Garner et al., 2017; Lee et al., 2016). Additional frontal-parietal dysfunction shared between sluggish cognitive tempo and inattention may explain the independence of this NDD-related experience from the trait-impulsivity etiological model (Junghänel et al., 2020; Lee et al., 2016). Even so, given the position of inattention within HiTOP Disinhibition (Krueger et al., 2021), and its close relationship with sluggish cognitive tempo (Fredrick et al., 2020;

Reinvall et al., 2017), there may likewise be a role of Disinhibition within sluggish cognitive tempo.

Emotional Dysregulation

Emotional dysregulation refers to difficulties in modulating or controlling emotional responses (Gross, 2015). Emotional dysregulation is strongly associated with ADHD (Asadi et al., 2021; Rüfenacht et al., 2019), which has prompted some researchers to suggest that emotional dysregulation is another core aspect of ADHD (Yue et al., 2022). However, emotional dysregulation is not solely restricted to ADHD, as it has also been identified in a group of children and adolescents with ASD (Dağdelen, 2021; Davico et al., 2022), and even at greater levels than the ADHD group (Dağdelen, 2021). This is likely due to emotional dysregulation being widely regarded as a transdiagnostic construct (Abdi & Pak, 2019; Faustino, 2021; Paulus et al., 2021). As such, we expected cross-loadings of emotional dysregulation traits between various HiTOP spectra within the current study.

The Current Study

Our aim for the current study was to investigate the latent structure and relevant HiTOP position of these four NDDs and three NDD-related experiences by considering their individual components and dimensional syndromes. Furthermore, we aimed to assess the association of these components and dimensional syndromes with global disability (i.e., functional impairment), as a means of validation. Our ability to assess remaining NDDs such as intellectual disabilities and communication disorders relied upon the use of pre-existing behavioural assessments, as opposed to self-report assessments that could be more readily used in the measurement of ASD, ADHD, specific learning disorder, and tic disorder traits. Given the online survey format of our research design, we did not aim to measure intellectual disabilities and communication disorders in the current study.

Method

Design, Participants, and Recruitment Procedures

This study had a cross-sectional, correlational design. We used convenience and snowball sampling to recruit participants aged 18+ years. We advertised the study on online forums and various sites (e.g., Reddit) that were relevant to the research topic to capture accounts of specific neurodevelopmental traits. We also advertised the study at Headspace Mandurah. Participants recruited through the broader community and Headspace were offered the chance to enter a prize draw, and Curtin University students who participated for their course requirement did so in exchange for course credit. Ethical approval was granted by the Human Research Ethics Committee at Curtin University (HRE2021-0352-10).

We recruited a final sample size of 440 participants (ages 18-82, M_{age} = 27.51 years, SD_{age} = 9.84) primarily from Australia and the United States. Sixty-five percent were female and 30% were male. Thirty-eight percent stated that they had one or more formal diagnoses of any NDD, 30% strongly identified with (but did not have a formal diagnosis of) one or more NDDs, and 37% did not have any NDD. Furthermore, 54% of the total sample identified with the term “neurodivergent”, 31% did not identify with this term, and 12% were unsure. Thirty-one percent also identified experiencing NDD-related extreme demand avoidance, 50% did not, and 19% were unsure. Additionally, 49% identified experiencing sluggish cognitive tempo, 41% did not, and 10% were unsure. Forty-nine percent also stated that they have one or more formal diagnoses of any additional mental disorder, 41% strongly identified with (but did not have a formal diagnosis of) one or more mental disorders, and 22% did not have any additional mental disorder. See Table 1c for sociodemographic descriptives. ADHD was the most common NDD (38%), followed by ASD (27%), specific learning disorder (12%), and then tic disorders (6%). See Table 2c for frequencies of specific NDDs.

Table 1c

Participant Sociodemographic Characteristics.

Variable	*n*	*%*
Sex assigned at birth		
Female	288	*65*
Male	132	*30*
Inter-sex	3	*1*
Prefer not to say	17	*4*
Gender identity		
Woman	238	*54*
Man	138	*31*
Non-binary or gender-diverse	59	*13*
Non-binary	40	*9*
Prefer to self-describe	14	*3*
I am not sure	5	*1*
Prefer not to say	5	*1*
Occupation		
Employed (full-time or part-time)	249	*57*
Studying (full-time or part-time)	189	*43*
Unemployed (looking or not looking for work)	59	*13*
Living with a disability and unable to work	30	*7*
Caring for another (children or another person)	14	*3*
Retired	5	*1*
Other	14	*3*
Highest level of education		
No formal education	2	*0*
Less than high school	15	*3*
High school graduate	162	*37*
Vocational training or other form of education	37	*8*
Undergraduate or postgraduate degree	224	*51*
Country		
United States of America	124	*28*
Australia	114	*26*
United Kingdom	66	*15*
Canada	24	*5*
Other	110	*25*
Survey-type		
Broader community	378	*86*
Curtin University	61	*14*
Headspace	1	*0*
Neurodevelopmental disorder endorsement		
Formal diagnosis of one (or more) specific NDD(s)	168	*38*
Strongly identify with one (or more) specific NDD(s)	131	*30*
No formal diagnosis and does not strongly identify with any NDD(s)	164	*37*
Prefer not to say	6	*1*
Neurodivergent identification		
Yes, neurodivergent	236	*54*
Yes, neurodivergent, but prefer to use a different term	12	*3*
No	135	*31*
Unsure	55	*12*
Prefer not to say	2	*0*
Identification with NDD-related experiences		
Extreme demand avoidance		
Yes	135	*31*
No	220	*50*
Unsure	85	*19*
Sluggish cognitive tempo		
Yes	214	*49*
No	181	*41*
Unsure	45	*10*

Variable	*n*	*%*
Other mental disorder endorsement		
Formal diagnosis of one (or more) specific MD(s)	216	*49*
Strongly identify with one (or more) specific MD(s)	180	*41*
No formal diagnosis and does not strongly identify with any MD(s)	96	*22*
Prefer not to say	3	*1*

Note. N = 440. Participants were on average 27.5 years old (SD = 9.8). NDD = neurodevelopmental disorder; MD = mental disorder.

Table 2c

Participant Frequencies of Specific Neurodevelopmental Disorders.

Variable	Combined		Formal diagnosis		Self-identify	
	n	*%*	*n*	*%*	*n*	*%*
Intellectual disability	5	*1*	2	*0*	3	*1*
Global developmental delay	2	*0*	0	*0*	2	*0*
Language disorder	4	*1*	2	*0*	2	*0*
Speech sound disorder	5	*1*	2	*0*	3	*1*
Childhood onset speech fluency disorder (stuttering)	9	*2*	5	*1*	4	*1*
Social (pragmatic) communication disorder	8	*2*	5	*1*	3	*1*
Autism spectrum disorder	117	*27*	58	*13*	59	*13*
Attention-deficit/hyperactivity disorder	165	*38*	105	*24*	60	*14*
Specific learning disorder	54	*12*	25	*6*	29	*7*
Developmental coordination disorder	6	*1*	1	*0*	5	*1*
Stereotypic movement disorder	0	*0*	0	*0*	0	*0*
Tic disorder	26	*6*	19	*4*	7	*2*
Tourette syndrome	19	*4*	16	*4*	3	*1*
Persistent motor or vocal tic disorder	3	*1*	1	*0*	2	*0*
Provisional tic disorder	4	*1*	2	*0*	2	*0*

Note. N = 440.

Measures

Participants completed a 20-to-30-minute online survey, which included 16 brief psychometric questionnaires via Qualtrics, designed to either measure NDD traits, NDD-related experiences, or aspects of existing HiTOP spectra. See Supplementary Material I2 for extended measures section, and Supplementary Materials J2 to X2 for information on the structural validity of each questionnaire. All measure total scale scores and subscales had an acceptable level of internal consistency or higher (i.e., ≥ .70), measured by Cronbach's alpha (α) and McDonald's omega (ω). See Supplementary Material Z2 for means, standard

deviations, and psychometric information for each measure, and Appendices A to V for copies of each measure below.

DSM-5-TR Neurodevelopmental Disorders

The 42-item *Comprehensive Autistic Trait Inventory* (CATI; English et al., 2021)[3] was used to assess six ASD traits: Social Interactions, Communication Difficulties, Social Camouflage, Repetitive Behaviours, Cognitive Rigidity, and Sensory Sensitivity. The 18-item *Adult ADHD Self-report Scale* (ASRS; Kessler et al., 2005) was used to assess three traits of ADHD: Inattention, Motor Hyperactivity-impulsivity, and Verbal Hyperactivity-impulsivity. The 16-item *Specific Learning Disorder Questionnaire-Adult* (SLDQ-A) was used to assess two traits of specific learning disorder: Reading-writing Difficulties, and Mathematical Difficulties. We created the SLDQ-A for the purposes of this study, as existing tools only measured difficulties with reading but not writing or mathematics[4]. The 11-item *Motor Tic, Obsessions and Compulsions, Vocal Tic Evaluation Survey – Revised* (MOVES-R) based off the original measure[5] (Gaffney et al., 1994), was used to assess two tic disorder traits (i.e., Verbal Tics/Echolalia, and Motor Tics).

[3] The CATI was used to measure autistic traits as opposed to the SATQ (as used in study one) given its recent validation and superior reliability of subscales (English et al., 2021).

[4] The SLDQ-A had excellent structural validity via CFA fit indices (see Supplementary Material L2) and had good criterion validity via ROC curve analysis (see Supplementary Material Y2). The subscales and total scale score of the SLDQ-A had good to excellent internal consistency (see Supplementary Material Z2).

[5] We revised this measure, as the previously specified structure (Gaffney et al., 1994) did not perform well in this sample. The MOVES-R had good structural validity via CFA fit indices (see Supplementary Material M2). The subscales and total scale score of the MOVES-R had good to excellent internal consistency (see Supplementary Material Z2).

Neurodevelopmental-related Experiences

The 19-item *Pathological Demand Avoidance Questionnaire – Adult – Revised* (PDAQ-A-R) based off the original measure[6] (Egan et al., 2019) was used to assess three traits of extreme demand avoidance: Domineering Demand Avoidance, Detached Demand Avoidance, and Reactivity to Demands. The 10-item *Adult Concentration Inventory* (ACI; Becker et al., 2018) was used to assess a single trait of Sluggish Cognitive Tempo. The first 16 items of the *Perth Emotion Regulation Competency Inventory* (PERCI; Preece et al., 2018) was used to assess four facets of emotional dysregulation for negative emotions: Negative-controlling Experience, Negative-inhibiting Behaviour, Negative-activating Behaviour, and Negative-tolerating Emotions.

Existing HiTOP Superspectra

Emotional Dysfunction

The 21-item *Depression, Anxiety, and Stress Scale – 21* (DASS-21; Osman et al., 2012) to assess three aspects of distress: Depression, Anxiety, and Stress. The 9-item *National Stressful Events Survey PTSD Short Scale* (NSESSS; LeBeau et al., 2014) was used to assess a single facet of Posttraumatic Stress. The 5-item *Dimensional Obsessive-compulsive Scale – Short Form* (DOCS-SF; Eilertsen et al., 2017) was to assess a single aspect of Obsessive-compulsivity.

[6] We revised this measure, as the previously specified structure (Egan et al., 2019) did not perform well in this sample. The PDQ-A-R had substantially improved structural validity when using a three-factor structure, but just fell below thresholds for CFA fit indices (see Supplementary Material N2). This factor structure also allowed for a more descriptive look at how different aspects of extreme demand avoidance load onto various HiTOP dimensions. The subscales and total scale score of the PDQ-A-R had acceptable consistency (see Supplementary Material Z2).

Psychosis

The 32-item *Schizotypal Personality Questionnaire-Brief Revised* (SPQ-BR; Davidson et al., 2016) was used to assess nine schizotypal personality traits: Ideas of Reference, Suspiciousness, Magical Thinking, Unusual Perceptions, No Close Friends, Constricted Affect, Social Anxiety, Eccentric Behaviour, and Odd Speech. The 8-item *Brief Dissociative Experiences Scale* (DES-B; APA, 2023) was used to assess a single aspect of Dissociation.

Externalising[7]

The 8-item *Adult Self-Report of ODD Symptoms, DSM-5* (ASROS-5; Johnston et al., 2018) was used to assess a single trait of Oppositional Defiance. The 9-item *Displaced Aggression Questionnaire - Short* (DAQ-S; Webster et al., 2015) was used to assess three levels of aggression: Angry Rumination, Revenge Planning, and Displaced Aggression.

Global Disability

The *World Health Organisation Disability Assessment Schedule 2.0 – 12-item Version* (WHODAS 2.0-12; Andrews et al., 2009) was used to assess a single trait of Global Disability, with reference to social-emotional functioning and day-to-day living. Although there is no agreed upon threshold for the WHODAS 2.0-12, it is suggested that those who score over 10 may have clinically significant disability (Andrews et al., 2009).

Analytic Strategy

We used the lavaan package (Rosseel, 2012) and tidyLPA packages (Rosenberg et al., 2022) in RStudio (RStudio Team, 2020) to conduct confirmatory factor analysis (CFA) with

[7] We also used the 13-item *Brief DSM-5 Alcohol Use Disorder Diagnostic Assessment* (AUDDA-5; Hagman, 2017) to assess behaviour indicative of alcohol use disorder. We later removed this tool from the analysis as the measure had missing data that was most likely tied to the restrictive dichotomous yes/no response format. Participants may have also not responded to certain questions if they felt they did not have alcohol use disorder.

robust maximum likelihood estimation, and latent profile analysis (LPA), respectively. CFA was used to first confirm the structural integrity of the measures (see Supplementary Materials J2 to X2 for results). We then used JAMOVI (Jamovi Project, 2023) to conduct an exploratory factor analysis (EFA) with parallel analysis. All other analyses were conducted using SPSS (v28; IBM Corp., 2023).

Exploratory Factor Analysis

For our main analysis, we placed all 40 subscales from the above measures (except Global Disability) into an EFA using principal axis factoring with Promax rotation to explore the structure of NDD traits, NDD-related experiences, and their relationships to existing HiTOP spectra. We used Horn's (1965) parallel analysis as our method of factor retention and considered the meaningfulness of the solution. If Heywood cases (i.e., loadings > 1.0) were present, or if there were less than three subscales on a factor, we manually tested a lower number of factors. A higher-order EFA was then conducted, with the estimated scores of the lower-order factors acting as the parameters, to explore the presence of any higher-order factors within the data. Loadings ≥ .30 were considered as meaningful (Costello & Osborne, 2005)[8].

Correlational and Regression Analyses

As a means of validation, we then ran Pearson's correlations between each of the resultant factors as well as Global Disability, measured by the WHODAS 2.0-12. We then ran further regression analyses to highlight which factors significantly predicted global disability. Weighted Least Squares Regression was used to correct for violations of homoscedasticity.

[8] Although loadings ≥ .40 within a factor is suggested as a meaningful cut-off (Matsunaga, 2010), we used the .30 threshold, given that there were a substantial number of subscales with lower primary loadings.

Latent Profile Analysis

Each lower-order factor extracted from the EFA was then used as a variable in an LPA to highlight specific profiles of participants with unique combinations of elevations or non-elevations across various factors (i.e., the dimensional syndromes). For a parsimonious solution, we tested solutions for one to nine profiles within the default model one specification (i.e., equal variances/zero covariances; Rosenberg et al., 2022). Each solution was compared according to clinical meaningfulness, as well as via Akogul and Erisoglu's (2017) analytic hierarchy process which considers the best solution across a combination of five fit index values (i.e., Akaike's information criterion [AIC], Bayesian information criterion [BIC], classification likelihood criterion [CLC], Kullback information criterion [KIC], and approximate weight of evidence [AWE]). We also manually considered Entropy ≥ .80, which indicates an acceptable level of participant-profile allocation certainty (Tein et al., 2013). Additionally, we specified the minimum and maximum probability of being assigned to a profile (i.e., *modal assignment*; Spurk et al., 2020), and the lowest possible percentage of profile sizes relative to the total sample size (i.e., no less than 3% of the total sample; Spurk et al., 2020).

Chi-square Test of Contingencies and Multivariate Analysis of Variance

We then ran Chi-square (χ^2) test of contingencies to highlight any associations between the profile solution and demographics (i.e., gender, biological sex, "neurodivergent" identity, and reported neurodevelopmental and mental disorder diagnosis). Cramer's V (ϕ_c) was used as the effect size (Rea & Parker, 2014). To compare all profiles on these variables, we then calculated the adjusted residual statistics (z) for each profile to determine individual χ^2 values and Bonferroni-corrected significance levels ($df = 1$; Beasley & Schumacker, 1995; García-pérez & Núñez-antón, 2003). Finally, we compared each profile's level of global disability using a Multivariate Analysis of Variance (MANOVA).

Results

We initially had 645 responses (573 broader community cases, 70 Curtin University student cases, and one Headspace case). We removed 164 cases with 50% missing data, 23 cases with missing data specific to one or more measures, as well as 18 cases that failed two or more attention checks. A missing values analysis highlighted 21 remaining cases with missing data under 5%. Little's MCAR test was statistically significant, χ^2 (4950) = 5124.95, p = .04, but was missing at random. Expectation maximisation was then used to impute missing values. Univariate outliers were found but not considered influential based on statistical criteria (i.e., Cook's distance < 1), so they remained in the final dataset. The final sample size was 440.

Exploratory Factor Analysis

Our lower-order EFA initially suggested seven factors, explaining 59.2% of the variance in the data. However, there were Heywood cases within factors 1 and 2, and factor 7 had only two loadings ≥ .30, both of which were tic disorder traits. Factor 7 was then preliminarily called "*Touretticism*". A six-factor solution was then manually tested and found to be the best solution, explaining 56.95% of the variance (see Table 3c). There were no Heywood cases. In the resultant six-factor model, we named the factors as the following, noting thematic similarity to various HiTOP spectra. Factor 1 was *Detachment – Social Communication and Cognition*, with loadings of negative schizotypal personality traits (e.g., constricted affect) and social-communication differences found within ASD. Factor 2 was called *Disinhibition*, primarily characterised by ADHD traits and sluggish cognitive tempo. Factor 3 was *Internalising*, characterised primarily by distress (e.g., depression and generalised anxiety), fear, and obsessive-compulsivity. Factor 4 was *Antagonism*, with loadings of interpersonal aggression and oppositional defiance. We called factor 5 *Detachment – Social-sensory Overload*, composed of restricted and repetitive behaviours

found in ASD, as well as social camouflage and social anxiety. And lastly, factor 6 was called *Psychoticism*, characterised by positive schizotypal traits (e.g., unusual perceptions), dissociation, tics, and specific learning difficulties. The additional *Touretticism* factor from the initial seven-factor solution was subsumed under *Psychoticism* in the six-factor solution. Factors 1 and 5 were indicated as Detachment, as they both had meaningful loadings of social interactive difficulties. This factor solution highlighted that traits of NDDs and NDD-related experiences generally fit into the pre-existing HiTOP structure, as opposed to a single neurodevelopmental spectrum. The only exception is that PERCI – Negative-Tolerating Emotions, and SLDQ-A – Mathematical Difficulties had loadings below .30. However, the next strongest loading of the former was on *Internalising* and *Antagonism*, and the latter was onto *Psychoticism*.

A higher-order EFA of all six factors then produced a single-factor solution, explaining 57.80% of the variance (see Table 4c). All subscales had loadings ≥ .30, with *Internalising* having the strongest loading. We named the resultant higher-order factor the *General "p" Factor of Psychopathology*, in line with the HiTOP conceptualisation (Kotov et al., 2021).

Correlational and Regression Analysis

Zero-order Pearson's correlations highlighted significant medium to large positive associations between all factors (lower- and higher-order) and the total score of the WHODAS 2.0-12, as a marker of global disability (r = .49-.75, p < .001). The largest correlation with global disability was the *General "p" Factor of Psychopathology* (r = .75, p < .001) at the higher-order level, followed by *Internalising* (r = .71, p < .001) at the lower-order. See Table 5c for correlation matrix.

Table 3c

Lower-order Exploratory Factor Analysis of all 40 Subscales.

	Factor loading					
	1	2	3	4	5	6
SPQ – No Close Friends	**1.00**	-0.19	-0.09	0.05	-0.08	-0.01
SPQ – Constricted Affect	**0.96**	-0.16	-0.07	-0.01	-0.04	0.00
CATI – Social Interactions	**0.81**	-0.18	0.01	-0.16	**0.43**	-0.17
PDAQ-R – Detached Demand Avoidance	**0.59**	0.18	-0.10	0.09	-0.01	0.19
SPQ – Eccentric Behaviour	**0.52**	0.22	-0.27	0.03	0.25	0.08
CATI - Communication	**0.50**	0.05	-0.22	0.07	**0.32**	0.05
SPQ – Ideas of Reference	0.28	-0.18	0.22	0.11	0.20	0.25
ASRS – Inattention	0.03	**0.98**	-0.03	-0.07	-0.10	-0.05
ASRS – Verbal Hyperactivity-impulsivity	**-0.44**	**0.89**	-0.20	0.16	0.10	0.10
SPQ – Odd/Tangential Speech	0.01	**0.76**	-0.15	-0.05	0.17	0.06
ASRS – Motor Hyperactivity-impulsivity	-0.25	**0.67**	0.21	-0.07	0.22	-0.01
ACI – Sluggish Cognitive Tempo	0.28	**0.56**	0.26	-0.17	-0.21	0.12
PERCI – Negative; Activating Behaviour	0.23	**0.48**	0.26	0.05	-0.01	**-0.32**
NESS'S – Posttraumatic Stress	-0.11	-0.16	**0.92**	-0.05	0.07	0.21
DASS21 – Anxiety	-0.03	-0.08	**0.86**	-0.21	0.00	0.31
DASS21 – Stress	-0.20	0.14	**0.81**	0.00	0.09	0.00
DOCS-SF – Obsessive-compulsivity	-0.11	-0.06	**0.66**	0.04	0.15	0.14
DASS21 – Depression	**0.52**	0.00	**0.57**	-0.02	**-0.31**	-0.04
PDAQ-R – Reactivity to Demands	-0.14	0.06	**0.37**	0.28	0.18	0.12
ASROS-5 – Oppositional Defiance	-0.05	0.10	-0.05	**0.80**	0.03	0.05
DAQ-S – Displaced Aggression	-0.12	-0.03	-0.01	**0.80**	-0.02	-0.01
DAQ-S – Revenge Planning	0.15	-0.15	-0.09	**0.77**	-0.03	0.07
PDAQ-R – Domineering Demand Avoidance	0.09	0.05	-0.21	**0.67**	-0.14	**0.30**
DAQ-S – Angry Rumination	-0.06	-0.09	0.29	**0.50**	0.18	-0.09
PERCI – Negative; Inhibiting Behaviour	0.05	**0.30**	0.21	**0.41**	-0.04	-0.03
PERCI – Negative; Tolerating Emotions	0.18	0.05	0.21	0.22	0.06	-0.09
CATI – Cognitive Rigidity	-0.03	-0.07	0.04	0.09	**0.77**	-0.02
CATI – Repetitive Behaviour	0.04	**0.36**	0.05	-0.08	**0.58**	-0.04
CATI – Sensory Sensitivity	0.04	0.22	0.09	-0.08	**0.54**	0.01
SPQ – Social Anxiety	**0.50**	-0.10	0.15	-0.15	**0.51**	-0.12
CATI – Social Camouflage	**0.32**	0.09	0.02	0.00	**0.46**	0.02
SPQ-BR – Magical Thinking	-0.12	-0.10	0.07	0.09	-0.08	**0.63**
SPQ-BR – Unusual Perceptions	0.16	0.03	0.13	0.06	0.04	**0.50**
MOVES-R – Verbal Tics/Echolalia	-0.08	0.18	0.05	0.06	0.13	**0.43**
DES-B - Dissociation	0.29	0.24	0.18	-0.07	-0.19	**0.41**
SPQ-BR - Suspiciousness	0.23	-0.13	0.22	0.20	0.10	**0.35**
PERCI – Negative; Controlling Experience	**0.32**	0.26	**0.31**	0.24	-0.04	**-0.33**
MOVES-R – Motor Tics	-0.02	0.14	0.07	-0.11	0.17	**0.32**
SLDQ-A – Reading-writing difficulties	0.15	0.29	0.06	-0.02	-0.07	**0.31**
SLDQ-A – Mathematical difficulties	-0.02	0.18	0.13	0.03	0.05	0.22
Variance Explained by Factors (%)	12.54	10.93	11.16	8.18	7.80	6.34
Total Variance Explained (%)	56.95					

Note. N = 440. The extraction method was principal axis factoring with a 'promax' rotation. Factor loadings above .30 are in bold. Factor 1: *Detachment - Social Communication and Cognition*; Factor 2: *Disinhibition*; Factor 3: *Internalising*; Factor 4: *Antagonism*; Factor 5: *Detachment – Social-sensory Overload*; Factor 6: *Psychoticism.*

Table 4c

Higher-order Exploratory Factor Analysis of all Six Lower-order Factors.

	Factor loading
	1
FACTOR 3 – Internalising	**0.87**
FACTOR 2 – Disinhibition	**0.86**
FACTOR 5 – Detachment – Social-sensory Overload	**0.73**
FACTOR 6 – Psychoticism	**0.71**
FACTOR 1 – Detachment – Social Communication and Cognition	**0.69**
FACTOR 4 – Antagonism	**0.68**
Total Variance Explained (%)	57.80

Note. N = 440. The extraction method was principal axis factoring with a 'promax' rotation. Factor loadings above .30 are in bold. Factor 1: General *"p"* Factor of Psychopathology

Table 5c

Inter-factor and WHODAS 2.0-12 Correlations.

		1	2	3	4	5	6	7	8
1	FACTOR 1 – Detachment – Social Communication and Cognition	—							
2	FACTOR 2 – Disinhibition	.59**	—						
3	FACTOR 3 – Internalising	.64**	.74**	—					
4	FACTOR 4 – Antagonism	.47**	.56**	.64**	—				
5	FACTOR 5 – Detachment – Social-sensory Overload	.53**	.64**	.61**	.42**	—			
6	FACTOR 6 – Psychoticism	.42**	.63**	.57**	.54**	.56**	—		
7	H-O FACTOR 1 – General "*p*" Factor of Psychopathology	.72**	.90**	.91**	.72**	.76**	.74**	—	
8	WHODAS 2.0-12	.64**	.66**	.71**	.51**	.49**	.52**	.75**	—

Note. N = 440. H-O = Higher-order; WHODAS 2.0-12 = World Health Organisation Disability Assessment Schedule 2.0 – 12-item Version.

** $p < 0.01$.

Weighted Least Squares Regression highlighted that 63.9% of the variance in global disability was accounted for by all six factors in combination, $R^2 = .64$, $F(6, 433) = 127.63$, $p < .001$ (see Table 6c for regression output). From strongest to weakest, with their respective percentage of unique variance, five out of the six factors were significant, unique predictors of global disability. These were: *Detachment – Social Communication and Cognition (*4.24%), *Internalising* (2.96%), *Disinhibition* (1.93%), *Psychoticism* (0.56%), and *Detachment – Social-sensory Overload* (0.44%), but not *Antagonism*. The significant

predictors all predicted higher accounts of global disability, except for *Detachment – Social-sensory Overload* which predicted lower accounts of disability, albeit a small amount.

Table 6c

Unstandardised (B) and Standardised (β) Weighted Least Squares Regression Coefficients and Squared Semi-Partial correlations (sr^2) of Each Predictor Variable for Global Disability.

Variable	Fit	*B*	*B* 95% CI [LL, UL]	β	*SE*	*t*	*p*	sr^2
Constant		13.58	[12.979, 14.178]		.31	44.50	< .001*	
Detachment – Social Communication and Cognition		2.69	[1.950, 3.433]	.31	.38	7.14	< .001*	.042
Disinhibition		2.27	[1.342, 3.206]	.25	.47	4.80	< .001*	.019
Internalising		3.01	[2.015, 3.994]	.31	.50	5.97	< .001*	.030
Antagonism		0.42	[-.460, 1.297]	.04	.45	0.94	.350	.001
Detachment – Social-sensory Overload		-0.94	[-1.738, -.136]	-.10	.41	-2.30	.022*	.004
Psychoticism		1.16	[.282, 2.034]	.10	.45	2.60	.010*	.006
R	.80							
R^2	.64							
Adjusted R^2	.63							

Note. $N = 440$. CI = confidence interval; LL = lower limit; UL = upper limit; SE = standard error.

* $p < 0.05$

Latent Profile Analysis

The analytic hierarchy process (Akogul & Erisoglu, 2017) suggested *model one* (i.e., equal variances/zero covariances) *with seven profiles* as the best solution (see Table 7c). The size of the smallest profile for this solution was 2.7% of the total sample, the Entropy value was .81, and the minimum modal membership saw a 73.7% chance of being assigned to the correct profile. Although the size of the smallest profile was slightly less than 3% of the total sample in this solution, we believed that the good Entropy value and visual distinctiveness of each profile suggested it to be the best solution. Profiles that have a higher standardised score had a higher intensity of psychopathology (see Figure 2c). See Supplementary Material AA2 for full LPA model comparison.

Table 7c

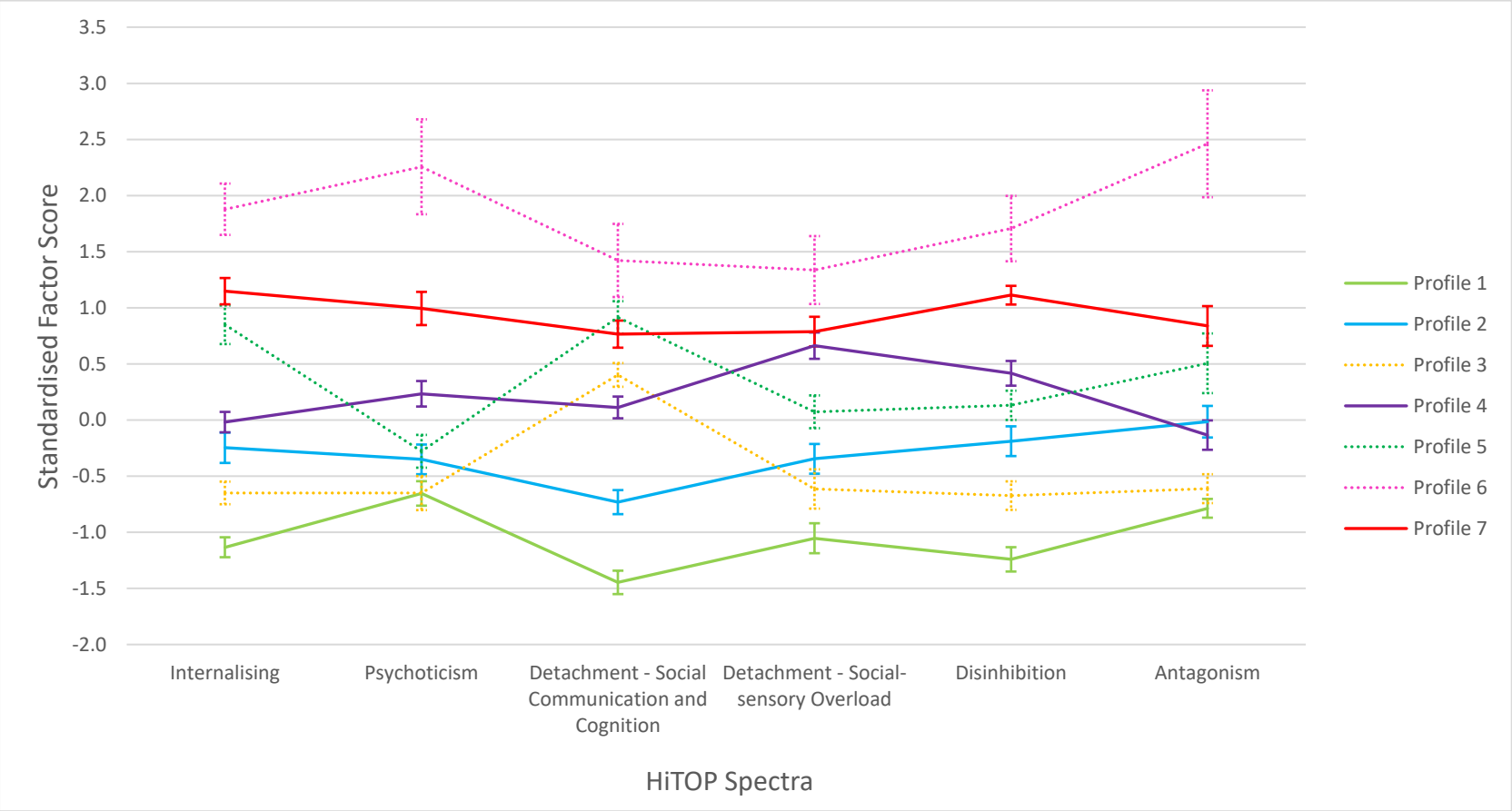
Latent Profile Analysis Model Fit Statistics.

Model	AIC	BIC	CLC	KIC	AWE	Entropy	Modal membership		*n*/total *n*	
							min	max	min	max
Model one - seven profiles (M1P7)	5742.78	5963.46	5636.39	5799.78	6452.53	.81	73.7%	94.9%	2.7%	21.8%

Note. $N = 440$. AIC = Akaike's information criterion; BIC = Bayesian information criterion, CLC = Classification likelihood criterion; KIC = Kullback information criterion; AWE = Approximate Weight of Evidence; *n* = number of participants within a profile.

Figure 2c

Latent Profile Analysis Using the Standardised Scores of Each Factor.



Note. 95% confidence intervals are displayed for each factor in every profile. The profiles were extracted using model one (i.e., equal variances/zero covariances). Bold lines are profiles considered to be "flat", and dotted lines are profiles considered to be "uneven".

Upon visual inspection, profiles 1, 2, 4, and 7 were considered as "flat", with roughly equal occurrences of each factor (see Figure 2c). Profile 1 (n = 78) had the lowest intensity of factors out of the profile solution, and profile 2 (n = 60) had a similar pattern to that of profile 1, but was elevated in its intensity pattern. Profile 4 (n = 96) had an even higher intensity pattern, with comparable levels of *Internalising* and *Antagonism* to profile 2 but was characterised by a higher level of *Detachment – Social-sensory Overload*. Profile 7 (n = 81) had the highest intensity level amongst the "flat" profiles, with comparable levels of *Detachment – Social-sensory Overload* to that of profile 4.

Profiles 3, 5, and 6 were somewhat "uneven", showcasing nuance across psychopathology (see Figure 2c). Profile 3 (n = 71) had an intensity pattern like that of profiles 1 and 2 but was divergent in that *Detachment – Social Communication and Cognition* was asymmetrically elevated. Profile 5 (n = 42) was visually alike profile 3 (i.e., elevated *Detachment – Social Communication and Cognition*), but had an overall elevated intensity pattern, and higher level of *Internalising.* Lastly, profile 6 (n = 12) was the smallest group with the highest overall intensity level out of the profile solution.

Chi-square Test of Contingencies

The χ^2 test found that the patterns of participants' gender, biological sex, formal and/or self-identified NDD or mental disorder, and identification with the term "neurodivergent" were significantly associated with the profile solution, overall. The strongest association with the profiles was with endorsement of having any NDD (ϕ_c = .49), followed by endorsement of any additional mental disorder (ϕ_c = .45), and identification with the term "neurodivergent" (ϕ_c = .40; see Table 8c). We then separated individual categorical NDDs according to DSM-5-TR neurodevelopmental subsections (i.e., intellectual disability, communication disorder, ASD, ADHD, specific learning disorder, and movement disorder; APA, 2022). We found that participant endorsement of either of the latter four disorder

subgroups were significantly associated with the profiles. The strongest association was with endorsement of having ASD (ϕ_c = .46), followed by ADHD (ϕ_c = .37). Similarly, endorsement of having NDD-related experiences of extreme demand avoidance (ϕ_c = .55) and sluggish cognitive tempo (ϕ_c = .50) were significantly associated with the profiles, overall (see Table 9c).

Participants in profile 1 had significantly lower accounts of having any NDD, any additional mental disorder, any NDD-related experience, as well as identification with the term “neurodivergent (see Table 8c). The proportion of women were significantly higher (see Table 8c), and the proportion of those with ASD, ADHD, extreme demand avoidance, and sluggish cognitive tempo were significantly reduced in profile 1 (see Table 9c). Similarly, participants in profile 2 had significantly lower accounts of ASD and extreme demand avoidance, as well as reduced endorsement of the “neurodivergent” identity. Profile 4 had a significantly higher proportion of non-binary or gender-diverse participants, and increased cases of formal NDD diagnoses and any additional mental disorder, along with identification with the term “neurodivergent” (see Table 8c). Cases of ASD and any movement disorder were significantly higher in profile 4 (see Table 9c). Profile 7 had similar patterns of NDD and mental disorder diagnoses, as well as “neurodivergent” identification to that of profile 4, but also had significantly higher accounts of any additional mental disorder (see Table 8c).

Profile 3 had a significantly higher proportion of males/men, a lower proportion of females/women, and higher accounts of having an additional self-identified mental disorder (see Table 8c). Profile 5 was only characterised by significantly higher accounts of having any additional mental disorder (see Table 8c). Lastly, profile 6 was characterised by significantly higher accounts of having a self-identified NDD and identification with the term “neurodivergent” (see Table 8c). Accounts of having ASD or specific learning disorder were significantly elevated in this profile (see Table 9c).

Table 8c

Participant Frequencies and Chi-square Test of Contingencies for Each Profile.

Variable	Profile														Chi-square test		
	1		2		3		4		5		6		7				
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	χ^2	*df*	ϕ_c
Profile size	78	*18*[a]	60	*14*[a]	71	*16*[a]	96	*22*[a]	42	*10*[a]	12	*3*[a]	81	*18*[a]			
Gender[b]															51.49***	12	.24
Man	23	*29*	17	*28*	38	*54*	28	*29*	14	*33*	2	*17*	16	*20*			
Non-binary/gender-diverse	0	*0*	4	*7*	10	*14*	22	*23*	6	*14*	3	*25*	14	*17*			
Woman	55	*71*	39	*65*	22	*31*	45	*47*	20	*48*	6	*50*	51	*63*			
Prefer not to say	0	*0*	0	*0*	1	*1*	1	*1*	2	*5*	1	*8*	0	*0*			
Sex[c]															30.03***	6	.27
Female	56	*72*	42	*70*	28	*39*	69	*72*	24	*57*	9	*75*	60	*74*			
Male	22	*28*	17	*28*	38	*54*	24	*25*	15	*36*	2	*17*	14	*17*			
Inter-sex	0	*0*	0	*0*	0	*0*	0	*0*	2	*5*	0	*0*	1	*1*			
Prefer not to say	0	*0*	1	*2*	5	*7*	3	*3*	1	*2*	1	*8*	6	*7*			
Formal NDD diagnosis?															61.85***	6	.38
No	68	*87*	41	*68*	52	*73*	35	*36*	29	*69*	9	*75*	38	*47*			
Yes	10	*13*	19	*32*	19	*27*	61	*64*	13	*31*	3	*25*	43	*53*			
Self-identify NDD diagnosis?															38.14***	6	.29
No	72	*92*	45	*75*	52	*73*	58	*60*	29	*69*	3	*25*	50	*62*			
Yes	6	*8*	15	*25*	19	*27*	38	*40*	13	*31*	9	*75*	31	*38*			
Any NDD diagnosis?															106.07***	6	.49
No	62	*79*	27	*45*	35	*49*	15	*16*	18	*43*	0	*0*	13	*16*			
Yes	16	*21*	55	*60*	36	*51*	81	*84*	24	*57*	12	*100*	68	*84*			
Formal MD diagnosis?															62.11***	6	.38
No	64	*82*	35	*58*	45	*63*	35	*36*	17	*40*	3	*25*	25	*31*			
Yes	14	*18*	25	*42*	26	*37*	61	*64*	25	*60*	9	*75*	56	*69*			
Self-identify MD diagnosis?															31.84***	6	.27
No	59	*76*	44	*73*	29	*41*	62	*65*	18	*43*	7	*58*	41	*51*			
Yes	19	*24*	16	*27*	42	*59*	34	*35*	24	*57*	5	*42*	40	*49*			
Any MD diagnosis?															89.01***	6	.45
No	45	*58*	20	*33*	13	*18*	15	*16*	0	*0*	0	*0*	6	*7*			
Yes	33	*42*	40	*67*	58	*82*	81	*84*	42	*100*	12	*100*	75	*93*			
Neurodivergent identity[d]															134.37***	12	.40
Yes	9	*12*	20	*33*	39	*55*	68	*71*	27	*64*	12	*100*	61	*75*			
No	58	*74*	30	*50*	18	*25*	14	*15*	8	*19*	0	*0*	7	*9*			
Yes, but use different term	2	*3*	1	*2*	2	*3*	4	*4*	1	*2*	0	*0*	2	*2*			

Variable	Profile														Chi-square test		
	1		2		3		4		5		6		7				
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	χ^2	*df*	ϕ_c
Unsure	9	*12*	9	*15*	12	*17*	10	*10*	6	*14*	0	*0*	9	*11*			
Prefer not to say	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	2	*3*			

Note. N = 440. NDD = Neurodevelopmental disorder, MD = Mental disorder. Red highlighting denotes a proportion of a demographic that is significantly lower in a profile. Green denotes a proportion of a demographic that is significantly higher in a profile. χ^2 = chi-square test; *df* = degrees of freedom; ϕ_c = Cramer's *V*.

Magnitude of ϕ_c is aided by the following parameters (negligible = $.00 \leq \phi_c < .10$; weak = $.10 \leq \phi_c < .20$; moderate = $.20 \leq \phi_c < .40$; relatively strong = $.40 \leq \phi_c < .60$; strong = $.60 \leq \phi_c < .80$; and very strong = $.80 \leq \phi_c \leq 1.00$; Rea & Parker, 2014).

[a] Percentage based on total number of participants.

[b] Chi-square test based on groups: Man, Woman, and Non-binary/gender-diverse; N = 435.

[c] Chi-square test based on groups: Female and Male; N = 420.

[d] Chi-square test based on groups: Yes, No, and Unsure; N = 426.

*** $p < .001$ (two-sided).

Table 9c

Neurodevelopmental Disorder Frequencies and Chi-square Test of Contingencies for Each Profile.

Variable	Profile														Chi-square test		
	1		2		3		4		5		6		7				
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	χ^2	*df*	ϕ_c
Profile size	78	*18*[a]	60	*14*[a]	71	*16*[a]	96	*22*[a]	42	*10*[a]	12	*3*[a]	81	*18*[a]			
Any intellectual disability[a b]															6.56	6	.36
No	77	*99*	60	*100*	70	*99*	95	*99*	42	*100*	11	*92*	79	*98*			
Yes	1	*1*	0	*0*	1	*1*	1	*1*	0	*0*	1	*8*	2	*2*			
Any communication disorder[a b]															5.69	6	.11
No	78	*100*	57	*95*	66	*93*	92	*96*	40	*95*	11	*92*	76	*94*			
Yes	0	*0*	3	*5*	5	*7*	4	*4*	2	*5*	1	*8*	5	*6*			
Autism spectrum disorder[a]															88.24***	6	.45
No	77	*99*	54	*90*	58	*82*	50	*52*	34	*81*	2	*17*	48	*59*			
Yes	1	*1*	6	*10*	13	*18*	46	*48*	8	*19*	10	*83*	33	*41*			
Attention-deficit/hyperactivity disorder[a]															59.30***	6	.37
No	70	*90*	37	*62*	55	*77*	48	*50*	28	*67*	6	*50*	31	*38*			
Yes	8	*10*	23	*38*	16	*23*	48	*50*	14	*33*	6	*50*	50	*62*			
Specific learning disorder[a]															31.28***	6	.27
No	76	*97*	55	*92*	67	*94*	80	*83*	36	*86*	6	*50*	66	*81*			
Yes	2	*3*	5	*8*	4	*6*	16	*17*	6	*14*	6	*50*	15	*19*			
Any movement disorder[a b]															23.84***	6	.23
No	77	*99*	59	*98*	68	*96*	80	*83*	40	*95*	10	*83*	76	*94*			
Yes	1	*1*	1	*2*	3	*4*	16	*17*	2	*5*	2	*17*	5	*6*			
Extreme demand avoidance[c]															106.33***	6	.55
No	73	*97*	44	*80*	36	*71*	39	*55*	11	*38*	4	*36*	13	*21*			
Yes	2	*3*	11	*20*	15	*29*	32	*45*	18	*62*	7	*64*	50	*79*			
Unsure	3	*4*	5	*8*	20	*28*	25	*26*	13	*31*	1	*8*	18	*22*			
Sluggish cognitive tempo[d]															99.80***	6	.50
No	66	*86*	33	*63*	30	*48*	32	*39*	8	*24*	2	*18*	10	*13*			
Yes	11	*14*	19	*37*	33	*52*	51	*61*	26	*76*	9	*82*	65	*87*			
Unsure	1	*1*	8	*13*	8	*11*	13	*14*	8	*19*	1	*8*	6	*7*			

Note. N = 440. Red highlighting denotes a proportion of a demographic that is significantly lower in a profile. Green denotes a proportion of a demographic that is significantly higher in a profile. χ^2 = chi-square test; *df* = degrees of freedom; ϕ_c = Cramer's *V*.

Magnitude of ϕ_c is aided by the following parameters (negligible = $.00 \leq \phi_c < .10$; weak = $.10 \leq \phi_c < .20$; moderate = $.20 \leq \phi_c < .40$; relatively strong = $.40 \leq \phi_c < .60$; strong = $.60 \leq \phi_c < .80$; and very strong = $.80 \leq \phi_c \leq 1.00$; Rea & Parker, 2014).

[a] Chi-square test based on combined formal and self-identified neurodevelopmental disorder.

[b] Expected frequencies assumption violated. More than 20% of cells had expected count less than 5.

[c] Chi-square test based on groups: No and Yes; $N = 355$.

[d] Chi-square test based on groups: No and Yes; $N = 395$.

*** $p < .001$.

Multivariate Analysis of Variance (MANOVA)

A MANOVA found a statistically significant omnibus difference between each of the profile's level of global disability and *General "p" Factor of Psychopathology*, combined, F (12, 866) = 70.33, $p < .001$, partial $\eta^2 = .49$. After making a Bonferroni correction (i.e., $\alpha = \frac{.05}{2}$) to decrease the risk of a family-wise type I error, there was a statistically significant difference between the seven profiles and global disability, F (6, 433) = 90.07, $p < .001$, partial $\eta^2 = .56$; and the *General "p" Factor of Psychopathology*, F (6, 433) = 693.99, $p < .001$, partial $\eta^2 = .91$ (see Table 10c). Both effect sizes were large (Cohen, 2013). The mean statistics of profiles regarding levels of both the *General "p" Factor of Psychopathology* (see Figure 3c) and global disability (see Figure 4c) were strikingly similar, suggesting that the general intensity level of psychopathology for each profile also corresponded to associated disability (i.e., higher "*p*" factor, higher global disability).

Profiles 1 and 2 had levels of global disability below a clinically significant level, suggesting a level of ability that is comparable to the general population (Andrews et al., 2009; see Figure 4c). However, profiles 3, 4, 5, 6, and 7 were deemed as having clinically significant disability, with profile 6 having the highest (Andrews et al., 2009; see Figure 4c).

Table 10c

Means, Standard Deviations, and One-Way Analysis of Variance of Global Disability and General "p" Factor Amongst Each Profile.

Measure	Profile														F (6, 433)	Partial η^2
	1		2		3		4		5		6		7			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Global Disability (WHODAS 2.0-12)	3.19	3.43	8.70	5.80	10.95	7.11	13.90	7.29	20.74	6.55	31.58	5.88	23.14	8.24	90.07***	.56
General "*p*" Factor of Psychopathology[a]	-1.30	.31	-.34	.25	-.66	.33	.26	.28	.47	.28	2.19	.32	1.21	.29	693.99***	.91

Note. $N = 440$. WHODAS 2.0-12 = World Health Organisation Disability Assessment Schedule 2.0 – 12-item Version.

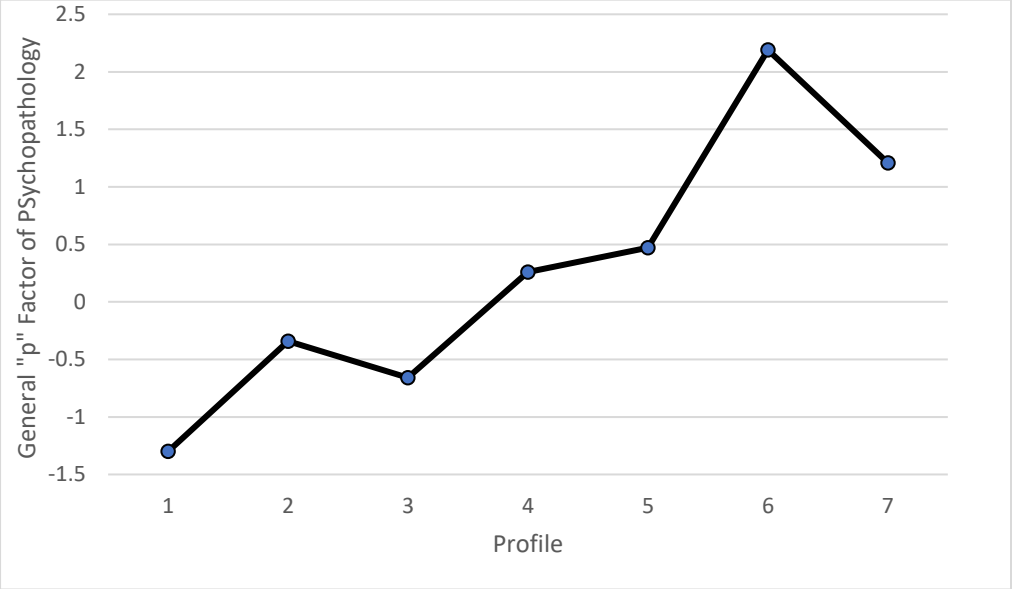
$\eta^2 > 0.01$ is a small effect; $\eta^2 > 0.06$ is medium; and $\eta^2 > 0.14$ is large (Cohen, 2013).

[a] Means and standard deviations based on standardised factor score.

$^{***}p < .001$

Figure 3c

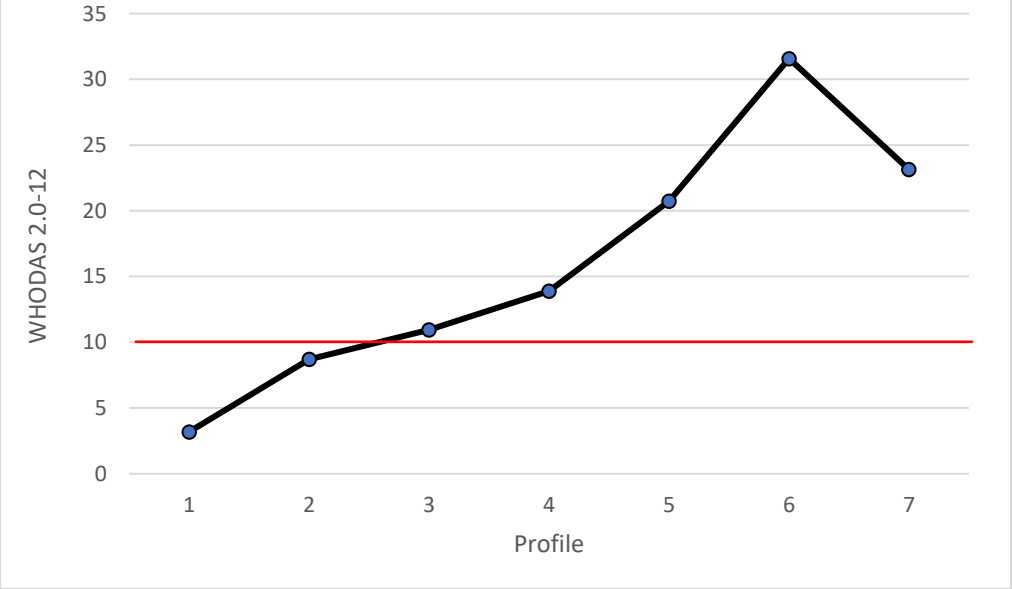
Comparison of the Level of the General "p" Factor of Psychopathology for Each Profile.



Note. $N = 440$.

Figure 4c

Comparison of the Level of Global Disability for Each Profile.



Note. $N = 440$. The red line indicates the threshold for clinically significant disability (Andrews et al., 2009).

Discussion

Our aim in this study was to explore the latent structure and HiTOP position of four NDDs (i.e., ASD, ADHD, specific learning disorder, and tic disorders) as well as three NDD-related experiences (i.e., extreme demand avoidance, sluggish cognitive tempo, and emotional dysregulation), and then investigate the dimensional syndromes (i.e., the combination of symptom/trait presentations) that emerged across this structure.

We identified a six-factor structure that closely resembled pre-existing HiTOP spectra (Kotov et al., 2021). These six factors appeared to be *Internalising,* denoting experiences of extreme negative emotionality, particularly Distress, Fear, and Obsessive-compulsivity subfactors of the HiTOP (Watson et al., 2022a); *Psychoticism,* detailing distortions of perception and reality (Kotov et al., 2020); *Detachment – Social Communication and Cognition*, a pattern of social avoidance, mirroring extreme introversion and the current conceptualisation of HiTOP Detachment (Zimmermann et al., 2022); *Detachment – Social-sensory Overload*, a flooding of social and sensory stimuli as well as restricted and repetitive behaviours, potentially reflecting sensitivities in the Ascending Reticular Activating System (Dadalko & Travers, 2018); *Disinhibition*, a dysregulation of impulse-control within cognition, emotion, and behaviour (Krueger et al., 2021); and *Antagonism*, a pattern of interpersonal opposition and dominance (Krueger et al., 2021).

Overall, the NDDs and NDD-related experiences we assessed loaded onto this six-factor structure. ASD traits were dually accounted for by *Detachment – Social Communication and Cognition* and *Detachment – Social-sensory Overload,* ADHD and sluggish cognitive tempo traits by *Disinhibition,* and both specific learning disorder and tic disorder traits by *Psychoticism.* Extreme demand avoidance traits were dispersed across *Internalising, Detachment,* and *Antagonism*, and emotional dysregulation was similarly dispersed across *Internalising, Psychoticism, Detachment – Social Communication and*

Cognition, *Disinhibition*, and *Antagonism*, but more so loaded onto the latter two (i.e., the Externalising superspectrum; Kotov et al., 2021). See Figure 5c for visual placement of NDDs and NDD-related experiences within the HiTOP spectra and subfactors.

All six factors were relatively strongly correlated with global disability in our study, supporting previous works (Keeley et al., 2014). And in line with previous regressions, we found that *Detachment – Social Communication and Cognition* was the strongest predictor of global disability (Keeley et al., 2014), and that *Antagonism* was the weakest predictor (Bach et al., 2023; Keeley et al., 2014). *Detachment – Social-sensory Overload* negatively predicted global disability in our study, suggesting that there may be a small protective aspect of this factor against functional impairments. This may be due, in part, to the perceived benefits of certain restricted and repetitive behaviours such as self-stimulatory behaviours (i.e., "stimming"; Kapp et al., 2019; Mantzalas et al., 2022) and special interests (Mantzalas et al., 2022) against functional impairment. However, the potentially protective aspect of *Detachment – Social-sensory Overload* in this study is small and novel, and should thus be further explored within future research.

These six factors then formed a set of reliable dimensional syndromes that were strongly associated with categorical NDDs and NDD-related experiences, particularly extreme demand avoidance, sluggish cognitive tempo, ASD, and ADHD, as well as endorsement of using the term "neurodivergent". The syndromes that emerged were largely "flat", representing relatively equal proportions of all six factors (i.e., *General "p" Factor of Psychopathology)*, similarly found in previous research (Hanegraaf et al., 2022; Lau et al., 2023). We also found that these profiles, ordered by symptom intensity, corresponded to greater global disability. We therefore provide preliminary evidence that various NDDs, particularly ASD and ADHD, as well as NDD-related experiences of extreme demand

avoidance and sluggish cognitive tempo can alternatively be expressed via reliable dimensional syndromes.

Relationships Between DSM-5-TR Neurodevelopmental Disorders and HiTOP Spectra

Autism Spectrum Disorder

We have demonstrated the presence of two potential subfactors of Detachment that divide the diagnostic criteria of ASD. Firstly, criterion A (i.e., social-communication) loads primarily onto *Detachment – Social Communication and Cognition* in our study (reflecting current HiTOP Detachment). This supports previous research by Zimmermann et al., (2022) which show that communication difficulties of ASD load onto Detachment. Secondly, criterion B (i.e., restricted and repetitive behaviours) loaded onto *Detachment – Social-sensory Overload* in our study, a factor which is not currently mapped by the HiTOP. The divergence of these factors may be indicated, given that sensory sensitivities (as found in *Social-sensory Overload*), was previously found to be partially independent from social introversion (as found in *Social Communication and Cognition*; Aron & Aron, 1997). Furthermore, their divergence may involve the differing roles of systemising. *Systemising* (i.e., a pattern of detail-oriented and system-wide thinking; Warrier et al., 2019), is genetically linked to ASD as a category (Baron-Cohen & Lombardo, 2017) but only with criterion B (i.e., restricted and repetitive behaviours; Warrier et al., 2019). This in turn may explain why "social camouflage" (i.e., the tendency to mask autistic traits; Cook et al., 2021) primarily loads onto *Social-sensory Overload*, as masking involves the systemisation of social behaviour so that these behaviours can be mimicked and replicated (Hull et al., 2017).

The separation of these factors is also shown across the syndromes we identified, as profile 3 highlights those with higher difficulties in *Social Communication and Cognition*, but lower *Social-sensory Overload*. Conversely, profile 4 highlights those with difficulties in *Social Communication and Cognition* but has an even higher difficulty with *Social-sensory*

Overload. Given these nuances, we provide an alternative structure to the current nosology of DSM-5-TR ASD that requires both criteria A and B to be met, unlike an ADHD diagnosis that allows for nuance in inattention and hyperactivity-impulsivity (APA, 2022).

"Repetitive behaviours" found within ASD also cross-loaded onto the *Disinhibition* spectrum in our study, alongside *Detachment – Social-sensory Overload*, although this cross-loading was small. This is in line with previous findings, as compared with criterion A (i.e., social-communication), criterion B of ASD (i.e., restricted and repetitive behaviour) has a stronger genetic correlation with inattention and hyperactivity-impulsivity of ADHD (Ghirardi et al., 2019; Polderman et al., 2014). Criterion B is also strongly associated with executive functioning (Faja & Nelson Darling, 2019; Perry et al., 2022), which is also evidenced by *Detachment – Social-sensory Overload* having its strongest correlation with *Disinhibition* out of the six factors in our study. Brain imaging has also highlighted the shared neurology between ASD and ADHD via the inferior frontal gyrus, a region responsible for inhibitory control (Geurts et al., 2013). Therefore, co-occurrences between ASD and ADHD (Pandolfi & Magyar, 2016) may be due to the shared presence of repetitive behaviour.

Attention-deficit/Hyperactivity Disorder

In line with previous HiTOP validation (Krueger et al., 2021; Mullins-Sweatt et al., 2022), ADHD traits of inattention, and verbal and motor hyperactivity-impulsivity loaded onto *Disinhibition* within our study. We also see that the proportion of participants with ADHD was significantly associated with profile 7, alongside ASD, extreme demand avoidance, and sluggish cognitive tempo, characterising a particularly disinhibited subgroup of people with a high level of associated global disability. This reflects prior findings noting the clustering of ADHD, ASD, extreme demand avoidance, and sluggish cognitive tempo (Brewe et al., 2020; Gillberg et al., 2015; Kildahl et al., 2021; McFayden et al., 2022;

Pandolfi & Magyar, 2016; Stuart et al., 2020), and substantiates the shared neurology between ASD and ADHD (Geurts et al., 2013).

Specific Learning Disorder

"Reading-writing difficulties" of specific learning disorder loaded onto *Psychoticism* in our study. Moreover, "mathematical difficulties" did not strongly load onto any factor, but the closest was onto *Psychoticism*. Therefore, specific learning disorder traits were primarily characterised by *Psychoticism*, suggesting that cognitive-perceptual aberrations may be a mechanism within the disorder, akin to psychotic-like disorders. Profile 6 from our LPA further supports this notion, as this group had a significantly higher proportion of cases with specific learning disorder, with *Psychoticism* being a factor with a high intensity.

Conceptually, specific learning disorder and schizotypy seem to share characteristics of "unusual perceptions", such that there may be perceptual distortions of words in specific learning disorder (e.g., "when reading, the words seem to move around"), and distortion of objects in schizotypy ("everyday things seem unusually large or small"; Davidson et al., 2016). This shared phenomenon may therefore explain why having specific learning disorder poses a greater risk of later experiencing schizophrenia, schizotypal, or delusional disorders than other mental disorders (Zakopoulou et al., 2014). Furthermore, procedural learning impairments that underpin specific learning disorder (e.g., difficulty encoding how to read and write) is comparable to that of schizophrenia, along with developmental coordination disorder and specific language impairment (Clark & Lum, 2017).

Tic Disorders

The initial EFA showed that a seventh factor, *Touretticism*, emerged with loadings of only tic disorder traits (i.e., verbal tics/echolalia and motor tics). However, it was later subsumed under the broader *Psychoticism* factor in a more viable six-factor solution, suggesting that *Touretticism* may be a subfactor of *Psychoticism*. This is supported by the

shared neurobiology between schizophrenic/psychotic conditions and tic disorders, particularly when considering shared symptomatology of echolalia (i.e., verbal echoing of other people's words) and palilalia (i.e., repetition of one's own words; Müller et al., 2002). Yet, the initial degree of separation between tic disorder traits and the remainder of *Psychoticism* in our study may have occurred given low rates of co-occurrence between schizophrenia and tic disorders, as their dual presence is mainly captured via a small series of case reports, with tics predating psychosis (Guan & Tsai, 2013; Müller et al., 2002; Salma et al., 2017). Moreover, the risk of developing a schizophrenic condition is 15 times higher in those with tic disorders one to two years after diagnosis (Maibing et al., 2015).

Additionally, we found that tic disorder and OCD traits did not load onto the same factor, despite their genetic overlap (Grotzinger et al., 2020; Yang et al., 2021) and tendency to co-occur (Eapen et al., 2016). Therefore, we did not find a compulsive explanatory framework for tic disorders (Yang et al., 2021) in this study. However, we did find that the proportion of having a movement disorder (which includes tic disorders) alongside ASD was increased within profile 4, where *Detachment – Social-sensory Overload* (constituting criterion B of ASD) had the highest psychopathological intensity. Since we found that "repetitive behaviours" of *Detachment – Social-sensory Overload* cross-loaded onto *Disinhibition* in our study, an impulsive mechanism might similarly be present within tic disorders (Yang et al., 2021). This is also supported by the strong genetic correlation between criterion B of ASD and executive functioning (Faja & Nelson Darling, 2019; Perry et al., 2022).

Relationships Between Neurodevelopmental-related Experiences and HiTOP Spectra

Extreme Demand Avoidance

The loadings of all three traits of extreme demand avoidance were multidimensional, loading on elements of all three HiTOP superspectra (i.e., Emotional Dysfunction, Psychosis,

and Externalising; Kotov et al., 2021). In line with previous research (Egan et al., 2019, 2020), we demonstrated extreme demand avoidance to partially have an *Internalising* mechanism. We see this via the specific loading of the "reactivity to demands" component onto this spectrum within our study, which may be underpinned by anxiety and intolerance of uncertainty (Stuart et al., 2020).

We also demonstrated two potential behavioural by-products of "reactivity to demands". Firstly, we show that the "detached demand avoidance" component (i.e., a technique of demand avoidance via social detachment and fantasy withdrawal) was attributable to *Detachment - Social Communication and Cognition,* alongside social-communication difficulties of ASD, supporting the link between extreme demand avoidance and ASD (Kildahl et al., 2021). This link is further established, as endorsement of having extreme demand avoidance was significantly higher in profile 7, alongside formal diagnoses of, or self-identification with ASD and/or ADHD. The second component is "domineering demand avoidance" (i.e., a pattern of demand avoidance by use of social control, dominance, and aggression) which loaded onto *Antagonism* alongside displaced aggression and traits of oppositional defiant disorder, supporting previous findings (Egan et al., 2020). This also supports previous notions that extreme demand avoidance and oppositional defiant disorder have conceptual overlap (Stuart et al., 2020) and can co-occur (Kildahl et al., 2021).

Sluggish Cognitive Tempo

The loading of sluggish cognitive tempo onto *Disinhibition* in our study is in line with our expectations, given that sluggish cognitive tempo and the inattention component of ADHD correlate strongly (Fredrick et al., 2020; Reinvall et al., 2017). We did not find any meaningful cross-loadings of sluggish cognitive tempo onto any other HiTOP spectrum. Therefore, sluggish cognitive tempo may indeed be a unitary construct characterised by *Disinhibition*, but future research should investigate if this NDD-related experience mediates

the link between Disinhibition and other spectra. This is because sluggish cognitive tempo-like experiences such as daydreaming are strongly associated with dissociation (Duarte et al., 2022) found within HiTOP Psychoticism (Cicero et al., 2022).

Emotional Dysregulation

As found with extreme demand avoidance, aspects of negative emotional dysregulation were largely multidimensional in our study, substantiating the current consensus that emotional dysregulation is transdiagnostic (Abdi & Pak, 2019; Faustino, 2021; Paulus et al., 2021). Firstly, the cross-loading of "negative emotional dysregulation – controlling experience" (i.e., difficulty down-regulating the experience of negative emotion) was near equally accounted for by *Internalising* and *Detachment – Social Communication and Cognition*. This supports previous findings that emotional dysregulation mediates internalising symptoms and disorders (Abdi & Pak, 2019; Paulus et al., 2021) and is also present in people with OCD (i.e., an internalising disorder; Yazici & Yazici, 2019). Furthermore, the partial contribution of Detachment, supports elevated emotional dysregulation found in those with ASD (Dağdelen, 2021; Davico et al., 2022), an NDD primarily characterised by Detachment in our study.

Despite this, negative emotional dysregulation had its strongest loadings on the Externalising superspectrum of the HiTOP, having mutually loaded with ADHD traits in the current study. This finding may support the hypothesis that disorders of emotional dysregulation and ADHD exist under a unitary network (Petrovic & Castellanos, 2016; Yue et al., 2022). Specifically, the "inhibiting behaviour" (i.e., engagement in risky behaviour when experiencing negative emotions) and "activating behaviour" (i.e., interference with everyday task completion when experiencing negative emotions) components of negative emotional dysregulation were accounted for by *Disinhibition*. Components such as these have previously been associated with the trait-impulsivity model (Garofalo et al., 2018), a

hallmark of HiTOP Disinhibition (Krueger et al., 2021). The “inhibiting behaviour “facet of emotional dysregulation was also party attributable to *Antagonism*, which was in line with previous strong associations between emotional dysregulation and Antagonism (Abdi & Pak, 2019).

Implications

We found that traits of NDDs and NDD-related experiences fitted within the existing HiTOP spectra, potentially warranting several revisions to the HiTOP in terms of NDD incorporation. Given their dispersion throughout the HiTOP, we provide preliminary evidence that these traits may not represent a unitary Neurodevelopmental spectrum that is separate from other HiTOP spectra. But considering that NDDs emerge within the early developmental period, these traits may constitute a deeper substrate of psychopathological pervasiveness that is separate from Symptom Components and Maladaptive Personality Traits of the HiTOP (Kotov et al., 2021). As such, pending further research, an added pervasiveness layer of *Neurodevelopmental Traits* to the HiTOP may be warranted, given that NDDs tend to mutually load within genetic analyses (Grotzinger et al., 2020; Lu et al., 2021; Waldman et al., 2020; Yang et al., 2021).

Within future research, the addition of a *Neurodevelopmental Traits* layer may be further elucidated into several sub-elements that cut across all NDDs. The Alternate Model of Personality Disorders (AMPD; APA, 2022) considers this by highlighting impairments in self-functioning (i.e., identity and self-direction) and interpersonal functioning (i.e., empathy and intimacy) that cut across all Maladaptive Personality Traits that characterise personality disorders (Bach & Tracy, 2022). The inclusion of these constructs has demonstrated high clinical utility of the AMPD (Milinkovic & Tiliopoulos, 2020), as well as improved inter-rater reliability and therapeutic decision making (Bach & Tracy, 2022).

Future research might also consider the development of a new dimensional measure of NDDs framed within the HiTOP, which could then herald the development of an alternate model of NDDs much like the AMPD. This may then remedy issues associated with discrete classification of NDDs, especially considering that discreet classification may result in healthcare system fragmentation (Stange, 2009). Therefore, a unified model of NDDs set within the broader HiTOP may rationalise the unification of neurodevelopmental-specific services (e.g., autism-specific, ADHD-specific) into the mainstream mental healthcare system. Such an effort can be supported by the flexible and combined use of Symptom Components, Maladaptive Personality Traits, and Neurodevelopmental Traits to describe a client's profile, as similarly suggested by Gamache et al. (2021).

Limitations and Future Research

Due to the large test battery of 16 measures, the sample size of 440 was modest, resulting in a small subsample within profile 6. However, we felt this profile still had value, in that it had significantly higher proportions of cases with ASD and specific learning disorder. As such, we believe the large test battery was beneficial in identifying a broad range of psychopathology, as was necessary for our aims and research question. That said, we did not include assessments of several other NDDs, including intellectual disabilities, communication disorders, developmental coordination disorder, and stereotypic movement disorder, so our conclusions cannot apply to those disorders. Furthermore, occurrences of these conditions were far fewer than ASD, ADHD, specific learning disorder, and tic disorders in our study, so future research might include a more targeted assessment of the traits within these conditions. We also did not include measurements of the *Somatoform* spectrum of the HiTOP (Kotov et al., 2021), limiting our understanding of the roles that this spectrum may provide in explaining the measured NDD and NDD-related constructs. Future research should consider the role of this spectrum. Future studies could also examine how the

dimensions themselves (i.e., the HiTOP spectra), as opposed to the categorically distinct profiles (i.e., the syndromes), are related to other participant characteristics (e.g., endorsement of NDD diagnosis).

We developed the SLDQ-A for the purposed of this study to assess specific learning disorder traits, as current measures do not assess impairments in reading, writing, and mathematics, in combination. Therefore, extensive validation of this measure does not currently exist. Although, the SLDQ-A showed good internal consistency and criterion validity (i.e., identifying people with specific learning disorder) in our study, future research is needed to further explore its validity. Furthermore, this measure, as well as the components and dimensional syndromes we identified in this study were based on data provided by adults from the general population within a primarily Western culture. Future research should consider the assessment of these traits within a clinical setting to further establish their diagnostic utility. Additionally, cross-cultural approaches across a range of child, adolescent, and adult samples should be taken to further establish the generalisability of these findings.

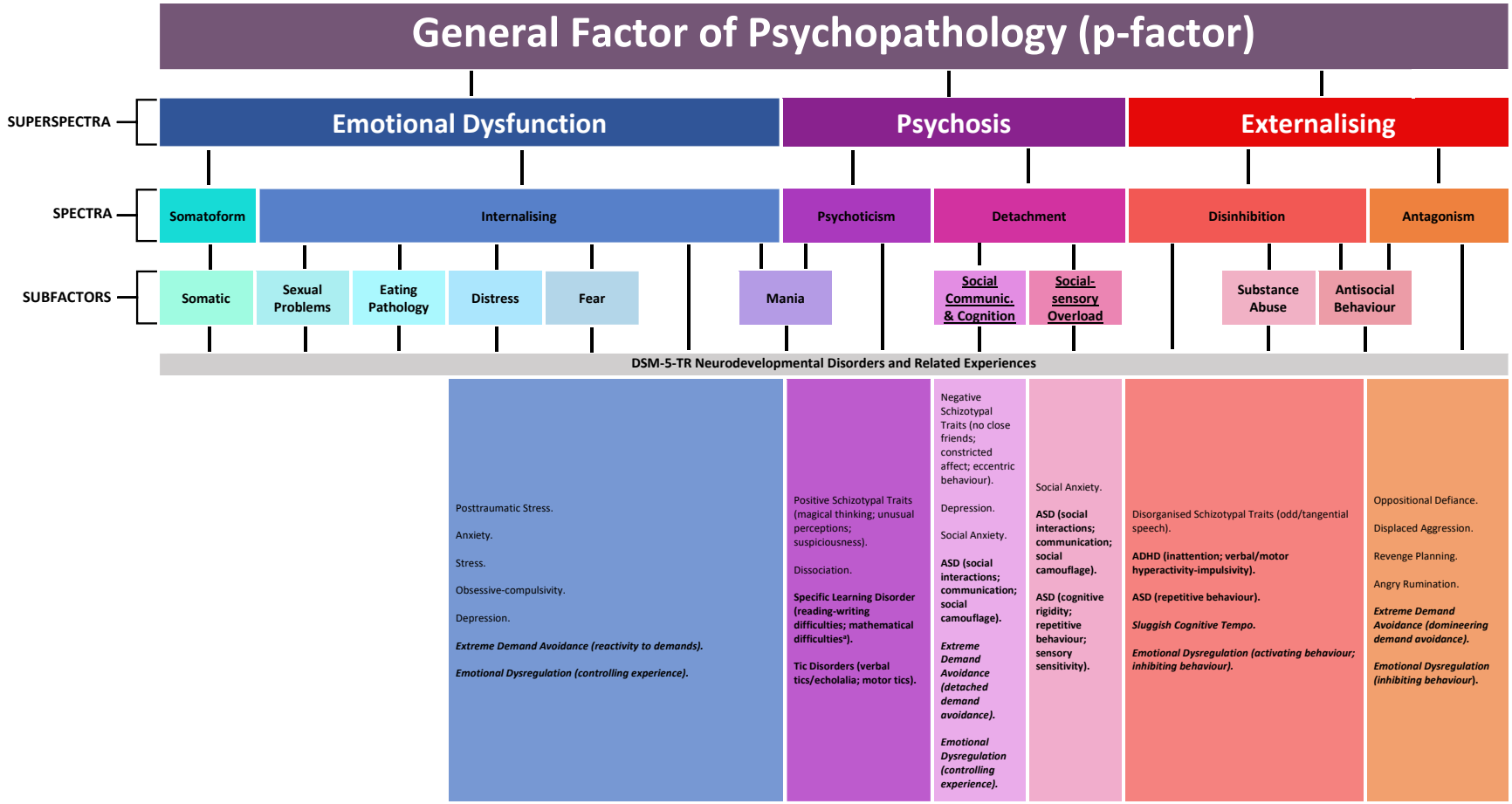
Conclusion

We found that various NDDs and NDD-related experiences generally load onto six pre-existing HiTOP spectra. ASD traits primarily load onto *Detachment*, ADHD traits load onto *Disinhibition*, and specific learning disorder as well as tic disorders both load onto *Psychoticism*. Moreover, NDD-related experiences of extreme demand avoidance load across *Internalising, Detachment*, and *Antagonism* domains. Sluggish cognitive tempo loads onto *Disinhibition*, and emotional dysregulation primarily loads across *Disinhibition* and *Antagonism* (i.e., the Externalising superspectrum). The factors we identified were all accounted for, at the higher-order level, by the *General "p" Factor of Psychopathology*. Dimensional syndromes then emerged from these factors which differed according to global disability and were significantly associated with the current categorical conceptualisation of

NDDs and NDD-related experiences. In sum, this study provides preliminary evidence for the integration of various NDDs and related experiences within the dimensional framework of the HiTOP, thereby informing theoretical revisions of the model as well promote the unification of neurodevelopmental-specific services into the mainstream mental healthcare system.

Figure 5c

Position of Neurodevelopmental Disorders and Related Experiences within the Current HiTOP Spectra and Subfactors.



Note. Underlined subfactors represent tentative naming and structural positions. NDDs and NDD-related experiences (italicised) are in bold. ASD = autism spectrum disorder; ADHD = attention-deficit/hyperactivity disorder.

[a] Mathematical Difficulties did not strongly load onto a factor over .30, however, its strongest was onto Psychoticism.

Chapter 4

General Discussion

General Discussion

The purpose of this thesis was to extend upon our understanding of NDDs within the dimensional framework of the HiTOP, as opposed to the categorical framework used in the DSM-5-TR. Two studies were conducted to explore this area with respect to identifying the individual components of psychopathology (i.e., the factors), as well as the dimensional syndromes of co-occurrence across these components (i.e., the latent profiles).

Components of Psychopathology

Study one had a narrow scope, allowing for a detailed investigation into the construct of autism and its conceptual overlap with the schizotypal personality. We found that, when subjecting autistic and schizotypal traits to factor analysis at the item-level, a large, shared higher-order factor emerged that was strongly associated with the schizoid personality, a hallmark of the HiTOP Detachment spectrum (Ringwald et al., 2021). We therefore called this factor *Detachment*, alongside a smaller higher-order factor that we called *Psychoticism*, which closely resembled HiTOP conceptualisation of Psychoticism/Thought Disorder, constituting cognitive-perceptual aspects of schizotypy (Kotov et al., 2020).

Study two then expanded upon this aim by assessing aspects of the Emotional Dysfunction, Psychosis, and Externalising superspectra of the HiTOP, with specific focus on whether facets of ASD, ADHD, specific learning disorder, and tic disorders fit into these domains or not. We also assessed other neurodevelopmental-related experiences outside of the DSM-5-TR (i.e., extreme demand avoidance, sluggish cognitive tempo, and emotional dysregulation) to allow for a potentially more comprehensive mapping of neurodevelopmental phenomena. As in study one, similar results were found in study two with respect to autism, with autistic traits loading onto a factor alongside negative schizotypal traits (i.e., *Detachment*), which supports another recent HiTOP study (Zimmermann et al., 2022). Therefore, considering both studies, it appears that the social-communication

difficulties of ASD are likely accounted for by Detachment. We also assessed criterion B of ASD (i.e., restricted and repetitive behaviours), which seemed to load onto a potential sub-factor of Detachment we called *Social-sensory Overload*, a novel contribution to the HiTOP model.

We also demonstrated across both studies that social anxiety seems to be accounted for, at least in part, by Detachment when assessed alongside autistic traits. This is because in study one, a specific "Social Discomfort" factor emerged under the higher-order *Detachment* factor; and in study two, social anxiety meaningfully cross-loaded onto two potential sub-factors of *Detachment – Social Communication and Cognition* and *Detachment – Social-sensory Overload*. This may challenge some aspects of the current HiTOP structure which sees social anxiety specified only under the Internalising spectrum (Watson et al., 2022a, 2022b). However, a recent meta-analysis of the HiTOP structure supports our findings via the additional loading of social anxiety onto Detachment, which may partially explain the dual position of Detachment under Psychosis and higher-order Internalising (i.e., Emotional Dysfunction; Ringwald et al., 2021). This finding has implications for future assessment of other autism-related anxieties such as selective mutism, given that both social anxiety and selective mutism are found to have genetic overlap (Stein et al., 2011).

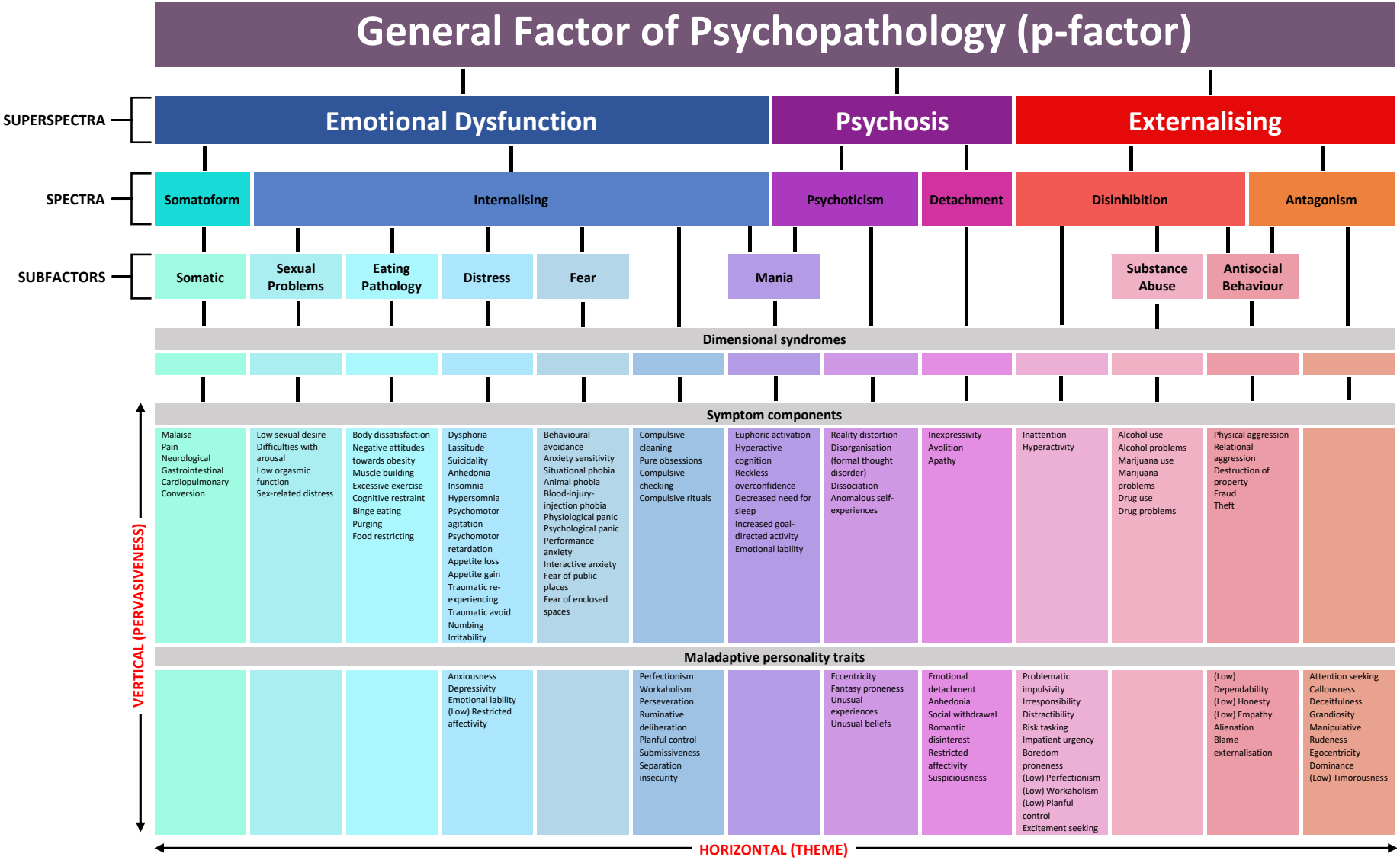
Both studies provide adequate support for the HiTOP position of ASD traits, but study two, specifically, further elucidates the HiTOP position of other NDDs (i.e., ADHD, specific learning disorder, and tic disorders). ADHD is extensively covered within the HiTOP literature, which is specified under the Disinhibition spectrum (Kotov et al., 2021); and we also confirmed this positioning in study two. Interestingly, the item content of the "Derailed Speech" factor that we found to exist under *Psychoticism* in study one, instead strongly loaded onto *Disinhibition* in study two, highlighting a benefit when considering a broadband assessment to reliably ascertain the structure of psychopathology. But beyond ADHD, we

found preliminary evidence that traits of specific learning disorder and tic disorders are accounted for by *Psychoticism*. However, some of these loadings were relatively weak, suggesting that further studies are needed to clarify their HiTOP position.

Uniquely, study two found evidence linking NDD-related phenomena to the HiTOP structure. Of those covered in study two, extreme demand avoidance, a severe behavioural manifestation commonly found within ASD (O'Nions & Eaton, 2020), crossed elements of all three HiTOP superspectra (i.e., Emotional Dysfunction, Psychosis, and Externalising). The multidimensionality of this phenomenon may therefore explain its severity. Likewise, emotional dysregulation was found to be multidimensional across all three HiTOP superspectra, but primarily loaded onto the Externalising superspectrum alongside ADHD traits, therefore supporting the notion that emotional dysregulation is a core component of ADHD (Yue et al., 2022). And lastly, we found sluggish cognitive tempo to fall under *Disinhibition* like ADHD traits, again supporting the link between the two constructs (Fredrick et al., 2020). All three of these NDD-related experiences have associated levels of impairment, but are not presently considered by the DSM-5-TR. Given our evidence of dimensionally mapping these experiences, there is potentially room to use the HiTOP to expand upon the diagnostic "borders" of well-established DSM-5-TR disorders, thereby mapping more comprehensive neurodevelopmental expressions. NDDs fall under various pre-existing HiTOP spectra in both studies, so we could therefore rule out the possibility that NDDs are characterised as a single, separate spectrum (i.e., they are not horizontally inclined within the HiTOP; see Figure 1d). However, the genetic clustering of NDDs (Grotzinger et al., 2020; Lu et al., 2021; Waldman et al., 2020; Yang et al., 2021) may mean that these traits are vertically inclined within the model (see Figure 1d), representing a biological substrate of pervasiveness.

Figure 1d

The Current HiTOP Model



Dimensional Syndromes of Psychopathology

Throughout both studies, we found that the resultant factors elicited the emergence of reliable dimensional syndromes, showcasing elevations across more than one factor. In study one, we showcased that the syndromes that had relatively equal elevations of *Detachment* and *Psychoticism* were most frequent, with rarer occurrences of separation between them (e.g., high *Detachment*, low *Psychoticism*). We also provided validation in study one, as the syndromes with the highest psychopathological intensity were associated with unemployment or employment due to disability. Likewise, in study two, we found that the syndromes with relatively equal elevations of *Internalising, Psychoticism, Detachment – Social Communication and Cognition, Detachment – Social-sensory Overload, Disinhibition*, and *Antagonism* were more common than syndromes that were characterised by only a few of these factors. We extended upon the validation strategy in study one by assessing associated global disability in study two. As a result, we found that syndromes with the highest psychopathological intensity also scored the highest on global disability. Additionally, we found that these syndromes were associated with higher participant endorsement of having a categorical NDD (e.g., ASD) or NDD-related experience (e.g., extreme demand avoidance).

Within both studies, we found that there were four profiles considered as "flat" (i.e., relatively equal intensity of factors) and three profiles considered "uneven" (i.e., nuanced intensity of factors), with the "flat" profiles having a higher number of participants on average. The consistency of this finding suggests that these "flat" profiles may represent the norm of mental disorders, with individuals tending to experience a range of psychopathology simultaneously, instead of isolated occurrences of a specific domain of psychopathology. This is in line with the HiTOP understanding of the General "*p*" Factor of Psychopathology (Gluschkoff et al., 2019), of which we found evidence for in study

two. However, we also demonstrate the emergence of more nuanced syndromes (i.e., the "uneven" profiles), representing difficulties mainly within a single domain of psychopathology, although these had fewer participants allocated to them. All "uneven" syndromes in both studies (i.e., profiles 2, 4, and 6 in study one, and profiles 3, 5, and 6 in study two) primarily seemed to be characterised by elevations in either Detachment or Psychoticism (i.e., the Psychosis superspectrum of the HiTOP), thus potentially acting as reference factors (i.e., the main driver of the syndrome).

Integrating the HiTOP into clinical practice requires further investigation into dimensional syndromes of mental disorders, which is an outstanding goal (Kotov et al., 2022). Yet, we provide preliminary evidence that traits of NDDs and NDD-related experiences can be expressed within these dimensional syndromes. In study one, we were able to extrapolate potentially meaningful narrow syndromes from the factor structure, but we did not collect diagnostic information from participants to validate these syndromes. Conversely, we identified very broad syndromes in study two that were associated with DSM-5-TR NDD diagnoses. Future research should combine both methodologies and identify empirical syndromes at the narrow level (i.e., presentation of individual symptoms and traits) and at the broad level (i.e., presentation of spectra and subfactors), as exemplified by Kotov et al. (2022).

Conclusions

Considering our findings in both studies, it is suggested that NDD and NDD-related traits do not constitute a separate "Neurodevelopmental" spectrum within the HiTOP. Rather, they are dispersed across the pre-existing HiTOP structure, much like personality traits. We provide growing evidence that traits of ASD are accounted for by the Detachment spectrum, alongside the well-established position of ADHD within Disinhibition. In addition, we provide evidence that specific learning disorder and tic

disorders may fall under Psychoticism, and that NDD-related experiences of extreme demand avoidance and emotional dysregulation are largely dispersed across the HiTOP spectra, although sluggish cognitive tempo was uniformly accounted for by Disinhibition. Further research is needed to clarify these positionings, particularly within clinical samples, but we think this provides a useful preliminary mapping to inform future study. We also find that components of NDDs elicit dimensional syndromes, most of which endorsed the presence of a General "*p*" Factor of Psychopathology and differed in terms of functional impairments. We therefore provide additional support for the use of the HiTOP to dimensionally map DSM-5-TR NDDs, as well as extending our understanding of the nature of NDD-related phenomena. Key findings from both studies may help inform revisions to the HiTOP structure at the lower- and higher-order levels, and could potentially expand the repertoire of clinicians when assessing, diagnosing, and supporting those with NDDs.

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Appendix A

Specific Learning Disorder Questionnaire – Adult (SLDQ-A) – Survey Version.

The following questions ask you about different aspects of your learning ability in reading, spelling, and mathematics.

Over the past six months, please select the option that best describes how much you agree with each question.

#	Question	Strongly disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Strongly agree (5)
Reading Difficulties						
1	I mix up words when reading (e.g., confuse visually similar words like "house" and "horse").	☐	☐	☐	☐	☐
2	I often delete or overlook certain words when reading.	☐	☐	☐	☐	☐
3	If I must read, I must put in a lot of mental effort so that I can understand the meaning (e.g., read slowly, re-read words and sentences).	☐	☐	☐	☐	☐
4	I have trouble understanding the meaning of the words and sentences I read.	☐	☐	☐	☐	☐
5	I have difficulty reading words I don't know.	☐	☐	☐	☐	☐
6	When looking at a page of text, all I notice are the spaces between the words (i.e., the "rivers").	☐	☐	☐	☐	☐
7	When reading, the words seem to move around.	☐	☐	☐	☐	☐
Writing Difficulties						
8	I often make spelling mistakes when writing (e.g., forget to add vowels [a, e, i, o, u], place letters incorrectly).	☐	☐	☐	☐	☐
9	When writing to other people, they mention that they have trouble understanding what I mean.	☐	☐	☐	☐	☐
10	I have trouble writing long bits of text that requires good grammar (i.e., text that follows the rules of language).	☐	☐	☐	☐	☐
11	I am confused when and where to write capital and lowercase letters within words.	☐	☐	☐	☐	☐
12	I don't really understand where to put commas (,) and full stops (.) within my written sentences.	☐	☐	☐	☐	☐
Mathematical Difficulties						
13	I struggle with mental math (i.e., working out basic maths in your head without a calculator).	☐	☐	☐	☐	☐
14	I count using my fingers to add or subtract single digit numbers (e.g., 4 + 5).	☐	☐	☐	☐	☐
15	I don't really understand the rules of mathematics (e.g., adding, subtracting, multiplying, and/or dividing numbers).	☐	☐	☐	☐	☐
16	When having to be somewhere by a certain time, I struggle to work out the specific time I need to leave.	☐	☐	☐	☐	☐
17	I have difficulty converting units of measurement (e.g., converting centimeters to meters).	☐	☐	☐	☐	☐
18	I have difficulty understanding the meaning of numbers when measuring something (e.g., how hot is 30°C? How heavy is 50kg? How far is 1.2km?).	☐	☐	☐	☐	☐

Note. This version of the SLDQ-A includes items that were originally developed for study two. Items were developed according to three subscales, corresponding to the three areas of impairment in specific learning disorder (APA, 2022).

Appendix B

Specific Learning Disorder Questionnaire – Adult (SLDQ-A) -Validated Version.

The following questions ask you about different aspects of your learning ability in reading, spelling, and mathematics.

Over the past six months, please select the option that best describes how much you agree with each question.

#	Question	Strongly disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Strongly agree (5)
Reading-writing Difficulties						
1	I mix up words when reading (e.g., confuse visually similar words like “house” and “horse”).	☐	☐	☐	☐	☐
2	I often delete or overlook certain words when reading.	☐	☐	☐	☐	☐
3	If I must read, I must put in a lot of mental effort so that I can understand the meaning (e.g., read slowly, re-read words and sentences).	☐	☐	☐	☐	☐
4	I have trouble understanding the meaning of the words and sentences I read.	☐	☐	☐	☐	☐
5	I have difficulty reading words I don’t know.	☐	☐	☐	☐	☐
6	When looking at a page of text, all I notice are the spaces between the words (i.e., the “rivers”).	☐	☐	☐	☐	☐
7	When reading, the words seem to move around.	☐	☐	☐	☐	☐
8	I often make spelling mistakes when writing (e.g., forget to add vowels [a, e, i, o, u], place letters incorrectly).	☐	☐	☐	☐	☐
9	When writing to other people, they mention that they have trouble understanding what I mean.	☐	☐	☐	☐	☐
10	I have trouble writing long bits of text that requires good grammar (i.e., text that follows the rules of language).	☐	☐	☐	☐	☐
12	I don’t really understand where to put commas (,) and full stops (.) within my written sentences.	☐	☐	☐	☐	☐
Mathematical Difficulties						
13	I struggle with mental math (i.e., working out basic maths in your head without a calculator).	☐	☐	☐	☐	☐
14	I count using my fingers to add or subtract single digit numbers (e.g., 4 + 5).	☐	☐	☐	☐	☐
15	I don’t really understand the rules of mathematics (e.g., adding, subtracting, multiplying, and/or dividing numbers).	☐	☐	☐	☐	☐
17	I have difficulty converting units of measurement (e.g., converting centimeters to meters).	☐	☐	☐	☐	☐
18	I have difficulty understanding the meaning of numbers when measuring something (e.g., how hot is 30°C? How heavy is 50kg? How far is 1.2km?).	☐	☐	☐	☐	☐

Note. This version of the SLDQ-A includes the final set of items post-validation for study two. Items were instead structured according to three levels of impairment within specific learning disorder, as opposed to three (APA, 2022).

Supplementary Material A1

Chapter 2: Study One Recruitment Poster.

Supplementary Material B1

Chapter 2: Study One Ethical Approval.

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18-Oct-2021

Name: Matt Ruggiero
Department/School: Curtin University
Email: M.Ruggiero@curtin.edu.au

Dear Matt Ruggiero

RE: Amendment approval
Approval number: HRE2021-0352

Thank you for submitting an amendment request to the Human Research Ethics Office for the project **PSYC4000: What are the unique and shared factors underlying dimensional traits of autism and schizotypy in the general population?**.

Your amendment request has been reviewed and the review outcome is: **Approved**

The amendment approval number is HRE2021-0352-05 approved on 18-Oct-2021.

The following amendments were approved:
Addition of David Preece to the project team.

Condition of Approval
It is the responsibility of the Chief Investigator to ensure that any activity undertaken under this project adheres to the latest available advice from the Government or the University regarding COVID-19.

Any special conditions noted in the original approval letter still apply.

Standard conditions of approval

1. Research must be conducted according to the approved proposal
2. Report in a timely manner anything that might warrant review of ethical approval of the project including:
   - proposed changes to the approved proposal or conduct of the study
   - unanticipated problems that might affect continued ethical acceptability of the project
   - major deviations from the approved proposal and/or regulatory guidelines
   - serious adverse events
3. Amendments to the proposal must be approved by the Human Research Ethics Office before they are implemented (except where an amendment is undertaken to eliminate an immediate risk to participants)
4. An annual progress report must be submitted to the Human Research Ethics Office on or before the anniversary of approval and a completion report submitted on completion of the project
5. Personnel working on this project must be adequately qualified by education, training and experience for their role, or supervised
6. Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, that bears on this project
7. Changes to personnel working on this project must be reported to the Human Research Ethics Office
8. Data and primary materials must be retained and stored in accordance with the Western Australian University Sector Disposal Authority (WAUSDA) and the Curtin University Research Data and Primary Materials policy
9. Where practicable, results of the research should be made available to the research participants in a timely and clear manner
10. Unless prohibited by contractual obligations, results of the research should be disseminated in a manner that will allow public scrutiny; the Human Research Ethics Office must be informed of any constraints on publication

11. Ethics approval is dependent upon ongoing compliance of the research with the Australian Code for the Responsible Conduct of Research, the National Statement on Ethical Conduct in Human Research, applicable legal requirements, and with Curtin University policies, procedures and governance requirements
12. The Human Research Ethics Office may conduct audits on a portion of approved projects.

Should you have any queries regarding consideration of your project, please contact the Ethics Support Officer for your faculty or the Ethics Office at hrec@curtin.edu.au or on 9266 2784.

Yours sincerely

Amy Bowater
Ethics, Team Lead

Supplementary Material C1

Chapter 2: Study One Participant Information Statement (SONA).

Curtin University

Factors underlying traits of autism and schizotypy.

PARTICIPANT INFORMATION STATEMENT

HREC Project Number:	HRE2021-0352
Project Title:	What are the shared and unique factors underlying dimensional traits of autism and schizotypy in the general population?
Chief Investigator:	Dr Matt Ruggiero
Student researcher:	Khaiden Dow
Version Number:	4
Version Date:	30/06/2021

What is the Project About?

Autism and schizotypy are currently thought to be two separate mental experiences. Generally, the term *autism* refers to social difficulties as well as restrictive behaviours that people may experience and are most often seen in an 'Autism Spectrum Disorder'. Similarly, the term *schizotypy* refers to a pattern of odd and/or eccentric ways of thinking, as well as high social anxiety, and are also seen in a 'Schizotypal Personality Disorder'. However, for the purposes of this study, we are only interested in traits of these two concepts that show up within the general population. This means terms like a 'disorder' (i.e., a collection of symptoms that require clinical intervention) is not of focus in this study. As such, we will only refer to the two concepts as *trait-autism* and *trait-schizotypy.*

From recent research, we now know there may be a major overlap between these two experiences, with higher levels of trait-autism relating to higher levels of trait-schizotypy. We also know that there may only be small differences between the two. Therefore, the way people experience trait-autism and trait-schizotypy may be more similar than different. However, these research findings are relatively recent and only a handful of studies have shown this. As such, replication of these findings in the current study is needed to determine the extent of their significance, by reassessing the relationship between trait-autism and trait-schizotypy. Replication will help us determine whether or not the overlap still appears. This research is important as it will help us better understand how 'different' mental experiences relate to one another. We therefore invite between 320 and 640 adult participants to join this study. The larger the set of participants in this study, the more accurate our results will be.

There will be no follow-up study.

Who is doing the research?

This project is being conducted by Khaiden Dow, a psychology student that is completing this project to obtain a Bachelor of Psychology (Honours) under the supervision of Dr Matt Ruggiero. The results from this research will be used by Khaiden Dow to obtain this qualification at Curtin University and is funded by the University. There will be no costs to you, and you will not receive any payment for participating in this project.

Curtin University

Factors underlying traits of autism and schizotypy.

Why am I being asked to take part and what will I have to do?

We are looking for Curtin University students that are interested to take part in this study. The minimum age to participate in this study is 17 (on the premise of being a 'mature minor'). There will be no maximum age limit.

You will be asked to compete a short online survey which will require details such as your age, gender, and educational status. You will then complete a 64-item questionnaire about traits of autism and schizotypy that you may experience. Your response to each question will be measured as either 'strongly disagree', 'disagree', 'agree', or 'strongly agree'. You will then complete a 9-item questionnaire on schizoid traits, using the same response format as previously mentioned. Finally, you will complete a 13-item questionnaire on social desirability which is measured by a response of 'yes' or 'no' to each question. You will then receive a debrief sheet once you have finished the survey, to summarise its content.

All questions will only need to be completed once and will be recorded electronically once the questionnaire is completed. In total, the survey should take no more than 30 minutes to complete. This study will only take place online, wherever you have access to an internet connection, so no travel is required from you. You can take your time in answering each question.

Are there any benefits' to being in the research project?

Although there will likely be no direct benefit to you, the results from this study will hopefully help us develop a better understanding and linkage between different mental experiences. However, you may appreciate this opportunity to express your thoughts and feelings.

These results may also help develop future research in this area, even at a clinical level. In particular, the findings from this study may help health professionals (e.g., psychologists, psychiatrists) provide a more accurate diagnosis when considering the overlap between autism and schizotypy in general. However, the current study will only focus on the overlap at a trait level as opposed to a clinical level.

Are there any risks, side-effects, discomforts, or inconveniences from being in the research project?

There are no major risks from you participating in this project. However, you may experience discomfort when completing the questionnaire, but we have been careful that the questions do not cause any distress to you. If at any point you feel uncomfortable with the content of the survey, you do not need to answer.

If any of the questions have raised concerns for you, you are able to contact us at any time and we can help you accordingly. Sometimes just thinking about this topic can be upsetting. If you chose not to be in this study, but experience distress from considering it, then please contact **the Samaritans (135 247)**, **Lifeline Australia (13 11 14)** or **the Autism Association of Western Australia (9489 8900).** Alternatively, you can visit **https://unitedgmh.org/mental-health-support** for country-specific support lines.

These concerns aside, we expect there may be a minor inconvenience to you in terms of the time spent completing the survey. Unfortunately, we are not able to provide monetary compensation for

your time spent. However, if you are a Curtin University student, you will receive two SONA points in exchange for participation. No other risks or inconveniences are associated with participation.

Who will have access to my information?

The information collected in this research will be non-identifiable (anonymous). This means that we do not need to collect individual names as information is anonymous and will not include a code number or name. No one, not even the research team will be able to identify your information. However, a cookie will be placed on the survey to prevent you from completing the survey twice. The following people will have access to the information/data we collect in this research: the research team and, in the event of an audit or investigation, staff from the Curtin University Office of Research and Development.

If you are a Curtin University psychology student that is completing this study in exchange for SONA points, your ID will not be needed for you to receive these points as automatic point rewards will be set up.

If you feel you need to contact us via professional email, any trail of your details and/or contacts will be destroyed after the final study has been submitted (after data collection and analysis).

Electronic data will be password-protected and hard copy data (e.g., printouts of data analysis) will be in locked in storage, though most of the data will be in an electronic format.

The information we collect in this study will be kept under secure conditions at Curtin University for 7-25 years after the research is published and then it will be destroyed.

No identifiers will be kept that would allow re-identification of your information. This permanently non-identified dataset may be uploaded to a public repository, and results of this research may be presented at conferences or published in professional journals. You will not be identified in any results that are published or presented.

Will you tell me the results of the research?

Once the study is complete, you are entitled to the project's overall results. However, we are not able to send you your individual results. If you are interested in obtaining a summary of the results, please contact the researchers after the end of November 2021.

Do I have to take part in the research project?

Taking part in a research project is voluntary. It is your choice to take part or not. You do not have to agree if you do not want to. If you decide to take part and then change your mind, that is okay, you can withdraw from the project at any time prior to submitting your final answers. If you choose not to take part or start and then stop the study, it will not affect your relationship with the University, staff, or colleagues.

If you choose to take part in this research project, you must complete all questions on this survey to receive full SONA points. However, if you do not wish to fully answer the questions, that is ok, but you will not receive full SONA points.

Curtin University

Factors underlying traits of autism and schizotypy.

However, once your results have been submitted (via the submit button on the survey), you will not be able to withdraw your participation as your data is anonymous and non-traceable.

What happens next and who can I contact about the research?

If you have any concerns, you can contact the chief investigator Dr Matt Ruggiero via email (M.Ruggiero@curtin.edu.au). Alternatively, you can contact the student researcher Khaiden Dow via email (khaiden.dow@student.curtin.edu.au).

If you decide to take part in this research, we will ask you to indicate your consent via a checkbox. By indicating your consent, you are telling us that you understand what you have read and what has been discussed. consent indicates that you agree to be in the research project and have your health information used as described. Please take your time and ask any questions you have before you decide what to do.

As this study will be conducted online, the start of the questionnaire (available via the link provided) will have a checkbox to indicate you have understood the information provided here in the information sheet. Please select this option if you wish to continue with the study, having consented to participate.

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number HRE2021-0352). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Supplementary Material D1

Chapter 2: Study One Participant Information Statement (Broader Community).

Curtin University

Factors underlying traits of autism and schizotypy.

PARTICIPANT INFORMATION STATEMENT

HREC Project Number:	HRE2021-0352
Project Title:	What are the shared and unique factors underlying dimensional traits of autism and schizotypy in the general population?
Chief Investigator:	Dr Matt Ruggiero
Student researcher:	Khaiden Dow
Version Number:	4
Version Date:	30/06/2021

What is the Project About?

Autism and schizotypy are currently thought to be two separate mental experiences. Generally, the term *autism* refers to social difficulties as well as restrictive behaviours that people may experience and are most often seen in an 'Autism Spectrum Disorder'. Similarly, the term *schizotypy* refers to a pattern of odd and/or eccentric ways of thinking, as well as high social anxiety, and are also seen in a 'Schizotypal Personality Disorder'. However, for the purposes of this study, we are only interested in traits of these two concepts that show up within the general population. This means terms like a 'disorder' (i.e., a collection of symptoms that require clinical intervention) is not of focus in this study. As such, we will only refer to the two concepts as *trait-autism* and *trait-schizotypy.*

From recent research, we now know there may be a major overlap between these two experiences, with higher levels of trait-autism relating to higher levels of trait-schizotypy. We also know that there may only be small differences between the two. Therefore, the way people experience trait-autism and trait-schizotypy may be more similar than different. However, these research findings are relatively recent and only a handful of studies have shown this. As such, replication of these findings in the current study is needed to determine the extent of their significance, by reassessing the relationship between trait-autism and trait-schizotypy. Replication will help us determine whether or not the overlap still appears. This research is important as it will help us better understand how 'different' mental experiences relate to one another. We therefore invite between 320 and 640 adult participants to join this study. The larger the set of participants in this study, the more accurate our results will be.

There will be no follow-up study.

Who is doing the research?

This project is being conducted by Khaiden Dow, a psychology student that is completing this project to obtain a Bachelor of Psychology (Honours) under the supervision of Dr Matt Ruggiero. The results from this research will be used by Khaiden Dow to obtain this qualification at Curtin University and is funded by the University. There will be no costs to you, and you will not receive any payment for participating in this project.

Curtin University

Factors underlying traits of autism and schizotypy.

Why am I being asked to take part and what will I have to do?

We are looking for adult participants that are interested to take part in this study. The minimum age to participate in this study is 18. There will be no maximum age limit.

You will be asked to compete a short online survey which will require details such as your age, gender, and educational status. You will then complete a 64-item questionnaire about traits of autism and schizotypy that you may experience. Your response to each question will be measured as either 'strongly disagree', 'disagree', 'agree', or 'strongly agree'. You will then complete a 9-item questionnaire on schizoid traits, using the same response format as previously mentioned. Finally, you will complete a 13-item questionnaire on social desirability which is measured by a response of 'yes' or 'no' to each question. You will then receive a debrief sheet once you have finished the survey, to summarise its content.

All questions will only need to be completed once and will be recorded electronically once the questionnaire is completed. In total, the survey should take no more than 30 minutes to complete. This study will only take place online, wherever you have access to an internet connection, so no travel is required from you. You can take your time in answering each question.

Are there any benefits' to being in the research project?

Although there will likely be no direct benefit to you, the results from this study will hopefully help us develop a better understanding and linkage between different mental experiences. However, you may appreciate this opportunity to express your thoughts and feelings.

These results may also help develop future research in this area, even at a clinical level. In particular, the findings from this study may help health professionals (e.g., psychologists, psychiatrists) provide a more accurate diagnosis when considering the overlap between autism and schizotypy in general. However, the current study will only focus on the overlap at a trait level as opposed to a clinical level.

Are there any risks, side-effects, discomforts, or inconveniences from being in the research project?

There are no major risks from you participating in this project. However, you may experience discomfort when completing the questionnaire, but we have been careful that the questions do not cause any distress to you. If at any point you feel uncomfortable with the content of the survey, you do not need to answer.

If any of the questions have raised concerns for you, you are able to contact us at any time and we can help you accordingly. Sometimes just thinking about this topic can be upsetting. If you chose not to be in this study, but experience distress from considering it, then please contact **the Samaritans (135 247)**, **Lifeline Australia (13 11 14)** or **the Autism Association of Western Australia (9489 8900**). Alternatively, you can visit **https://unitedgmh.org/mental-health-support** for country-specific support lines.

These concerns aside, we expect there may be a minor inconvenience to you in terms of the time spent completing the survey. Unfortunately, we are not able to provide monetary compensation for your time spent. No other risks or inconveniences are associated with participation.

Curtin University

Factors underlying traits of autism and schizotypy.

Who will have access to my information?
The information collected in this research will be non-identifiable (anonymous). This means that we do not need to collect individual names as information is anonymous and will not include a code number or name. No one, not even the research team will be able to identify your information. However, a cookie will be placed on the survey to prevent you from completing the survey twice. The following people will have access to the information/data we collect in this research: the research team and, in the event of an audit or investigation, staff from the Curtin University Office of Research and Development.

If you feel you need to contact us via professional email, any trail of your details and/or contacts will be destroyed after the final study has been submitted (after data collection and analysis).

Electronic data will be password-protected and hard copy data (e.g., printouts of data analysis) will be in locked in storage, though most of the data will be in an electronic format.

The information we collect in this study will be kept under secure conditions at Curtin University for 7 years after the research is published and then it will be destroyed.

No identifiers will be kept that would allow re-identification of your information. This permanently non-identified dataset may be uploaded to a public repository, and results of this research may be presented at conferences or published in professional journals. You will not be identified in any results that are published or presented.

Will you tell me the results of the research?
Once the study is complete, you are entitled to the project's overall results. However, we are not able to send you your individual results. If you are interested in obtaining a summary of the results, please contact the researchers after the end of November 2021.

Do I have to take part in the research project?
Taking part in a research project is voluntary. It is your choice to take part or not. You do not have to agree if you do not want to. If you decide to take part and then change your mind, that is okay, you can withdraw from the project at any time prior to submitting your final answers. If you choose not to take part or start and then stop the study, it will not affect your relationship with the University, staff, or colleagues.

However, once your results have been submitted (via the submit button on the survey), you will not be able to withdraw your participation as your data is anonymous and non-traceable.

What happens next and who can I contact about the research?
If you have any concerns, you can contact the chief investigator Dr Matt Ruggiero via email (M.Ruggiero@curtin.edu.au). Alternatively, you can contact the student researcher Khaiden Dow via email (khaiden.dow@student.curtin.edu.au).

If you decide to take part in this research, we will ask you to indicate your consent via a checkbox. By indicating your consent, you are telling us that you understand what you have read and what has been discussed. consent indicates that you agree to be in the research project and have your

health information used as described. Please take your time and ask any questions you have before you decide what to do.
As this study will be conducted online, the start of the questionnaire (available via the link provided) will have a checkbox to indicate you have understood the information provided here in the information sheet. Please select this option if you wish to continue with the study, having consented to participate.

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number HRE2021-0352). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Supplementary Material E1

Chapter 2: Study One Debrief Sheet

Factors underlying traits of autism & schizotypy.

Curtin University

Thank you for participating in this research. Please see below a summary of the study you have just completed, as well as support contacts you can use if you feel it is appropriate.

If you know any friends, family, or colleagues that may participate in this study, we ask you do not discuss the content of the survey with them, as this may invalidate their results. We thank you for your cooperation.

Background:

- Trait-autism and trait-schizotypy are generally thought to be two different mental experiences. However, recent research suggests that the two are more similar than they are different, but further research is needed to confirm this.

Aim:

- We therefore aim to replicate previous research to see whether there still exists an overlap between trait-autism and trait-schizotypy, whilst addressing some limitations in prior studies. This research will help use determine if autism and schizotypy (at least at a trait level) are two 'faces' of a common underlying concept. This may then have implications for clinical practice.

Method:

- You have completed a survey that includes demographic questions (e.g., age, gender) as well as four different questionnaires.
- Of the four questionnaires, two have been combined and randomised. Those two questionnaires are the Subthreshold Autism Trait Questionnaire (SATQ) and Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR).
- You have also completed a separate questionnaire called the Coolidge Axis II Inventory 260-Schizoid Subscale (CATI-Sd).
- You have also completed a separate questionnaire called the Marlowe-Crowne Social Desirability Scale-13 (MCSDS-13).

If you have any questions regarding this study, you are welcome to email the chief investigator Dr Matt Ruggiero (M.Ruggiero@curtin.edu.au) or student researcher Khaiden Dow (khaiden.dow@student.curtin.edu.au). If you feel distressed by the content of the survey, please contact **the Samaritans (135 247)**, **Lifeline Australia (13 11 14),** or **the Autism Association of Western Australia (9489 8900).**

PSYC4000 Debrief sheet Version 12, 29/05/2021.

Supplementary Material F1

Chapter 2: Structural Validity of Each Measure in Study One.

Confirmatory Factor Analysis Model Comparison via Fit Statistics for the SATQ, SPQ-BR, and CATI-Sd.

Model	χ^2	*df*	χ^2/df	*CFI*	*TLI*	*RMSEA [90% CI]*	*SRMR*
SATQ							
Five-factor; single-factor bifactor	592.56	214	2.77	.93	.91	0.05 [0.047-0.056], p = .298	0.04
SPQ-BR							
Nine-factor; three-factor hierarchical	1031.60	452	2.28	.94	.93	0.04 [0.040, 0.047], p = .999	0.06
CATI-Sd							
Single factor; 9-item	119.33	27	4.42	.95	.94	0.07 [0.060, 0.083], p = .001	0.05
Single factor; 8-item, item 6 removed)	59.81	20	2.99	.98	.97	0.06 [0.041, 0.069], p = .279	0.03

Note. N = 669. The extraction method was robust maximum likelihood. SATQ = Subthreshold Autism Trait Inventory; SPQ-BR = Schizotypal Personality Questionnaire – Brief Revised; CAT-Sd = Coolidge Axis II Inventory 260: Schizoid Subscale; χ^2 = Chi-square Test*; df* = Degrees of Freedom*;* χ^2/df = Chi-square/Degrees of Freedom Ratio*; CFI* = Comparative Fit Index*; TLI* = Tucker-Lewis Index*; RMSEA* = Root Mean Square Error of Approximation*; SRMR* = Standardised Root Mean Square Residual.

All χ^2 are significant at $p < .001$.

Supplementary Material A2

Chapter 3: Study Two Recruitment Poster (Broader Community).

Supplementary Material B2

Chapter 3: Study Two Recruitment Poster (Headspace).

Supplementary Material C2

Chapter 3: Study Two Ethical Approval.

Curtin University

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23-Jun-2022

Name: David Preece
Department/School: Curtin University
Email: David.Preece@curtin.edu.au

Dear David Preece

RE: Amendment approval
Approval number: HRE2021-0352

Thank you for submitting an amendment request to the Human Research Ethics Office for the project **PSYC4000: What are the unique and shared factors underlying dimensional traits of autism and schizotypy in the general population?**.

Your amendment request has been reviewed and the review outcome is: **Approved**

The amendment approval number is HRE2021-0352-10 approved on 23-Jun-2022.

The following amendments were approved:

Commencement of Phase Two of the Study:

The research question is changing from "What are the shared and unique factors underlying dimensional traits of autism and schizotypy within the general population?" to "What is the latent structure of neurodevelopmental traits within the hierarchical taxonomy of psychopathology (HiTOP)?"

Condition of Approval
It is the responsibility of the Chief Investigator to ensure that any activity undertaken under this project adheres to the latest available advice from the Government or the University regarding COVID-19.

Any special conditions noted in the original approval letter still apply.

Standard conditions of approval

1. Research must be conducted according to the approved proposal
2. Report in a timely manner anything that might warrant review of ethical approval of the project including:
   - proposed changes to the approved proposal or conduct of the study
   - unanticipated problems that might affect continued ethical acceptability of the project
   - major deviations from the approved proposal and/or regulatory guidelines
   - serious adverse events
3. Amendments to the proposal must be approved by the Human Research Ethics Office before they are implemented (except where an amendment is undertaken to eliminate an immediate risk to participants)
4. An annual progress report must be submitted to the Human Research Ethics Office on or before the anniversary of approval and a completion report submitted on completion of the project
5. Personnel working on this project must be adequately qualified by education, training and experience for their role, or supervised
6. Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, that bears on this project

7. Changes to personnel working on this project must be reported to the Human Research Ethics Office
8. Data and primary materials must be retained and stored in accordance with the Western Australian University Sector Disposal Authority (WAUSDA) and the Curtin University Research Data and Primary Materials policy
9. Where practicable, results of the research should be made available to the research participants in a timely and clear manner
10. Unless prohibited by contractual obligations, results of the research should be disseminated in a manner that will allow public scrutiny; the Human Research Ethics Office must be informed of any constraints on publication
11. Ethics approval is dependent upon ongoing compliance of the research with the Australian Code for the Responsible Conduct of Research, the National Statement on Ethical Conduct in Human Research, applicable legal requirements, and with Curtin University policies, procedures and governance requirements
12. The Human Research Ethics Office may conduct audits on a portion of approved projects.

Should you have any queries regarding consideration of your project, please contact the Ethics Support Officer for your faculty or the Ethics Office at hrec@curtin.edu.au or on 9266 2784.

Yours sincerely

Amy Bowater
Ethics, Team Lead

Supplementary Material D2

Chapter 3: Study Two Participant Information Statement (SONA).

Curtin University

Latent structure of neurodevelopmental traits.

PARTICIPANT INFORMATION STATEMENT

HREC Project Number:	HREXXXX-XXXX
Project Title:	What is the latent structure of neurodevelopmental traits within the HiTOP?
Chief Investigator:	Dr David Preece
Student researcher:	Khaiden Dow
Version Number:	2
Version Date:	06/06/2022

What is the Project About?

Health professionals currently view mental and neurodevelopmental disorders as categories (i.e., boxes, where people either meet diagnostic criteria or not). However, evidence is now starting to suggest that traits of mental and neurodevelopmental disorders exist on dimensions (i.e., a continuum from normality to psychopathology). A new model that captures these dimensions is called the *Hierarchical Taxonomy of Psychopathology* (HiTOP) and is comprised of three main areas informing various traits of mental disorders: (1) internalising (e.g., anxiety, depression); (2) thought disorder (e.g., schizophrenia); and (3) externalising (e.g., conduct issues, substance use issues).

This new system is promising but the underlying dimensions of neurodevelopmental disorders (e.g., autism, ADHD) have not yet been mapped. Research suggests that neurodevelopmental disorders may form its own domain with the HiTOP, that is separate from the internalising, thought disorder, and externalising domains. Alternatively, these conditions may slot in with the existing domains. Therefore, within the current study, we aim to focus on the traits of four neurodevelopmental disorders (i.e., autism spectrum disorder, ADHD, specific learning disorder, and tic disorders) and highlight their position within the HiTOP.

This research is beneficial as it may help resolve some of the issues of the current categorical system within the diagnostic and statistical manual of mental disorders, version 5 (DSM-5): (1) substantial overlap between separate diagnostic criteria; (2) high levels of co-occurrence between diagnoses; and (3) extreme variability within a single diagnosis. Not only will this research help expand our theoretical understandings of the HiTOP, but it may also help change how we assess and diagnose neurodevelopmental disorders by providing a more detailed psychological profile of a person. This in turn may also help how we support the needs of those with neurodevelopmental disorders.

We invite around **205 to 410 participants** to join this study. The larger the set of participants in this study, the more accurate our results will be. There will be no follow-up study.

Curtin University

Latent structure of neurodevelopmental traits.

Who is doing the research?

This project is being conducted by Khaiden Dow, a psychology student that is completing this project to obtain a Master of Research (Psychology) under the supervision of Professor Lauren Breen and Dr David Preece. Professor Wai Chen, and Associate Professor Simon Boag will also act as research collaborators. The results from this research will be used by Khaiden Dow to obtain this qualification at Curtin University and is funded by the University. There will be no costs for you to participate and you will not be paid for your time completing the study.

Why am I being asked to take part and what will I have to do?

We are looking for adult participants that are interested to take part in this study. The minimum age to participate in this study is **17 years** (on the premise of being a 'mature minor'). There will be no maximum age limit.

You will be asked to complete an online survey which will require details such as your age, gender, sex, occupational and educational status, as well as the country you reside in. You may also state if you have a formal diagnosis of any neurodevelopmental or mental disorder. If you don't have a formal diagnosis yet strongly identify with any neurodevelopmental or mental disorder, you may also state this diagnosis as well. Alternatively, you may not have any diagnosis, but you will still be able to participate. We also ask if you identify with the term "neurodivergent".

You will then be asked to complete a series of 16 questionnaires assessing your traits of autism, ADHD, learning impairment, tics, extreme demand avoidance, sluggish cognitive tempo, emotional dysregulation, depression, anxiety, stress, posttraumatic responses, OCD, schizotypal personality, dissociation, oppositional defiance, alcohol use, aggression, and global functioning. Most of these questionnaires are relatively brief. We will not be asking you to detail the nature of any traumatic events you may have experienced, only your emotional responses to these events. You will then receive a debrief sheet once you have finished the survey to summarise its content.

All questions will only need to be completed once and will be recorded electronically once the questionnaire is completed. In total, the survey should take approximately **20 to 30 minutes** to complete. This study will only take place online, wherever you have access to an internet connection, so no travel is required from you. You can take your time in answering each question.

Are there any benefits to being in the research project?

Although there will likely be no direct benefit to you, the results from this study will hopefully help us develop a better understanding and linkage between different mental experiences. However, you may appreciate this opportunity to express your thoughts and feelings, as well as your experiences of your condition if you have one.

These results may also help develop future research in this area, even at a clinical level. In particular, the findings from this study may help health professionals (e.g., psychologists, psychiatrists) provide a more accurate diagnosis when considering the overlap between neurodevelopmental disorders.

Curtin University

Latent structure of neurodevelopmental traits.

Are there any risks, side-effects, discomforts, or inconveniences from being in the research project?

There are no major risks from you participating in this project. However, you may experience discomfort when completing the questionnaire, but we have been careful that the questions do not cause any significant distress to you. If at any point you feel uncomfortable with the content of the survey, you do not need to answer.

If any of the questions have raised concerns for you, you are able to contact us at any time and we can help you accordingly. Sometimes just thinking about this topic can be upsetting. If you chose not to be in this study, but experience distress from considering it, then please contact the following:

- **Lifeline** 13 11 14; a support line for 24/7 crisis support.
- **The Samaritans** 135 247; an emotional support line open 8am-8pm (AWST).
- **The Autism Association of Western Australia** (08) 9489 8900 for metro, 1800 636 427 for regional; or **Embrace Autism** (https://embrace-autism.com/contact/); associations that can provide information on autistic and related experiences.
- **Blue Knot Foundation Helpline** 1300 657 380; a support line for complex trauma.
- **alcoholthinkagain** (08) 9442 5000; a support line for alcohol use issues.
- Alternatively, participants can use this link to find country-specific helplines via **United for Global Mental Health** (https://unitedgmh.org/mental-health-support).

These concerns aside, we expect there may be a minor inconvenience to you in terms of the time spent completing the survey. Unfortunately, we are not able to provide monetary compensation for your time spent. However, if you are a Curtin University student, you will receive **three SONA points** in exchange for participation. No other risks or inconveniences are associated with participation.

Who will have access to my information?

The information collected in this research will be non-identifiable (anonymous). This means that we do not need to collect individual names and we will not ask for a code number or name. No one, not even the research team will be able to personally identify your survey information. However, a cookie will be placed on the survey to prevent you from completing the survey twice. The following people will have access to the information/data we collect in this research: the research team and, in the event of an audit or investigation, staff from the Curtin University Office of Research and Development.

If you are a Curtin University student that is completing this study in exchange for SONA points, your student ID will not be needed for you to receive these points as automatic point rewards will be set up.

If you feel you need to contact us via professional email, any trail of your details and/or contacts will be destroyed after the final study has been submitted (after data collection and analysis).

Electronic data will be password-protected and hard copy data (e.g., printouts of data analysis) will be in locked in storage, though most of the data will be in an electronic format.

Curtin University

Latent structure of neurodevelopmental traits.

The information we collect in this study will be kept under secure conditions at Curtin University for 7-25 years after the research is published and then it will be destroyed.

No identifiers will be kept that would allow re-identification of your survey information. This permanently non-identified dataset may be uploaded to a public repository, and results of this research may be presented at conferences or published in professional journals. You will not be identified in any results that are published or presented.

Will you tell me the results of the research?

Once the study is complete, you are entitled to the project's overall results. However, we are not able to send you your individual results. If you are interested in obtaining a summary of the results, please contact the researchers after the end of November 2022.

Do I have to take part in the research project?

Taking part in a research project is voluntary. It is your choice to take part or not. You do not have to agree if you do not want to. If you decide to take part and then change your mind, that is okay, you can withdraw from the project at any time prior to submitting your final answers. If you choose not to take part or start and then stop the study, it will not affect your relationship with the University, staff, or colleagues.

If you choose to take part in this research project, you must complete all questions on this survey to receive full SONA points. However, if you do not wish to fully answer the questions, that is ok, but you will not receive full SONA points.

Once your results have been submitted (via the submit button on the survey), you will not be able to withdraw your participation as your data is anonymous and non-traceable.

What happens next and who can I contact about the research?

If you have any concerns, you can contact via email (in order of individual research involvement):

- The student researcher, Khaiden Dow (khaiden.dow@postgrad.curtin.edu.au)
- The chief investigator, Dr David Preece (david.preece@curtin.edu.au)
- Professor Lauren Breen (Lauren.Breen@curtin.edu.au)
- Professor Wai Chen (wai.chen@curtin.edu.au)
- Associate Professor Simon Boag (simon.boag@mq.edu.au)

If you decide to take part in this research, we will ask you to indicate your consent via a checkbox. By indicating your consent, you are telling us that you understand what you have read and what has been discussed. Your consent indicates that you agree to be in the research project and have your health information used as described. Please take your time and ask any questions you have before you decide what to do.

As this study will be conducted online, the start of the questionnaire (available via the link provided) will have a checkbox to indicate you have understood the information provided here in the information sheet. Please select this option if you wish to continue with the study, having consented to participate.

Curtin University

Latent structure of neurodevelopmental traits.

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number XX-XXXX). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Supplementary Material E2

Chapter 3: Study Two Participant Information Statement (Broader Community).

Curtin University

Latent structure of neurodevelopmental traits.

PARTICIPANT INFORMATION STATEMENT

HREC Project Number:	HREXXXX-XXXX
Project Title:	What is the latent structure of neurodevelopmental traits within the HiTOP?
Chief Investigator:	Dr David Preece
Student researcher:	Khaiden Dow
Version Number:	2
Version Date:	06/06/2022

What is the Project About?

Health professionals currently view mental and neurodevelopmental disorders as categories (i.e., boxes, where people either meet diagnostic criteria or not). However, evidence is now starting to suggest that traits of mental and neurodevelopmental disorders exist on dimensions (i.e., a continuum from normality to psychopathology). A new model that captures these dimensions is called the *Hierarchical Taxonomy of Psychopathology* (HiTOP) and is comprised of three main areas informing various traits of mental disorders: (1) internalising (e.g., anxiety, depression); (2) thought disorder (e.g., schizophrenia); and (3) externalising (e.g., conduct issues, substance use issues).

This new system is promising but the underlying dimensions of neurodevelopmental disorders (e.g., autism, ADHD) have not yet been mapped. Research suggests that neurodevelopmental disorders may form its own domain with the HiTOP, that is separate from the internalising, thought disorder, and externalising domains. Alternatively, these conditions may slot in with the existing domains. Therefore, within the current study, we aim to focus on the traits of four neurodevelopmental disorders (i.e., autism spectrum disorder, ADHD, specific learning disorder, and tic disorders) and highlight their position within the HiTOP.

This research is beneficial as it may help resolve some of the issues of the current categorical system within the diagnostic and statistical manual of mental disorders, version 5 (DSM-5): (1) substantial overlap between separate diagnostic criteria; (2) high levels of co-occurrence between diagnoses; and (3) extreme variability within a single diagnosis. Not only will this research help expand our theoretical understandings of the HiTOP, but it may also help change how we assess and diagnose neurodevelopmental disorders by providing a more detailed psychological profile of a person. This in turn may also help how we support the needs of those with neurodevelopmental disorders.

We invite around **205 to 410 participants** to join this study. The larger the set of participants in this study, the more accurate our results will be. There will be no follow-up study.

Curtin University

Latent structure of neurodevelopmental traits.

Who is doing the research?

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Curtin University

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No identifiers will be kept that would allow re-identification of your survey information. This permanently non-identified dataset may be uploaded to a public repository, and results of this research may be presented at conferences or published in professional journals. You will not be identified in any results that are published or presented.

Will you tell me the results of the research?

Once the study is complete, you are entitled to the project's overall results. However, we are not able to send you your individual results. If you are interested in obtaining a summary of the results, please contact the researchers after the end of November 2022.

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Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number XX-XXXX). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Supplementary Material F2

Chapter 3: Study Two Participant Information Statement (Headspace).

Curtin University

Latent structure of neurodevelopmental traits.

PARTICIPANT INFORMATION STATEMENT

HREC Project Number:	HRE2021-0352
Project Title:	What is the latent structure of neurodevelopmental traits within the Hierarchical Taxonomy of Psychopathology (HiTOP)?
Chief Investigator:	Dr David Preece
Student researcher:	Khaiden Dow
Version Number:	1
Version Date:	09/08/2022

What is the Project About?

Health professionals currently view mental and neurodevelopmental disorders as categories (i.e., boxes, where people either meet diagnostic criteria or not). However, evidence is now starting to suggest that traits of mental and neurodevelopmental disorders exist on dimensions (i.e., a continuum from normality to psychopathology). A new model that captures these dimensions is called the *Hierarchical Taxonomy of Psychopathology* (HiTOP) and is comprised of three main areas informing various traits of mental disorders: (1) internalising (e.g., anxiety, depression); (2) thought disorder (e.g., schizophrenia); and (3) externalising (e.g., conduct issues, substance use issues).

This new system is promising but the underlying dimensions of neurodevelopmental disorders (e.g., autism, ADHD) have not yet been mapped. Research suggests that neurodevelopmental disorders may form its own domain with the HiTOP, that is separate from the internalising, thought disorder, and externalising domains. Alternatively, these conditions may slot in with the existing domains. Therefore, within the current study, we aim to focus on the traits of four neurodevelopmental disorders (i.e., autism spectrum disorder, ADHD, specific learning disorder, and tic disorders) and highlight their position within the HiTOP.

This research is beneficial as it may help resolve some of the issues of the current categorical system within the diagnostic and statistical manual of mental disorders, version 5 (DSM-5): (1) substantial overlap between separate diagnostic criteria; (2) high levels of co-occurrence between diagnoses; and (3) extreme variability within a single diagnosis. Not only will this research help expand our theoretical understandings of the HiTOP, but it may also help change how we assess and diagnose neurodevelopmental disorders by providing a more detailed psychological profile of a person. This in turn may also help how we support the needs of those with neurodevelopmental disorders.

We invite around **205 to 410 participants** to join this study. The larger the set of participants in this study, the more accurate our results will be. There will be no follow-up study.

Curtin University

Latent structure of neurodevelopmental traits.

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Supplementary Material G2

Chapter 3: Study Two Debrief Sheet (SONA).

Debrief Sheet.

Latent structure of neurodevelopmental traits

Curtin University

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Background:
Neurodevelopmental and mental disorders are currently classed as separate experiences (i.e., categories). However, research is now suggesting that mental disorders can be captured by overlapping dimensions (from low frequency to high frequency) by a new model called the *Hierarchical Taxonomy of Psychopathology* (HiTOP). But we are yet to find the dimensions of neurodevelopmental disorders (e.g., autism, ADHD, learning disorder, tic disorders) within the HiTOP.

Aim:
We therefore aim to find where the above four neurodevelopmental disorders fit into the HiTOP. This research will help use expand the theoretical implications of the HiTOP and may also change how we assess and diagnose neurodevelopmental disorders.

Method:
You have completed a survey that includes demographic questions (e.g., age, gender) as well as 16 different questionnaires:

- The Comprehensive Autistic Trait Inventory (CATI)
- Adult Self-Report ADHD Scale (ASRAS)
- Specific Learning Disorder Questionnaire – Adult (SLD-QA)
- Motor Tic, Obsessions and Compulsions, Vocal Tic Evaluation Survey (MOVES)
- Extreme Demand Avoidance Questionnaire – Adult (EDA-QA)
- Adult Concentration Inventory (ACI)
- Perth Emotional Regulation Competency Inventory (PERCI)
- Depression, Anxiety, and Stress Scale (DASS-21)
- Severity of Posttraumatic Stress Symptoms – Adult (SPTSS-A)
- Dimensional Obsessive-Compulsive Scale – Short Form (DOCS-SF)
- Schizotypal Personality Questionnaire – Brief Revised (SPQ-BR)
- Severity of Dissociative Symptoms – Adult (SDS-A)

Debrief Sheet Version 2, 02/06/2022

Debrief Sheet.

Latent structure of neurodevelopmental traits

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- Adult Self-Report of ODD Symptoms (ASROS)
- Brief DSM-5 Alcohol Use Disorder Assessment (AUDDA-5)
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Supplementary Material H2

Chapter 3: Study Two Debrief Sheet (Broader Community and Headspace).

Debrief Sheet.

Latent structure of neurodevelopmental traits

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Debrief Sheet Version 2, 02/06/2022

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Supplementary Material I2

Chapter 3: Study Two Extended Measures Section.

Neurodevelopmental

Comprehensive Autistic Trait Inventory (CATI)

A 42-item self-report measure that assesses autistic traits in adults, having been validated in the general adult population as well as diagnosed and self-identifying autistic adults, measured on a five-point Likert scale (i.e., 1 = definitely disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, and 5 = definitely agree; English et al., 2021). The CATI has good convergent validity with other autistic trait measures (English et al., 2021). The measure has a general *Social-communication* factor characterised by: (1) *Social Interactions*; (2) *Communication Difficulties* and (3) *Social Camouflage*. The general *Restricted and Repetitive Behaviours* factor is characterised by: (4) *Repetitive Behaviours*; (5) *Cognitive Rigidity*; and (6) *Sensory Sensitivity*.

Adult ADHD Self-report Scale (ASRS)

An 18-item self-report measure that assesses traits of ADHD and has been validated in both clinical adult samples (Kessler et al., 2005) and university samples (Gray et al., 2014). The ASRS is measured on a five-point Likert scale, and asks over the last 6 months how often a symptom has occurred (i.e., 0 = never, 1 = rarely, 2 = sometimes, 3 = often, and 4 = very often; Kessler et al., 2005). The ASRS has strong convergent validity with similar ADHD measures (Brevik et al., 2020). We utilised the recent three-factor structure found by Stanton et al. (2018): (1) *Inattention*; (2) *Motor Hyperactivity-impulsivity*; and (3) *Verbal Hyperactivity-impulsivity*.

Specific Learning Disorder Questionnaire-Adult (SLDQ-A)

A 16-item self-report measure that we designed to capture traits of specific learning disorder in adults, measured on a five-point Likert scale (i.e., 1 = strongly disagree, 2 =

disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree). The Adult Reading Questionnaire (ARQ) is the only current measure designed to assess reading impairments specifically but does not consider impairments in written expression and mathematics (Snowling et al., 2012). We were not aware of any other measure that captures writing and mathematical impairments, hence our rationale for developing the SLDQ-A that assess all three domains of specific learning disorder (i.e., reading, writing, and mathematical). The SLDQ-A has two factors that emerged via EFA (see Supplementary Material L2 for structural validity): (1) *Reading-writing Difficulties*; and (2) *Mathematical Difficulties*. The SLDQ-A had good criterion validity across formally diagnosed and/or self-identified groups of SLD, but the measure worked best identifying the former. Collapsing these two groups, the total score of the SLDQ-A had the best discriminant ability (sensitivity = 88.9%; specificity = 73.8%) with a cut-off of ≥ 36.5 indicating those with SLD. See Supplementary Material Y2 for criterion validity.

Motor Tic, Obsessions and Compulsions, Vocal Tic Evaluation Survey; Revised (MOVES-R)

The MOVES is a 20-item self-report measure that captures verbal and motor tics, obsessions, compulsions, as well as associated features (i.e., echolalia) in adolescents and adults (Gaffney et al., 1994), and has been validated in OCD and tic disorder samples (Gaffney et al., 1994; Jalenques et al., 2018). We used a revised version of the MOVES, by omitting the obsessive and compulsive scales, and substituting them with a separate obsessive-compulsive measure with superior reliability. The revised version retained a four-point Likert scale (i.e., 0 = never, 1 = sometimes, 2 = often, and 3 = always; Gaffney et al., 1994). We then reassessed the structure via EFA (see Supplementary Material M2 for structural validity), as CFA of the motor and verbal tics as well as associated features

subscales showed poor fit. The MOVES-R is a shortened 11-item scale with two subscales: (1) *Verbal Tics/Echolalia*; and (2) *Motor Tics.*

Neurodevelopmental-related

Pathological Demand Avoidance Questionnaire – Adult; Revised (PDAQ-A-R)

The PDAQ-A is a 26-item self-report measure that assesses extreme demand avoidance within adults and has been validated in ASD as well as depressive and anxiety disorder samples (Egan et al., 2019, 2020). We used a revised version of the PDAQ-A, as CFA of the specified structure (Egan et al., 2019) had poor fit in our sample. The revised version of this measure retained a four-point Likert scale (i.e., 1 = not true, 2 = somewhat true, 3 = mostly true, and 4 = very true; Egan et al., 2019). We then reassessed the structure via EFA (see Supplementary Materials N2 for structural validity). The PDAQ-A-R is a shortened 19-item scale with three subscales, all having acceptable internal consistency: (1) *Domineering Demand Avoidance*; (2) *Detached Demand Avoidance*; and (3) *Reactivity to Demands*.

Adult Concentration Inventory (ACI)

A 10-item self-report questionnaire that captures sluggish cognitive tempo (i.e., slow thinking speed) within adults (Becker et al., 2018), and has been validated in ADHD, and anxiety and depressive disorder samples (Becker et al., 2018; Fredrick et al., 2020, 2022). The ACI is measured on a four-point Likert scale (0 = not at all, 1 = sometimes, 2 = often, and 3 = very often), and has good discriminant validity when factored with other ADHD, anxiety, and depression measures (Becker et al., 2018). The ACI constitutes a single *Sluggish Cognitive Tempo* scale.

Perth Emotion Regulation Competency Inventory (PERCI)

A 32-item self-report questionnaire assessing emotional regulation skills (i.e., controlling, inhibiting, activating, and tolerating emotions) with respect to negative and positive feelings in adults (Preece et al., 2018). The PERCI has a seven-point Likert scale (i.e., 1 = strongly disagree, to 7 = strongly agree), and has been validated within the general adult population and has good convergent validity with similar emotional dysregulation measures (Preece et al., 2018, 2021). To remain parsimonious, we only used four subscales focusing on negative aspects of emotional regulation: (1) *Negative-controlling Experience*; (2) *Negative-inhibiting Behaviour*; (3) *Negative-activating Behaviour*; and (4) *Negative-tolerating Emotions*.

HiTOP; Emotional Dysfunction

Depression, Anxiety, and Stress Scale – 21 (DASS-21)

A 21-item self-report measure that assesses general distress as well as specific traits of depression, anxiety, and stress, and has been validated within the adult general population (Antony et al., 1998; Henry & Crawford, 2005; Osman et al., 2012). The DASS-21 has a four-point Likert scale (i.e., 0 = never, 1 = sometimes, 2 = often, and 3 = almost always), and has good convergent validity with other depression, anxiety, and stress-specific scales (Osman et al., 2012). The measure has three subscales: (1) *Depression*; (2) *Anxiety*; and (3) *Stress*.

National Stressful Events Survey PTSD Short Scale (NSESSS)

A 9-item self-report measure that assesses posttraumatic responses to stressful events in adults (LeBeau et al., 2014). The NSESSS has a five-point Likert scale (i.e., 0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, and 4 = extremely), and has been validated in the general adult population as well as those with probable cases of PTSD, and shows

convergent and discriminant validity (LeBeau et al., 2014). The NSESSS constitutes a single *Posttraumatic Stress* scale.

Dimensional Obsessive-compulsive Scale – Short Form (DOCS-SF).

A 5-item self-report measure that assesses four aspects of OCD (i.e., fears of contamination, responsibility for harm, unacceptable/immoral thoughts, and preoccupation with symmetry and completeness) in adults (Eilertsen et al., 2017). The DOCS-SF has a six-point Likert scale, but differs in terms of time spent on OCD (i.e., 0 = not at all, to 5 = constantly); avoidance of situations to prevent OCD thoughts and behaviours (i.e., 0 = not at all, to 5 = extreme avoidance); distress associated with OCD (i.e., 0 = not at all, to 5 = extremely distressed); impact on daily routine (i.e., 0 = not at all, to 5 = completely disrupted); and difficulty disregarding OCD thoughts and behaviours (i.e., 0 = not at all, to 5 = extremely difficult; Eilertsen et al., 2017). The DOCS-SF has been validated in the general population and OCD samples, and has good convergent and discriminant validity with other OCD measures (Eilertsen et al., 2017; Kühne et al., 2021). The DOCS-SF constitutes a single *Obsessive-compulsive* scale.

HiTOP; Psychosis

Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR)

A 32-item self-report measure that assesses schizotypal traits within adults and has been validated within the general adult population (Davidson et al., 2016). The SPQ-BR has a five-point Likert scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree; Davidson et al., 2016). Convergent validity has been established with similar schizotypy and anhedonia measures (Fonseca-Pedrero et al., 2017). The measure has three higher-order factors. The first is *Cognitive-Perceptual*, characterised by: (1) *Ideas of Reference*; (2) *Suspiciousness*; (3) *Magical Thinking;* and (4) *Unusual Perceptions.* The second higher-order factor is *Interpersonal*, characterised by: (5) *No Close Friends*; (6)

Constricted Affect; and (7) *Social Anxiety.* The last is *Disorganised*, characterised by: (8) *Eccentric Behaviour*; and (9) *Odd Speech*.

Brief Dissociative Experiences Scale (DES-B)

An 8-item self-report measure designed to capture aspects of dissociation in the general population (APA, 2023). The DES-B has a five-point Likert scale regarding the frequency of each dissociative symptom (i.e., 0 = not at all, 1 = once or twice, 2 = almost every day, 3 = about once a day, and 4 = more than once a day; APA, 2023). The DES-B constitutes a single *Dissociation* scale.

HiTOP; Externalising

Adult Self-Report of ODD Symptoms, DSM-5 (ASROS-5)

An 8-item self-report measure based on the diagnostic criteria of oppositional defiant disorder, validated within undergraduate university students (Johnston et al., 2018). The ASROS-5 has a four-point Likert scale (i.e., 1 = never, 2 = sometimes, 3 = often, and 4 = very often), and has predictive utility of social impairment, online antagonism, conflict with authority, romantic difficulty, and conflict with parents (Johnston et al., 2018). The ASROS-5 constitutes a single *Oppositional Defiance* scale.

Brief DSM-5 Alcohol Use Disorder Diagnostic Assessment (AUDDA-5).

The AUDDA-5 is a 13-item self-report measure that assesses alcohol use behaviour within an adult over the past year (e.g., "…were you unable to or failed to fulfil major role obligations at work, school, or home?"; Hagman, 2017). It has been validated within undergraduate university students, including those with a diagnosis of an alcohol use disorder (Hagman, 2017). It has a dichotomous scale (i.e., 0 = no; 1 = yes; Hagman, 2017). The AUDDA-5 shows convergent validity with external ratings of alcohol use (e.g., the average episodes of binge drinking in the past 2 weeks; Hagman, 2017) and the Alcohol Use

Disorders Identification Test (AUDIT; Källmén et al., 2019). The items load onto a single factor, having acceptable to good internal consistency (α = .78-.86; Hagman, 2017; Källmén et al., 2019).

Displaced Aggression Questionnaire - Short (DAQ-S)

A 9-item self-report measure, assessing levels of aggression in the general population, and has good convergent validity with other aggression constructs (Webster et al., 2015). The DAQ-S has a seven-point Likert scale (i.e., 1 = extremely uncharacteristic of me, to 7 = extremely characteristic of me (Webster et al., 2015). The measure has three subscales: (1) *Angry Rumination*; (2) *Revenge Planning*; and (3) *Displaced Aggression.*

Global Disability

World Health Organisation Disability Assessment Schedule 2.0 – 12 item (WHODAS 2.0-12)

A 12-item self-report measure that assesses general levels of disability, with reference to social-emotional functioning and day-to-day living, and has been validated in those with mental and physical disorders (Andrews et al., 2009). The WHODAS 2.0-12 has a five-point Likert scale (i.e., 0 = none, 1 = mild, 2 = moderate, 3 = severe, and 4 = extreme or cannot do; Andrews et al., 2009). Although there is no agreed upon threshold for the WHODAS 2.0-12, Andrews et al. (2009) suggest that those who score over 10 have clinically significant disability. The WHODAS 2.0-12 constitutes a single *Global Disability* scale.

Supplementary Material J2

Comprehensive Autistic Traits Inventory (CATI) Structural Validity.

We will run confirmatory factor analysis with robust maximum likelihood estimation to test structure of pre-existing measures. Statistics are the robust variants, as opposed to standard.

CATI; Six-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
1597.134	804	$p < .001$	1.135	.923	.917	.047 [0.044, 0.051]	.057

Conclusion: CATI has good structural validity.

ACTION: Use CATI subscales.

Supplementary Material K2

Adult ADHD Self-Report Scale (ASRS) Structural Validity.

ASRS; Three-factor lower-order

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
272.048	132	$p < .001$	1.148	.960	.953	.049 [0.041, 0.057]	.046

Conclusion: ASRS has good structural validity.

ACTION: Use ASRS subscales.

Supplementary Material L2

Specific Learning Disorder Questionnaire – Adult (SLDQ-A) Structural Validity.

We first ran confirmatory factor analysis with robust maximum likelihood estimation to a three-factor structure of the SLDQ-A (i.e., Reading Difficulties, Written Difficulties, and Mathematical Difficulties).

SLDQ-A; Three-factor lower-order

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
390.589	132	$p < .001$	1.341	.910	.896	.067 [0.060, 0.073]	.058

Conclusion: SLDQ-A has a good level of structural validity. Reading and writing subscales may be one factor given high covariance, and SLD_16 has a comparatively lower loading.

ACTION: Run initial reliability and EFA on the SLDQ-A to find unique solution.

Frequentist Scale Reliability Statistics

Estimate	McDonald's ω	Cronbach's α
Point estimate	0.911	0.912
95% CI lower bound	0.899	0.899
95% CI upper bound	0.923	0.923

Frequentist Individual Item Reliability Statistics

	If item dropped		
Item	McDonald's ω	Cronbach's α	Item-rest correlation
SLD_1	0.905	0.906	0.629
SLD_2	0.904	0.905	0.638
SLD_3	0.906	0.907	0.597
SLD_4	0.904	0.905	0.672
SLD_5	0.904	0.905	0.659
SLD_6	0.908	0.909	0.502
SLD_7	0.906	0.907	0.612
SLD_8	0.906	0.907	0.593
SLD_9	0.907	0.907	0.567
SLD_10	0.905	0.905	0.654
SLD_11	0.909	0.911	0.458
SLD_12	0.906	0.906	0.629
SLD_13	0.907	0.907	0.585
SLD_14	0.908	0.908	0.548
SLD_15	0.909	0.909	0.491
SLD_16	0.909	0.910	0.485
SLD_17	0.907	0.907	0.600
SLD_18	0.908	0.908	0.556

All items had item-rest correlations above .30.

ACTION: Retain all items in EFA.

Exploratory Factor Analysis

Use EFA with parallel analysis based on factor analysis as the criteria of factor retention. Use Promax rotation method.

Kaiser-Meyer-Olkin test

	MSA
Overall MSA	0.919
SLD_1	0.936
SLD_2	0.949
SLD_3	0.911
SLD_4	0.899
SLD_5	0.935
SLD_6	0.918
SLD_7	0.932
SLD_8	0.921
SLD_9	0.947
SLD_10	0.917
SLD_11	0.937
SLD_12	0.913
SLD_13	0.889
SLD_14	0.908
SLD_15	0.900
SLD_16	0.924
SLD_17	0.893
SLD_18	0.910

Bartlett's test

X^2	df	p
3942.207	153.000	< .001

Chi-squared Test

	Value	df	p
Model	269.002	87	< .001

Factor Loadings

	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
SLD_17	0.874				0.279
SLD_13	0.835				0.307
SLD_15	0.792				0.443
SLD_18	0.683				0.500
SLD_14	0.657				0.520
SLD_3		0.846			0.406
SLD_4		0.824			0.318
SLD_1		0.519			0.471
SLD_2		0.428			0.544
SLD_5		0.424	0.447		0.436
SLD_12			0.793		0.361
SLD_10			0.761		0.343
SLD_8			0.562		0.487
SLD_6				0.803	0.434
SLD_7				0.643	0.399
SLD_9					0.555
SLD_11					0.657
SLD_16					0.718

Note. Applied rotation method is promax.

Factor Characteristics

	Unrotated solution			Rotated solution		
	SumSq. Loadings	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Factor 1	6.979	0.388	0.388	3.109	0.173	0.173
Factor 2	1.806	0.100	0.488	2.873	0.160	0.332
Factor 3	0.584	0.032	0.520	2.308	0.128	0.461
Factor 4	0.453	0.025	0.546	1.532	0.085	0.546

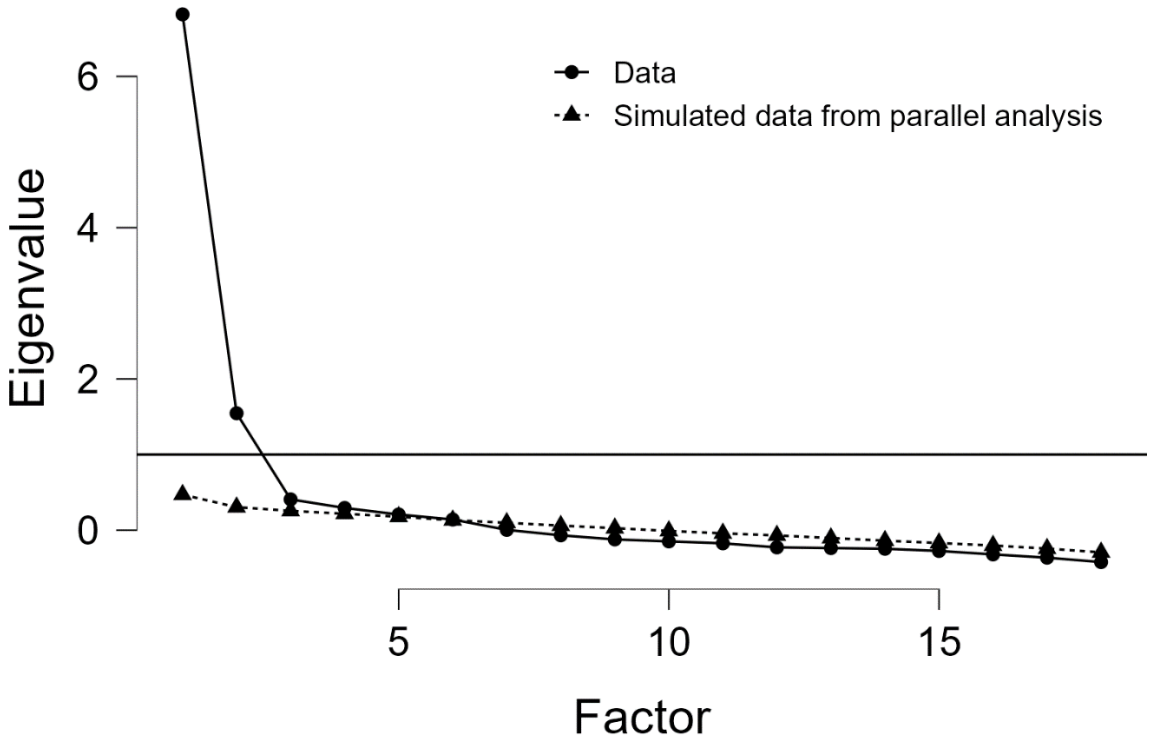
Factor Correlations

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1.000	0.522	0.471	0.440
Factor 2	0.522	1.000	0.709	0.637
Factor 3	0.471	0.709	1.000	0.704
Factor 4	0.440	0.637	0.704	1.000

Additional fit indices

RMSEA	RMSEA 90% confidence	TLI	BIC
0.069	0.06 - 0.078	0.915	-260.548

Scree plot



A four-factor model is produced, explaining 54.6% of the variance. All items load on a factor with a loading above .40, however, SLD_9, SLD_11, and SLD_16 does not load on any factor. The third and fourth factor only just passes their simulated eigenvalues.

ACTION: Force a two-factor solution.

Chi-squared Test

	Value	df	p
Model	511.605	118	< .001

Factor Loadings

	Factor 1	Factor 2	Uniqueness
SLD_1	0.751		0.476
SLD_10	0.745		0.452
SLD_4	0.742		0.442
SLD_8	0.732		0.515
SLD_5	0.710		0.469
SLD_12	0.710		0.495
SLD_9	0.687		0.566
SLD_7	0.668		0.537
SLD_3	0.666		0.554
SLD_2	0.591		0.549
SLD_6	0.568		0.677
SLD_11	0.500		0.741
SLD_17		0.887	0.274
SLD_13		0.848	0.330
SLD_15		0.773	0.479
SLD_18		0.682	0.503
SLD_14		0.662	0.520
SLD_16			0.733

Note. Applied rotation method is promax.

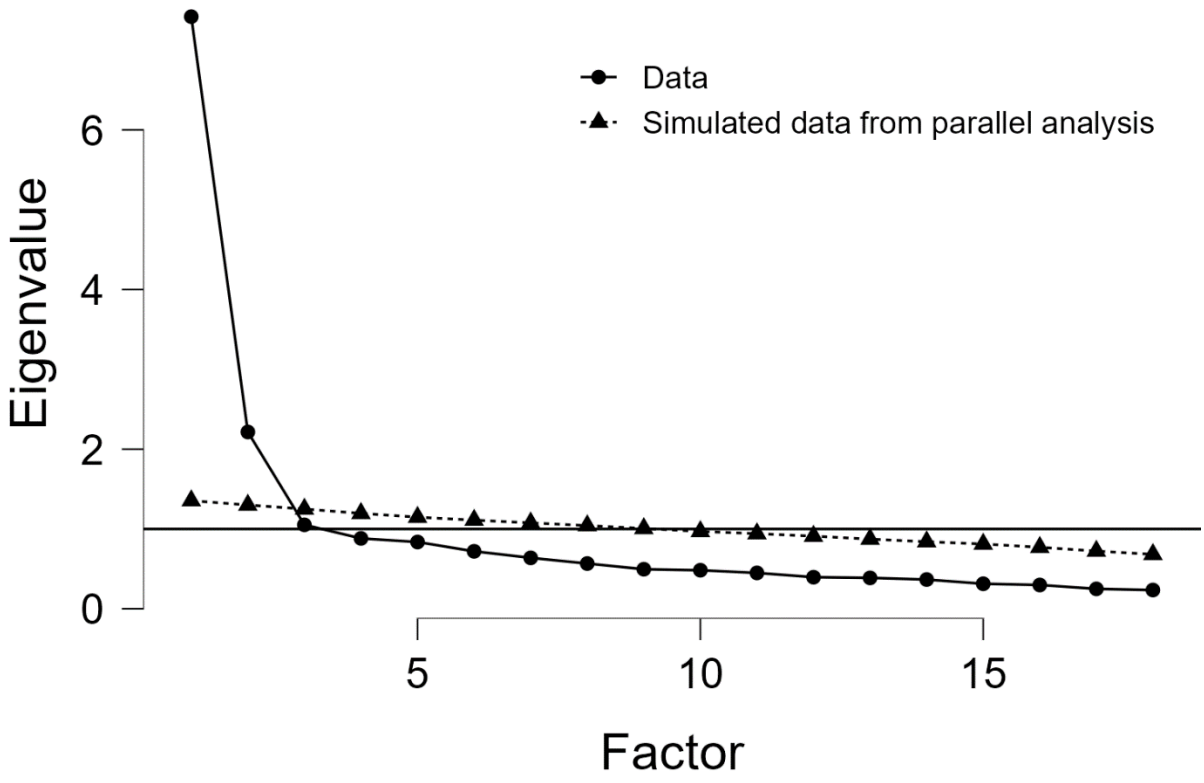
Factor Characteristics

	Unrotated solution			Rotated solution		
	SumSq. Loadings	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Factor 1	6.913	0.384	0.384	5.544	0.308	0.308
Factor 2	1.774	0.099	0.483	3.143	0.175	0.483

Factor Correlations

	Factor 1	Factor 2
Factor 1	1.000	0.552
Factor 2	0.552	1.000

Scree plot



A two-factor model is produced, explaining 48.3% of the variance. All items load on a factor with a loading above .40, however, SLD_16 does not load on any factor. SLD_11 had a relatively lower loading than all other items. SLD_16 and SLD_11 had the lowest item-rest correlation, supporting their removal.

ACTION: Remove SLD_11 and SLD_16.

Kaiser-Meyer-Olkin test

	MSA
Overall MSA	0.914
SLD_1	0.932
SLD_2	0.948
SLD_3	0.905
SLD_4	0.897
SLD_5	0.938
SLD_6	0.911
SLD_7	0.926
SLD_8	0.913
SLD_9	0.943
SLD_10	0.913
SLD_12	0.914
SLD_13	0.883
SLD_14	0.905
SLD_15	0.889

Kaiser-Meyer-Olkin test

	MSA
SLD_17	0.881
SLD_18	0.913

Bartlett's test

X^2	df	p
3618.744	120.000	< .001

Chi-squared Test

	Value	df	p
Model	419.901	89	< .001

Factor Loadings

	Factor 1	Factor 2	Uniqueness
SLD_1	0.757		0.465
SLD_4	0.749		0.437
SLD_10	0.741		0.449
SLD_8	0.722		0.521
SLD_5	0.716		0.455
SLD_12	0.689		0.512
SLD_9	0.684		0.564
SLD_3	0.679		0.544
SLD_7	0.658		0.542
SLD_2	0.603		0.556
SLD_6	0.546		0.691
SLD_17		0.870	0.271
SLD_13		0.823	0.334
SLD_15		0.767	0.470
SLD_14		0.661	0.504
SLD_18		0.652	0.522

Note. Applied rotation method is promax.

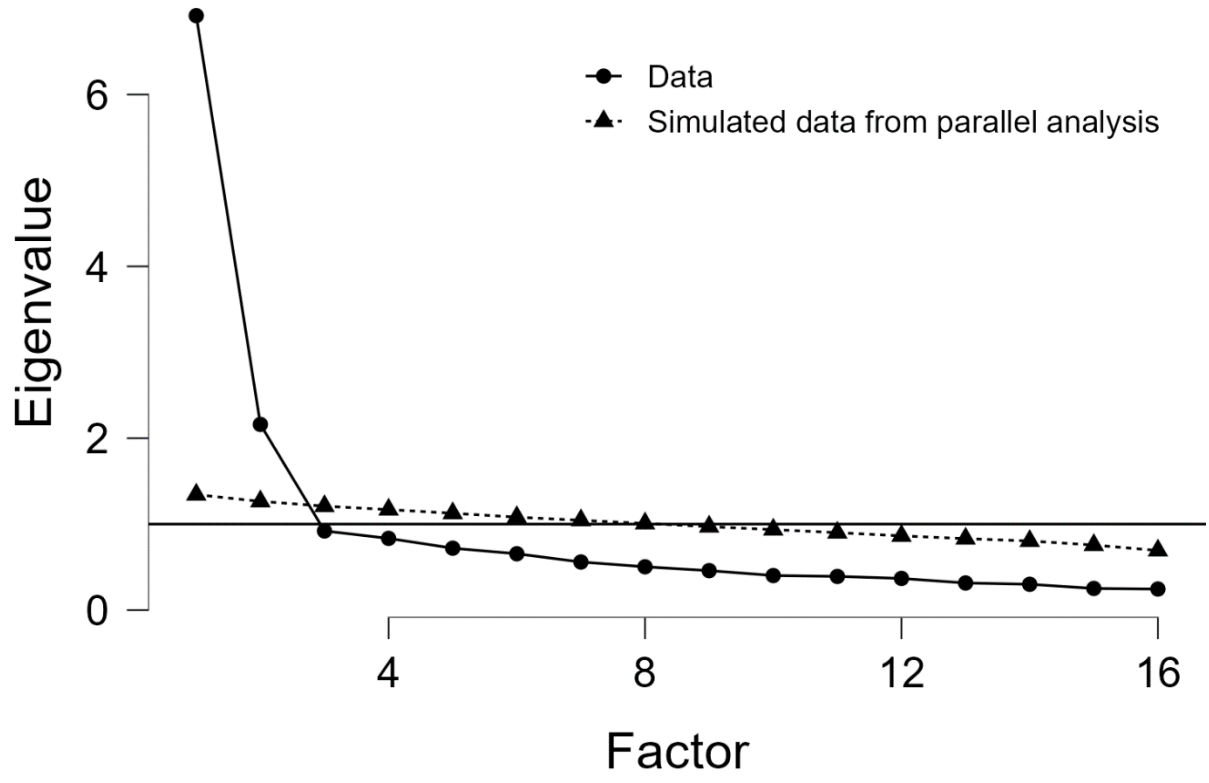
Factor Characteristics

	Unrotated solution			Rotated solution		
	SumSq. Loadings	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Factor 1	6.431	0.402	0.402	5.243	0.328	0.328
Factor 2	1.731	0.108	0.510	2.919	0.182	0.510

Factor Correlations

	Factor 1	Factor 2
Factor 1	1.000	0.518
Factor 2	0.518	1.000

Scree plot



A two-factor model is produced, explaining 51.0% of the variance. All items load on a factor with a loading above .40.

ACTION: Interpret factors.

Factor 1: Dyslexia-Dysgraphia (reading-writing impairment)

Factor 2: Dyscalculia (mathematical impairment)

ACTION: Test in CFA

SLDQ-A; Two-factor lower-order

χ2	***df***	***p-value***	***S-B correction***	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
329.824	103	$p < .001$	1.370	.918	.904	.071 [0.063, 0.078]	.050

Conclusion: The revised model of the SLDQ-A still has a good level of structural validity. The CFI, TLI and SRMR has improved slightly.

ACTION: Run modification indices with a minimum $\Delta \chi^2$ of at least 10.82, $df = 1$, $p < .001$, and a standardised expected parameter change on all variables of .50 or greater (Whittaker, 2012).

	lhs	op	rhs	mi	epc	sepc.lv	sepc.all	sepc.nox
72	SLD_4	~~	SLD_3	86.453	0.451	0.451	0.505	0.505
83	SLD_10	~~	SLD_12	48.300	0.262	0.262	0.377	0.377
145	SLD_7	~~	SLD_6	42.039	0.237	0.237	0.330	0.330
68	SLD_4	~~	SLD_8	28.112	-0.241	-0.241	-0.288	-0.288
167	SLD_13	~~	SLD_14	15.510	0.250	0.250	0.259	0.259
130	SLD_9	~~	SLD_6	15.378	0.152	0.152	0.199	0.199
53	SLD_1	~~	SLD_10	14.858	-0.158	-0.158	-0.212	-0.212
164	SLD_17	~~	SLD_14	14.766	-0.235	-0.235	-0.275	-0.275
86	SLD_10	~~	SLD_7	12.758	-0.132	-0.132	-0.192	-0.192
124	SLD_12	~~	SLD_15	11.863	0.126	0.126	0.182	0.182

SLD_4 and SLD_3 met these criteria, suggesting a correlated residual pair. It made theoretical sense to correlate these items as they both reflected increased mental effort when reading.

ACTION: Include correlated residual pair between SLD_4 and SLD_3 in the model.

SLDQ-A; Two-factor lower-order with correlated residual.

χ2	***df***	***p-value***	***S-B correction***	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
268.655	102	$p < .001$	1.360	.939	.929	.061 [0.053, 0.069]	.046

Conclusion: This revised model of the SLDQ-A has better structural validity with improved CFI, TLI, and SRMR.

ACTION: Accept model, and test criterion validity of this structure. See Supplementary Material X2.

Supplementary Material M2

Motor Tic, Obsessions and Compulsions, Vocal Tic Evaluation Survey (MOVES)

Structural Validity

MOVES; Three-factor lower-order

χ2	*df*	*p-value*	*S-B correction*	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
202.193	51	$p < .001$	1.790	.851	.808	.082 [0.073, 0.091]	.076

Conclusion: MOVES has mediocre structural validity.

ACTION: Run initial reliability and EFA on MOVES to find unique solution.

Frequentist Scale Reliability Statistics

Estimate	McDonald's ω	Cronbach's α
Point estimate	0.918	0.914
95% CI lower bound	0.906	0.902
95% CI upper bound	0.929	0.925

Frequentist Individual Item Reliability Statistics

	If item dropped		
Item	McDonald's ω	Cronbach's α	Item-rest correlation
MOVES_1	0.908	0.904	0.705
MOVES_2	0.908	0.905	0.697
MOVES_3	0.908	0.905	0.698
MOVES_4	0.918	0.916	0.418
MOVES_5	0.907	0.904	0.720
MOVES_6	0.907	0.904	0.728
MOVES_7	0.911	0.907	0.648
MOVES_8	0.912	0.908	0.635
MOVES_9	0.911	0.907	0.657
MOVES_10	0.914	0.910	0.567
MOVES_11	0.911	0.908	0.656
MOVES_12	0.909	0.904	0.708

All items had item-rest correlations above .30.

ACTION: Retain all items in EFA.

Exploratory Factor Analysis

Use EFA with parallel analysis based on factor analysis as the criteria of factor retention. Use Promax rotation method.

Kaiser-Meyer-Olkin test

	MSA
Overall MSA	0.912
MOVES_1	0.855
MOVES_2	0.899
MOVES_3	0.911
MOVES_4	0.954
MOVES_5	0.950
MOVES_6	0.909
MOVES_7	0.920
MOVES_8	0.946
MOVES_9	0.869
MOVES_10	0.905
MOVES_11	0.942
MOVES_12	0.927

Bartlett's test

X^2	df	p
3024.470	66.000	< .001

Chi-squared Test

	Value	df	p
Model	72.615	33	< .001

Factor Loadings

	Factor 1	Factor 2	Factor 3	Uniqueness
MOVES_1	1.013			0.149
MOVES_2	0.873			0.269
MOVES_3	0.794			0.328
MOVES_5	0.631			0.383
MOVES_7		0.960		0.344
MOVES_6		0.787		0.330
MOVES_11		0.716		0.466
MOVES_8		0.628		0.500
MOVES_9			1.083	0.089

Factor Loadings

	Factor 1	Factor 2	Factor 3	Uniqueness
MOVES_10		0.496		0.578
MOVES_12		0.440		0.403
MOVES_4				0.797

Note. Applied rotation method is promax.

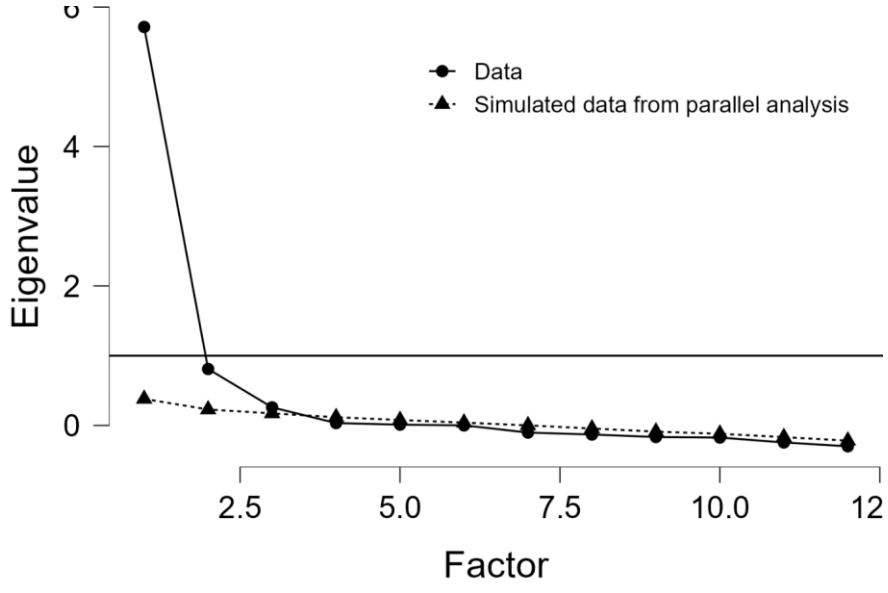
Factor Characteristics

	Unrotated solution			Rotated solution		
	SumSq. Loadings	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Factor 1	5.861	0.488	0.488	2.874	0.240	0.240
Factor 2	1.008	0.084	0.572	2.824	0.235	0.475
Factor 3	0.494	0.041	0.614	1.666	0.139	0.614

Factor Correlations

	Factor 1	Factor 2	Factor 3
Factor 1	1.000	0.685	0.600
Factor 2	0.685	1.000	0.755
Factor 3	0.600	0.755	1.000

Scree plot



A three-factor model is produced, explaining 61.4% of the variance. All items load on a factor with a loading above .40, however, MOVES_4 does not load on any factor. The third factor only just passes the third simulated eigenvalue. Furthermore, there are Heywood cases in factors 1 and 3.

ACTION: Remove MOVES_4 and force a two-factor solution.

Kaiser-Meyer-Olkin test

	MSA
Overall MSA	0.908
MOVES_1	0.853
MOVES_2	0.897
MOVES_3	0.909
MOVES_5	0.948
MOVES_6	0.908
MOVES_7	0.915
MOVES_8	0.950
MOVES_9	0.864
MOVES_10	0.900
MOVES_11	0.942
MOVES_12	0.923

Bartlett's test

X^2	df	p
2928.733	55.000	< .001

Chi-squared Test

	Value	df	p
Model	179.737	34	< .001

Factor Loadings

	Factor 1	Factor 2	Uniqueness
MOVES_7	0.797		0.438
MOVES_6	0.778		0.350
MOVES_9	0.743		0.462
MOVES_12	0.725		0.409
MOVES_8	0.702		0.510
MOVES_10	0.622		0.612
MOVES_11	0.589		0.520
MOVES_1		0.991	0.154
MOVES_2		0.864	0.269

Factor Loadings

	Factor 1	Factor 2	Uniqueness
MOVES_3	0.776		0.329
MOVES_5	0.620		0.380

Note. Applied rotation method is promax.

Factor Characteristics

	Unrotated solution			Rotated solution		
	SumSq. Loadings	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Factor 1	5.624	0.511	0.511	3.716	0.338	0.338
Factor 2	0.944	0.086	0.597	2.851	0.259	0.597

Factor Correlations

	Factor 1	Factor 2
Factor 1	1.000	0.681
Factor 2	0.681	1.000

A two-factor model is produced, explaining 59.7% of the variance. All items load on a factor with a loading above .40.

ACTION: Interpret factors

Factor 1: Verbal Tics/Echolalia

Factor 2: Motor Tics

ACTION: Test in CFA

MOVES; Two-factor lower-order

χ2	***df***	***p-value***	***S-B correction***	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
133.564	43	$p < .001$	1.726	.902	.874	.069 [0.059, 0.079]	.048

Conclusion: The revised model of the MOVES has improved CFI, TLI and SRMR. Although the RMSEA is less than ideal.

ACTION: Run modification indices with a minimum $\Delta \chi^2$ of at least 10.82, $df = 1$, $p < .001$, and a standardised expected parameter change on all variables of .50 or greater (Whittaker, 2012).

	lhs	op	rhs	mi	epc	sepc.lv	sepc.all	sepc.nox
82	MOVES_9	~~	MOVES_12	43.270	0.098	0.098	0.381	0.381
84	MOVES_9	~~	MOVES_10	40.666	0.083	0.083	0.343	0.343
36	verbal_tics_and_echolalia	=~	MOVES_5	26.786	0.417	0.217	0.276	0.276
33	verbal_tics_and_echolalia	=~	MOVES_1	19.267	-0.318	-0.165	-0.205	-0.205
72	MOVES_7	~~	MOVES_9	17.782	-0.056	-0.056	-0.240	-0.240
76	MOVES_7	~~	MOVES_11	15.895	0.042	0.042	0.224	0.224
41	MOVES_1	~~	MOVES_6	15.882	-0.038	-0.038	-0.259	-0.259
85	MOVES_9	~~	MOVES_11	15.651	-0.044	-0.044	-0.220	-0.220
71	MOVES_7	~~	MOVES_6	13.381	0.043	0.043	0.227	0.227
78	MOVES_6	~~	MOVES_12	12.739	-0.047	-0.047	-0.226	-0.226
37	MOVES_1	~~	MOVES_2	11.489	0.050	0.050	0.334	0.334

Conclusion: No modification indices met these criteria.

ACTION: Retain structure of previous model.

Supplementary Material N2

Pathological Demand Avoidance Questionnaire - Adult (PDAQ-A) Structural Validity.

EDA-QA; One-factor lower-order

χ2	*df*	*p-value*	*S-B correction*	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
1001.806	299	$p < .001$	1.261	.675	.646	.073 [0.069, 0.078]	.080

Conclusion: The one-factor PDAQ-A is not structurally valid.

ACTION: Test two-factor model from validation study.

EDA-QA; Two-factor lower-order

χ2	*df*	*p-value*	*S-B correction*	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
620.445	208	$p < .001$	1.317	.751	.724	.067 [0.062, 0.072]	.072

Conclusion: The two-factor PDAQ-A is not structurally valid.

ACTION: Run initial reliability analysis and EFA on the PDAQ-A items to find unique solution.

Scale Reliability Statistics

	Cronbach's α	McDonald's ω
scale	0.869	0.879

Item Reliability Statistics

		If item dropped	
	Item-rest correlation	Cronbach's α	McDonald's ω
PDA_1	0.3811	0.865	0.876
PDA_2	0.5082	0.862	0.872
PDA_3	0.4899	0.862	0.873
PDA_4	0.3507	0.866	0.877
PDA_5	0.4589	0.864	0.874
PDA_6	0.5815	0.859	0.871

Item Reliability Statistics

		If item dropped	
	Item-rest correlation	**Cronbach's α**	**McDonald's ω**
PDA_7	0.5356	0.862	0.871
PDA_8	0.5879	0.860	0.870
PDA_9	0.4428	0.863	0.875
PDA_10	0.3668	0.866	0.876
PDA_11	0.3965	0.865	0.875
PDA_12	0.4906	0.862	0.874
PDA_13	0.4501	0.865	0.874
PDA_14	0.4916	0.862	0.873
PDA_15	0.4838	0.862	0.874
PDA_16	0.4228	0.864	0.875
PDA_17	0.2977	0.867	0.878
PDA_18	0.4241	0.864	0.876
PDA_19	0.4827	0.863	0.873
PDA_20	0.4435	0.863	0.874
PDA_21	0.5255	0.861	0.873
PDA_22	0.1098	0.874	0.882
PDA_23	0.0728	0.875	0.883
PDA_24	0.4652	0.863	0.874
PDA_25	0.4695	0.863	0.874
PDA_26	0.4647	0.863	0.874

All items had item-rest correlations above .30, except for PDA_17, PDA_22, and PDA_23. PDA_17 only just has item-rest correlation below .30, so we chose to retain that item and remove PDA_22 and PDA_23

ACTION: Remove PDA_22 and PDA_23. Rerun analysis.

Scale Reliability Statistics

	Cronbach's α	**McDonald's ω**
scale	0.882	0.887

Item Reliability Statistics

		If item dropped	
	Item-rest correlation	Cronbach's α	McDonald's ω
PDA_1	0.369	0.880	0.885
PDA_2	0.516	0.876	0.881
PDA_3	0.481	0.877	0.882
PDA_4	0.320	0.881	0.886
PDA_5	0.458	0.878	0.882
PDA_6	0.599	0.873	0.879
PDA_7	0.533	0.876	0.880
PDA_8	0.615	0.874	0.878
PDA_9	0.466	0.877	0.883
PDA_10	0.360	0.881	0.885
PDA_11	0.431	0.878	0.884
PDA_12	0.471	0.877	0.883
PDA_13	0.456	0.879	0.882
PDA_14	0.497	0.877	0.882
PDA_15	0.503	0.876	0.882
PDA_16	0.427	0.878	0.884
PDA_17	0.328	0.881	0.886
PDA_18	0.435	0.878	0.884
PDA_19	0.475	0.877	0.882
PDA_20	0.479	0.877	0.882
PDA_21	0.492	0.877	0.882
PDA_24	0.459	0.878	0.883
PDA_25	0.481	0.877	0.883
PDA_26	0.472	0.877	0.883

All items had item-rest correlations above .30.

ACTION: Retain the items in an EFA.

Bartlett's Test of Sphericity

χ^2	df	p
3100	276	< .001

KMO Measure of Sampling Adequacy

	MSA
Overall	0.897
PDA_1	0.853
PDA_2	0.925
PDA_3	0.882
PDA_4	0.869
PDA_5	0.917
PDA_6	0.935
PDA_7	0.908
PDA_8	0.929
PDA_9	0.906
PDA_10	0.845
PDA_11	0.890
PDA_12	0.831
PDA_13	0.918
PDA_14	0.933
PDA_15	0.906
PDA_16	0.900
PDA_17	0.850
PDA_18	0.877
PDA_19	0.941
PDA_20	0.877
PDA_21	0.915
PDA_24	0.868
PDA_25	0.867
PDA_26	0.913

Conclusion: Bartletts and KMO both indicate factorability of items.

Factor Loadings

	Factor						
	1	**2**	**3**	**4**	**5**	**6**	**Uniqueness**
PDA_7	0.816						0.406
PDA_5	0.564						0.640
PDA_13	0.560						0.636
PDA_19	0.480						0.678
PDA_14							0.684
PDA_12		1.008					0.243
PDA_3		0.624					0.539
PDA_16		0.500					0.598
PDA_11			0.678				0.587
PDA_17			0.536				0.743
PDA_2			0.478				0.582
PDA_8							0.511
PDA_6							0.560
PDA_9							0.709
PDA_20				0.850			0.407
PDA_18				0.528			0.586
PDA_15				0.430			0.580
PDA_24					0.725		0.492
PDA_25					0.691		0.438
PDA_21					0.399		0.601
PDA_26							0.698
PDA_10						0.690	0.500
PDA_1						0.598	0.546
PDA_4							0.664

Note. 'Principal axis factoring' extraction method was used in combination with a 'promax' rotation

Summary

Factor	**SS Loadings**	**% of Variance**	**Cumulative %**
1	2.29	9.55	9.55
2	2.01	8.37	17.92

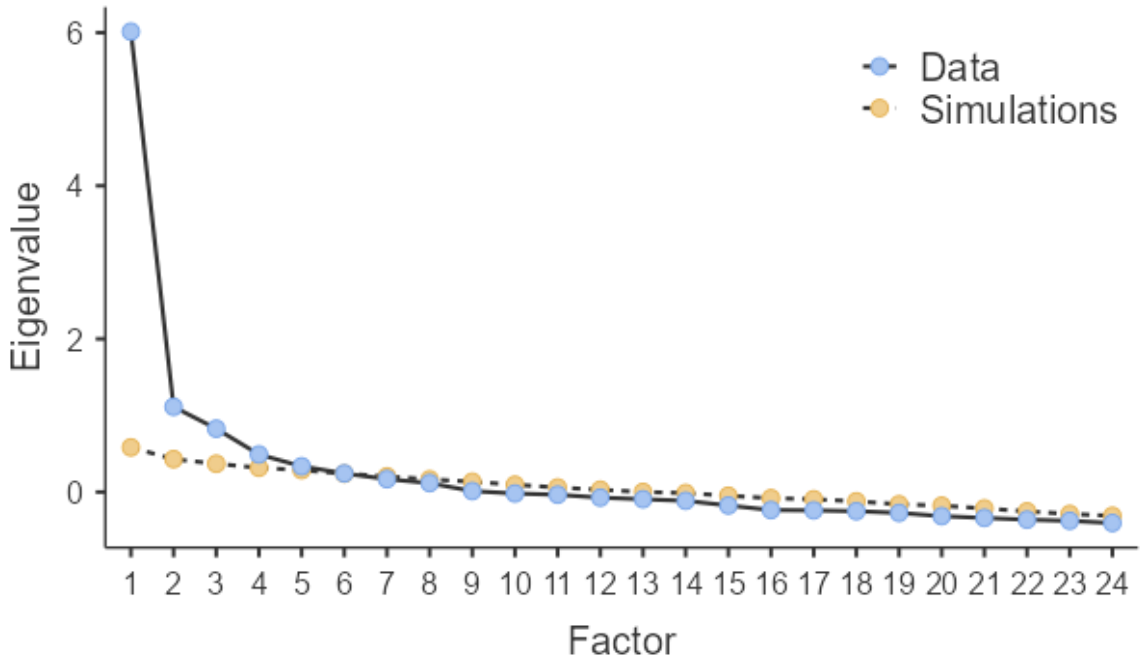
Summary

Factor	SS Loadings	% of Variance	Cumulative %
3	1.69	7.03	24.95
4	1.64	6.84	31.79
5	1.44	6.02	37.81
6	1.30	5.41	43.22

Inter-Factor Correlations

	1	2	3	4	5	6
1	—	0.584	0.631	0.418	0.421	0.483
2		—	0.529	0.489	0.454	0.294
3			—	0.552	0.367	0.400
4				—	0.611	0.267
5					—	0.257
6						—

Scree Plot



A six-factor model is produced, explaining 43.22% of the variance. All items load on a factor with a loading on above .40, except PDA_4, PDA_6, PDA_8, PDA_9, PDA_14, and PDA_26, which do not load on any factor. There is also a Heywood case in factor 2. The scree plot indicates that three factors are suitable to retain as they are above the scree point.

ACTION: Force a three-factor solution. Leave in items that do not load on any factor for now, as they may load on a factor in a forced solution.

Factor Loadings

	Factor			
	1	**2**	**3**	**Uniqueness**
PDA_7	0.651			0.506
PDA_1	0.637			0.670
PDA_4	0.605			0.700
PDA_10	0.580			0.692
PDA_5	0.507			0.682
PDA_2	0.501			0.645
PDA_13	0.455			0.696
PDA_14	0.400			0.692
PDA_19				0.716
PDA_8				0.557
PDA_25		0.692		0.596
PDA_18		0.675		0.635
PDA_20		0.658		0.610
PDA_15		0.491		0.620
PDA_11		0.434		0.715
PDA_6		0.425		0.581
PDA_26		0.410		0.727
PDA_24				0.731
PDA_9				0.741
PDA_21				0.696
PDA_17				0.832
PDA_12			0.829	0.374
PDA_3			0.660	0.527
PDA_16			0.483	0.690

Note. 'Principal axis factoring' extraction method was used in combination with a 'promax' rotation

Summary

Factor	SS Loadings	% of Variance	Cumulative %
1	3.11	12.95	12.9
2	3.08	12.82	25.8
3	2.19	9.11	34.9

Inter-Factor Correlations

	1	2	3
1	—	0.590	0.446
2		—	0.494
3			—

A three-factor model is produced, explaining 34.9% of the variance. All items load on a factor with a loading on above .40, except PDA_8, PDA_9, PDA_17, PDA_19, PDA_21, and PDA_24, which do not load on any factor.

ACTION: Systematically delete items with loadings below .40, from lowest to highest.

Remove PDA_17

Remove PDA_8 (equal cross-loading)

Remove PDA_9

Remove PDA_11

Remove PDA_6

Factor Loadings

	Factor			
	1	2	3	Uniqueness
PDA_1	0.687			0.619
PDA_7	0.644			0.499
PDA_10	0.622			0.670
PDA_4	0.559			0.700
PDA_5	0.520			0.664

Factor Loadings

	Factor			
	1	**2**	**3**	**Uniqueness**
PDA_2	0.480			0.691
PDA_13	0.426			0.704
PDA_19	0.422			0.697
PDA_14	0.402			0.697
PDA_25		0.755		0.517
PDA_18		0.672		0.617
PDA_20		0.563		0.676
PDA_15		0.437		0.639
PDA_21		0.430		0.665
PDA_24		0.421		0.713
PDA_26		0.415		0.721
PDA_12			0.823	0.381
PDA_3			0.630	0.545
PDA_16			0.573	0.661

Note. 'Principal axis factoring' extraction method was used in combination with a 'promax' rotation

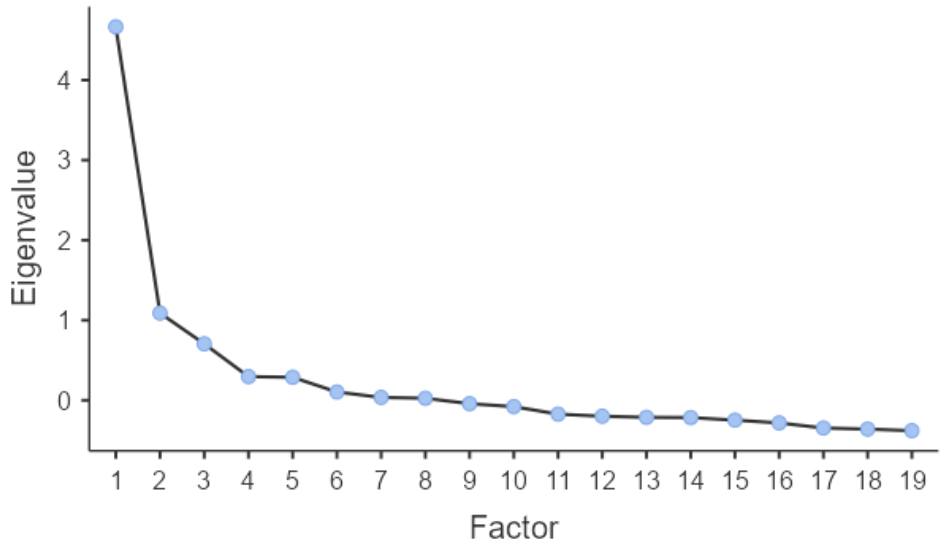
Summary

Factor	**SS Loadings**	**% of Variance**	**Cumulative %**
1	2.69	14.2	14.2
2	2.29	12.1	26.2
3	1.94	10.2	36.4

Inter-Factor Correlations

	1	**2**	**3**
1	—	0.511	0.503
2		—	0.516
3			—

Scree Plot



A three-factor model is produced, explaining 36.4% of the variance. All items load on a factor with a loading on above .40,

ACTION: Interpret factors

Factor 1: Domineering Demand Avoidance.

Factor 2: Detached Demand Avoidance.

Factor 3: Reactivity to Demands.

ACTION: Test in CFA.

EDA-QA; Three-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
351.105	149	$p < .001$	1.259	.860	.839	.056 [0.049, 0.062]	.061

Conclusion: The revised model of the PDAQ-A has a substantial improvement in the CFI, TLI and SRMR, though it just falls short of specified cut-offs (i.e., CFI > .90).

ACTION: Run modification indices with a minimum $\Delta \chi^2$ of at least 10.82, df =1, p < .001, and a standardised expected parameter change on all variables of .50 or greater (Whittaker, 2012).

	lhs	op	rhs	mi	epc	sepc.lv	sepc.all	sepc.nox
84	PDA_1	~~	PDA_10	56.308	0.243	0.243	0.384	0.384
213	PDA_25	~~	PDA_24	28.018	0.159	0.159	0.309	0.309
218	PDA_18	~~	PDA_20	21.771	0.194	0.194	0.253	0.253
79	reactivity	=~	PDA_15	18.640	0.426	0.348	0.307	0.307
228	PDA_20	~~	PDA_24	16.353	-0.128	-0.128	-0.219	-0.219
58	detached	=~	PDA_4	15.306	-0.318	-0.219	-0.265	-0.265
202	PDA_14	~~	PDA_15	14.100	0.119	0.119	0.196	0.196
67	reactivity	=~	PDA_1	13.881	-0.235	-0.192	-0.238	-0.238
230	PDA_20	~~	PDA_12	13.802	-0.134	-0.134	-0.229	-0.229
76	reactivity	=~	PDA_25	12.896	-0.323	-0.264	-0.249	-0.249
69	reactivity	=~	PDA_10	12.131	-0.278	-0.227	-0.225	-0.225
238	PDA_15	~~	PDA_16	11.094	0.113	0.113	0.175	0.175

Conclusion: No modification indices met these criteria.

ACTION: Retain structure of previous model.

Supplementary Material O2

Adult Concentration Inventory (ACI) Structural Validity.

ACI; One-factor lower-order

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
470.078	35	$p < .001$	1.336	.869	.832	.168 [0.157, 0.180]	.079

Conclusion: The ACI has mediocre structural validity, especially considering the inadequate RMSEA statistic.

ACTION: Run modification indices with a minimum $\Delta \chi^2$ of at least 10.82, $df = 1$, $p < .001$, and a standardised expected parameter change on all variables of .50 or greater (Whittaker, 2012).

	lhs	op	rhs	mi	epc	sepc.lv	sepc.all	sepc.nox
33	ACI_2	~~	ACI_5	172.598	0.385	0.385	0.664	0.664
41	ACI_3	~~	ACI_6	118.457	0.240	0.240	0.593	0.593
28	ACI_1	~~	ACI_8	91.740	0.194	0.194	0.578	0.578
62	ACI_7	~~	ACI_9	73.725	0.208	0.208	0.460	0.460
51	ACI_4	~~	ACI_10	67.434	0.197	0.197	0.436	0.436
26	ACI_1	~~	ACI_6	38.398	-0.137	-0.137	-0.343	-0.343
59	ACI_6	~~	ACI_9	34.960	0.139	0.139	0.321	0.321
29	ACI_1	~~	ACI_9	28.292	-0.120	-0.120	-0.300	-0.300
30	ACI_1	~~	ACI_10	24.756	0.122	0.122	0.268	0.268
60	ACI_6	~~	ACI_10	23.156	-0.123	-0.123	-0.251	-0.251
66	ACI_9	~~	ACI_10	20.502	-0.118	-0.118	-0.239	-0.239
27	ACI_1	~~	ACI_7	19.035	-0.099	-0.099	-0.238	-0.238
45	ACI_3	~~	ACI_10	17.155	-0.101	-0.101	-0.220	-0.220
58	ACI_6	~~	ACI_8	14.407	-0.079	-0.079	-0.219	-0.219
44	ACI_3	~~	ACI_9	14.332	0.085	0.085	0.210	0.210
24	ACI_1	~~	ACI_4	14.264	0.079	0.079	0.214	0.214
39	ACI_3	~~	ACI_4	13.943	-0.077	-0.077	-0.208	-0.208
64	ACI_8	~~	ACI_9	12.814	-0.077	-0.077	-0.210	-0.210
61	ACI_7	~~	ACI_8	12.408	-0.075	-0.075	-0.200	-0.200

ACI_2 and ACI_5; ACI_3 and ACI_6; and ACI_1 and ACI_8 met these criteria, suggesting correlated residual pairs. It made theoretical sense to correlate these items as the first pair reflected tiredness; the second reflected losing train of thought; and the third reflected "zoning out"

ACTION: Include correlated residual pairs in the model.

ACI; One-factor lower-order with correlated residuals

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
190.255	32	$p < .001$	1.283	.952	.933	.106 [0.093, 0.119]	.053

Conclusion: The ACI with correlated residuals has good structural validity, with improvements in CFI, TLI, RMSEA, and SRMR. However, the RMSEA is still below specified cut-offs.

ACTION: Retain structure of model.

Supplementary Material P2

Perth Emotion Regulation Competency Inventory (PERCI) Structural Validity.

PERCI; Four-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
188.469	98	$p < .001$	1.267	.982	.978	.046 [0.037, 0.055]	.039

Conclusion: The PERCI has excellent structural validity.

ACTION: Retain structure of model.

Supplementary Material Q2

Depression, Anxiety, and Stress Scale – 21 (DASS21) Structural Validity.

DASS21; Three-factor lower-order

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
487.328	167	$p < .001$	1.197	.922	.911	.066 [0.060, 0.072]	.065

Conclusion: The three-factor model of the DASS21 has good structural validity.

ACTION: Retain structure of model.

Supplementary Material R2

National Stressful Events Survey PTSD Short Scale (NSESSS) Structural Validity.

NSESSS; One-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
85.452	27	$p < .001$	1.269	.972	.963	.070 [0.056, 0.085]	.034

Conclusion: The one-factor model of the NSESSS has good structural validity, though the RMSEA is less-than-ideal. Modification indices do not substantially improve structural validity.

ACTION: Retain structure of model.

Supplementary Material S2

Dimensional Obsessive-Compulsive Scale – Short Form (DOCS-SF) Structural Validity.

DOCS-SF; One-factor lower-order

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
16.629	5	p = .005	1.606	.993	.985	.073 [0.043, 0.104]	.020

Conclusion: The one-factor model of the DOCS-SF has good structural validity, though the RMSEA is less-than-ideal. Modification indices do not substantially improve structural validity.

ACTION: Retain structure of model.

Supplementary Material T2

Schizotypal Personality Questionnaire – Brief Revised (SPQ-BR) Structural Validity.

SPQ-BR; Nine-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
854.501	428	$p < .001$	1.087	.945	.936	.048 [0.043, 0.052]	.053

Conclusion: The nine-factor model of the DOCS has excellent structural validity.

ACTION: Retain structure of model.

Supplementary Material U2

Brief Dissociative Experiences Scale (DES-B) Structural Validity.

DES-B; One-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
60.024	20	$p < .001$	1.228	.943	.920	.067 [0.050, 0.085]	.046

Conclusion: The one-factor model of the DES-B has good structural validity.

ACTION: Retain structure of model.

Supplementary Material V2

Adult Self-Report of ODD Symptoms, DSM-5 (ASROS-5) Structural Validity.

ASROS-5; One-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
95.881	20	p = .014	1.244	.875	.910	.093 [0.077, 0.110]	.052

Conclusion: The one-factor model of the ASROS-5 has mediocre structural validity; however, no other modifications would render the model more valid.

ACTION: Retain structure of model.

Supplementary Material W2

Displaced Aggression Questionnaire - Short (DAQ-S) Structural Validity.

Displaced Aggression Questionnaire – Short (DAQ-S); Three-factor lower-order

χ2	***df***	***p-value***	***S-B* correction**	***CFI***	***TLI***	***RMSEA [90% CI lower, upper]***	***SRMR***
50.824	24	p = .001	1.419	.990	.984	.050 [0.034, 0.067]	.028

Conclusion: The three-factor model of the DAQ-S has excellent structural validity.

ACTION: Retain structure of model.

Supplementary Material X2

World Health Organisation Disability Assessment Scale 2.0 - 12-item Version

(WHODAS 2.0-12) Structural Validity

WHODAS 2.0-12; One-factor lower-order

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
390.369	54	$p < .001$	1.324	.841	.806	.119 [0.109, 0.129]	.076

Conclusion: The one-factor model of the WHODAS 2.0-12 has mediocre structural validity.

ACTION: Run modification indices with a minimum $\Delta \chi^2$ of at least 10.82, $df = 1$, $p < .001$, and a standardised expected parameter change on all variables of .50 or greater (Whittaker, 2012).

	lhs	op	rhs	mi	epc	sepc.lv	sepc.all	sepc.nox
82	WHO_8	~~	WHO_9	172.035	0.347	0.347	0.672	0.672
31	WHO_1	~~	WHO_7	82.626	0.367	0.367	0.454	0.454
59	WHO_4	~~	WHO_8	30.248	-0.236	-0.236	-0.286	-0.286
61	WHO_4	~~	WHO_10	28.908	0.277	0.277	0.287	0.287
62	WHO_4	~~	WHO_11	28.180	0.297	0.297	0.278	0.278
60	WHO_4	~~	WHO_9	27.977	-0.198	-0.198	-0.275	-0.275
35	WHO_1	~~	WHO_11	22.477	-0.214	-0.214	-0.241	-0.241
91	WHO_11	~~	WHO_12	18.367	0.192	0.192	0.231	0.231
89	WHO_10	~~	WHO_11	18.290	0.203	0.203	0.226	0.226
47	WHO_3	~~	WHO_4	16.503	0.183	0.183	0.220	0.220
44	WHO_2	~~	WHO_10	15.905	-0.158	-0.158	-0.221	-0.221
36	WHO_1	~~	WHO_12	14.076	-0.148	-0.148	-0.197	-0.197
57	WHO_4	~~	WHO_6	12.695	-0.180	-0.180	-0.188	-0.188
80	WHO_7	~~	WHO_11	12.522	-0.162	-0.162	-0.180	-0.180
58	WHO_4	~~	WHO_7	11.861	-0.171	-0.171	-0.177	-0.177
88	WHO_9	~~	WHO_12	11.387	-0.101	-0.101	-0.180	-0.180
85	WHO_8	~~	WHO_12	11.302	-0.116	-0.116	-0.179	-0.179

Conclusion: WHO_8 and WHO_9 met these criteria, suggesting correlated residual pairs. It made theoretical sense to correlate these items as the first pair reflected bodily maintenance (i.e., dressing and washing).

ACTION: Include correlated residual pairs in the model.

WHODAS 2.0-12; One-factor lower-order with correlated residuals.

χ2	*df*	*p-value*	*S-B* correction	*CFI*	*TLI*	*RMSEA [90% CI lower, upper]*	*SRMR*
246.34	53	$p < .001$	1.298	.909	.886	.091 [0.081, 0.101]	.064

Conclusion: The revised one-factor model of the WHODAS 2.0-12 has good structural validity, though the RMSEA is less-than-ideal.

ACTION: Retain structure of model.

Supplementary Material Y2

Specific Learning Disorder Questionnaire – Adult (SLDQ-A) Criterion Validity.

ROC Curve Analysis of the Specific Learning Disorder Questionnaire – Adult.

Model	Positive	Negative	AUC [95% CI LB, UB]	Std. error	Asymptotic sig.	Sensitivity (%)	Specificity (%)	Cut-off score
SLD – Formal diagnosis	25	415						
Reading-writing			.84 [.755, .917]	.041	$p < .001$	80.0	72.5	25.5
Mathematics			.82 [.736, .893]	.040	$p < .001$	80.0	72.0	13.5
Total score			.89 [.842, .936]	.024	$p < .001$	96.0	71.1	37.5
SLD – Self-identified	29	411						
Reading-writing			.71 [.622, .803]	.046	$p < .001$	69.0	70.6	24.5
Mathematics			.82 [.741, .900]	.041	$p < .001$	72.4	82.7	16.5
Total score			.81 [.758, .870]	.028	$p < .001$	93.1	61.6	33.5
SLD – Combined	54	386						
Reading-writing			.79 [.724, .853]	.033	$p < .001$	74.1	73.8	24.5
Mathematics			.84 [.783, .897]	.029	$p < .001$	79.6	75.9	13.5
Total score			.87 [.835, .912]	.020	$p < .001$	88.9	73.8	36.5

Note. Total N = 440. SLD = Specific learning disorder; AUC = Area under the curve; 95% CI = 95% confidence interval; LB = lower bound; UB = upper bound.

Conclusion: The total score of the SLDQ-A has a good level of criterion validity across all diagnostic groups (i.e., formal, self-identified, and combined), with the combined score having optimal levels of sensitivity and specificity.

ACTION: Accept model.

Supplementary Material Z2

Study Two Measure Means and Psychometrics.

Variable	Definition	*M*	*SD*	α	ω
CATI total score		129.5	33.7	.95	.95
Social-communication		62.4	18.1	.93	.93
Social Interactions	Avoidance and anhedonia towards social situations.	24.1	7.8	.93	.93
Communication Difficulties	Difficulty understanding social cues.	16.7	6.8	.89	.88
Social Camouflage	Attempts to mask/hide autistic tendencies.	21.6	7.4	.88	.88
Restricted and Repetitive Behaviours		67.1	18.8	.93	.93
Sensory Sensitivity	Over-sensitivity to sensory stimuli (e.g., smell).	21.9	7.7	.88	.88
Repetitive Behaviour	Repetitive interests, actions, and habits.	22.1	7.5	.86	.86
Cognitive Rigidity	Rigidity of thought and behaviour.	23.1	6.7	.85	.85
ASRS total score		54.1	14.6	.92	.92
Inattention	Difficulty with concentration and procrastination.	29.3	8.3	.90	.90
Motor Hyperactivity-impulsivity	Excessive motor activity (e.g., restlessness).	14.4	4.6	.79	.79
Verbal Hyperactivity-impulsivity	Excessive verbal activity (e.g., interrupting).	10.3	3.9	.82	.82
SLDQ-A total score		32.8	13.9	.91	.90
Reading-writing impairment	Difficulty understanding and producing written text.	21.7	10.1	.91	.91
Mathematics impairment	Difficulty understanding mathematical concepts.	11.1	5.9	.87	.87
MOVES-R total score		4.4	6.0	.92	.91
Verbal Tics/Echolalia	Repetitive/compulsive verbal outbursts and thoughts.	2.7	3.7	.88	.89
Motor Tics	Repetitive/compulsive motor actions (e.g., body jerks).	1.7	2.8	.90	.91
PDAQ-A-R total score		33.5	8.8	.79	.78
Domineering Demand Avoidance	Avoidance of demands via social control/dominance.	13.6	4.2	.73	.73
Reactivity to Demands	Hypersensitivity/emotionality to requests and demands.	14.6	4.5	.72	.75
Detached Demand Avoidance	Avoidance of demands via social detachment.	5.3	2.3	.70	.70
ACI total score	Pattern of sluggish thought and daydreaming.	17.5	7.6	.92	.92
PERCI-negative Composite total score		62.2	20.7	.93	.92
Negative-controlling Experience	Difficulty shifting negative emotionality to positive.	15.9	6.5	.89	.89
Negative-inhibiting Behaviour	Risky behaviour when feeling negative emotions.	12.1	6.5	.89	.89

Variable	Definition	*M*	*SD*	*α*	*ω*
Negative-activating Behaviour	Interference of negative emotions with task completion.	19.6	6.7	.94	.94
Negative-tolerating Emotion	Difficulty allowing and accepting negative emotions.	14.6	6.5	.89	.89
DASS21 total score		23.1	13.3	.93	.92
Depression	Negative mood (e.g., downhearted) and low motivation.	9.0	6.0	.91	.91
Anxiety	Worry, fear, and nervousness of everyday events.	5.7	4.7	.85	.85
Stress	General psychological tension (e.g., agitation).	8.4	4.8	.85	.85
NSESSS total score	Prolonged stress response after a traumatic event.	12.4	9.4	.91	.91
DOCS-SF total score	Obsessions (e.g., contamination) and compulsions.	10.1	6.8	.91	.91
SPQ-BR total score		93.8	23.2	.93	.92
Cognitive-perceptual		33.1	11.3	.89	.88
Ideas of Reference	Excessive belief that others watch/talk about oneself.	8.9	3.6	.85	.85
Suspiciousness	Excessive belief that others intend harm to oneself.	8.2	3.3	.80	.80
Magical Thinking	Tendency to hold superstitious beliefs (e.g., telepathy).	7.1	3.8	.86	.86
Unusual Perceptions	Distortions of perception (e.g., hearing voices).	9.0	4.0	.73	.73
Interpersonal		33.9	9.5	.89	.89
No Close Friends	Difficulty forming emotional connections with others.	10.1	3.9	.88	.88
Constricted Affect	Tendency to have a blunted emotional expression.	9.4	3.0	.72	.73
Social Anxiety	Fear and avoidance of social situations.	14.5	4.5	.89	.89
Disorganised		26.7	7.4	.87	.86
Eccentricity	Behaviour that does not conform to social norms.	13.0	4.5	.89	.89
Odd Speech	Tangential or disconnected speech	13.7	4.2	.84	.85
DES-B total score	Lapses in attention, memory, or identity.	10.2	6.8	.80	.80
ASROS-5 total score	Pattern of defiance to authority.	14.5	4.1	.84	.84
DAQ-S total score		22.8	10.9	.91	.88
Angry Rumination	Excessive repetition of angry thoughts about others.	11.6	5.7	.95	.95
Revenge Planning	Tendency to think about or plan revenge against others.	7.0	4.8	.91	.91
Displaced Aggression	Tendency to redirect anger onto other people.	6.2	4.2	.94	.94
WHODAS 2.0-12 total score	Difficulty completing everyday tasks (e.g., work).	13.7	9.9	.90	.90

Note. *M* = Mean, *SD* = Standard deviation, *α* = Cronbach's alpha, *ω* = McDonald's omega.

Supplementary Material AA2

LPA Model Comparison.

Compare tidyLPA solutions:

Model	Classes	AIC	BIC	CLC	KIC	AWE	ICL	LogLik	BLRT_val	BLRT_p	prob_min	prob_max	n_min	n_max	Entropy
1	1	7232.037	7281.079	7210.037	7247.037	7388.120	-7281.079	-3604.019			1.000	1.000	1.000	1.000	1.000
1	2	6301.927	6379.576	6265.612	6323.927	6550.539	-6426.491	-3131.963	944.111	0.010	0.952	0.958	0.480	0.520	0.843
1	3	5966.269	6072.525	5915.975	5995.269	6307.075	-6142.667	-2957.134	349.658	0.010	0.912	0.948	0.259	0.477	0.853
1	4	5859.886	5994.749	5795.580	5895.886	6292.918	-6090.166	-2896.943	120.383	0.010	0.864	0.928	0.057	0.411	0.847
1	5	5805.951	5969.422	5727.575	5848.951	6331.270	-6098.289	-2862.976	67.934	0.010	0.816	0.913	0.032	0.339	0.812
1	6	5821.858	6013.936	5729.405	5871.858	6439.467	-6184.303	-2863.929	-1.906	1.000	0.753	0.946	0.125	0.209	0.774
1	7	5742.775	5963.461	5636.387	5799.775	6452.534	-6120.458	-2817.387	93.083	0.010	0.737	0.949	0.027	0.218	0.806
1	8	5733.387	5982.680	5612.980	5797.387	6535.380	-6163.767	-2805.693	23.388	0.020	0.654	0.964	0.027	0.202	0.797
1	9	5734.126	6012.027	5599.759	5805.126	6628.294	-6178.123	-2799.063	13.261	0.337	0.750	0.954	0.025	0.216	0.816
1	10	5707.461	6013.969	5559.094	5785.461	6693.844	-6186.368	-2778.730	40.665	0.010	0.712	0.960	0.030	0.195	0.817

Best model according to AIC is Model 1 with 10 classes.
Best model according to BIC is Model 1 with 7 classes.
Best model according to CLC is Model 1 with 10 classes.
Best model according to KIC is Model 1 with 10 classes.
Best model according to AWE is Model 1 with 4 classes.
Best model according to ICL is Model 1 with 4 classes.
Best model according to LogLik is Model 1 with 10 classes.
Best model according to BLRT_val is Model NA with NA classes.
Best model according to BLRT_p is Model NA with NA classes.
Best model according to prob_min is Model NA with NA classes.
Best model according to prob_max is Model NA with NA classes.
Best model according to n_min is Model NA with NA classes.
Best model according to n_max is Model NA with NA classes.
Best model according to Entropy is Model NA with NA classes.

An analytic hierarchy process, based on the fit indices AIC, AWE, BIC, CLC, and KIC (Akogul & Erisoglu, 2017), suggests the best solution is Model 1 with 7 classes.