



Cluster analysis of autism spectrum disorder symptomatology: Qualitatively distinct subtypes or quantitative degrees of severity of a single disorder?



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ABSTRACT

The decision to collapse several related disorders into a single diagnosis of Autism Spectrum Disorder (ASD) generated significant controversy and debate. There has been mixed evidence as to whether various ASD subtypes are qualitatively distinct or if they exist on a spectrum of symptom severity. The present study conducted a two-step cluster analysis of major ASD symptoms in a sample of 147 young males with ASD aged between 6yr and 18yr with IQ > 70. Results indicated that a two-cluster solution (high and low severity of ASD symptomatology) was reliable and valid. Further, the construct of challenging behaviour was not a necessary component of the two-cluster solution, verifying the new conceptualisation of ASD. Further replication of these findings with other subsets of individuals with ASD is needed.

What this paper adds

- The ongoing clinical debate regarding the appropriate diagnostic classification protocol for Autism Spectrum Disorders (ASD) reflects confusion in the field. To help clarify this issue, Cluster Analytic techniques were used to form models of the diagnostic criteria for ASD in a sample of 147 young males with ASD. Results verified the recent DSM-5 model, excluding challenging behaviour as a major indicator of ASD. These findings assist in the accurate diagnosis and treatment planning for youth with ASD.

1. Introduction

In the prior edition of the *Diagnostic and Statistical Manual of Mental Disorders* (i.e., DSM-IV-TR) (APA, 2000), several qualitatively distinct but related conditions were described within the category of Pervasive Developmental Disorders. These were Autistic Disorder, Rett's Disorder, Childhood Disintegrative Disorder, Asperger's Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). The DSM-5 (APA, 2013) collapsed these disorders into a single dimensional diagnosis of Autism Spectrum Disorder (ASD), a decision that has been the subject of ongoing debate and controversy. Some review papers (e.g., Witwer & Lecavalier, 2008) argued that there was little qualitative distinction between the subtypes that were collapsed into ASD, while others (Tsai, 2013; Tsai & Ghaziuddin, 2014) took the opposite perspective, arguing that the subtypes were real and will likely return in a future revision of the DSM. These different perspectives argue for further investigation of differences in symptomatology across individuals with ASD, with the aim of testing for the presence of identifiable and valid subtypes of ASD. One statistical analytic

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procedure that can be of use in identifying underlying subgroups of symptoms in a sample is Cluster Analysis (CA: Aldenderfer & Blashfield, 1984).

Despite this ongoing controversy about the nature of ASD subtypes, only a few studies employing CA have been undertaken with variables representing ASD symptomatology. The results of these studies have been mixed, with one study supporting qualitatively distinct subtypes (Eaves, Ho, & Eaves, 1994), others supporting distinctions based upon cognitive ability (Prior et al., 1998; Stevens et al., 2000), and another supporting a quantitative spectrum of ASD severity in line with DSM-5 conceptualisations (Kamp-Becker et al., 2010). The present study sought to further investigate whether young males with ASD could be divided into qualitatively distinct subtypes or into a quantitative severity spectrum within a single ASD condition. To inform a series of CAs, a rationale for the types of characteristics representative of an ASD diagnosis needs to be established. Further, to validate the resulting cluster solutions, variables known to differ between ASD subtypes or severity levels are needed. The following sections detail these ASD symptomatology and validating variables.

1.1. ASD symptomatology

The core symptoms of ASD are understood to be characterised by deficits in social-communication ability and understanding, and restricted and repetitive patterns of behaviour. The DSM-IV-TR (APA, 2000) and DSM-5 (APA, 2013) broadly agreed on these core symptoms, but slightly differed in their conceptualisations of them. The DSM-IV-TR presented social interaction impairments as distinct from communication impairments, though aspects of both were necessary for a diagnosis of Autistic Disorder. In the DSM-5, social and communication impairments were combined into a single category of symptoms to improve the sensitivity and specificity of ASD diagnoses. Where there remains uncertainty is in regards to the importance of associated clinical features that are pervasive in individuals with ASD, such as sensory features (SF) or various aspects of challenging behaviour (CB) in childhood.

In children with ASD, SF (i.e., abnormalities in processing or responding to sensory input from the environment) are both qualitatively and quantitatively distinct from the SF of typically-developing children (e.g., Tomchek & Dunn, 2007), and various domains of CB such as irritability or hyperactivity are frequently elevated (Gabriels, Cuccaro, Hill, Ivers, & Goldson, 2005). Other domains of CB include lethargy, stereotypic behaviours, and inappropriate speech (Aman, Singh, Stewart, & Field, 1985). CB constitutes behavioural difficulties that may arise as a common associated feature of ASD (APA, 2000). The DSM-IV-TR also described various aspects of SF as a common associated feature of Autistic Disorder, while the DSM-5 has included SF in the diagnostic criteria for ASD. Thus, SF can be considered as an additional component of ASD symptomatology that is included alongside core ASD symptoms when trying to classify individuals into subgroups via CA. Additionally, as reviewed by DeBoth and Reynolds (2017), several recent studies have investigated whether, and to what degree, sensory-based subtypes of individuals with ASD can be identified. That systematic review found mixed results with respect to the qualitative characteristics of sensory subtypes, with studies supporting a varying number of subtypes and varying features of sensory responsivity. Consistent among several of the studies reviewed was the identification of degrees of severity of sensory impairment: a subset of individuals with ASD without clinically significant sensory impairment, and another subset of individuals with marked sensory impairments requiring intensive intervention, consistently emerged from the data. These patterns suggested a degree of heterogeneity amongst the clinical characteristics of sensory difficulties amongst individuals with ASD, but also suggested a need for further research into sensory-based subtypes. In their conclusion, DeBoth and Reynolds (2017) also noted a need to investigate how sensory-based subtypes relate to other aspects of the ASD phenotype (e.g., core social and behavioural symptoms of ASD). Further, they recommended CA as an analytic technique to subtype individuals.

Baker et al. (2008) and Lane et al. (2010) employed measures of adaptive behaviour as a means of investigating the extent that overall levels of CB relate to empirically-derived sensory-based subtypes of ASD. Results from these studies supported the presence of relationships between overall levels of CB and ASD subtypes, but highlighted the need for considering more specific domains of CB in relation to CA. Whether domains of CB can be considered as core aspects of ASD symptomatology in children is unclear, and CAs could be run with, and without, CB to determine whether any obtained cluster solution was more reliable when including the CB construct and its various domains.

1.2. Validation variables

CA solutions can be validated by their agreement with other variables that have previously been shown to identify differences in ASD subtypes and/or severity levels, and that process could be undertaken by reference to age, IQ, anxiety, and depression. Age has been identified as variant with both ASD subtypes and with ASD severity levels in two ways. First, current age is thought to be related to ASD symptom severity, such that symptoms typically abate over time as a result of intervention (Esbensen, Seltzer, Lam, & Bodfish, 2009; Helles, Gillberg, Gillberg, & Billstedt, 2015). Second, younger age at diagnosis is typically associated with greater symptom severity and with receiving a diagnosis of Autistic Disorder over Asperger's Disorder, because symptoms are more pronounced and noticeable to caregivers and clinicians (Mayes & Calhoun, 2004). Poorer cognitive ability (i.e., lower IQ) is associated with greater ASD symptom severity and may explain subtype distinctions (Mayes & Calhoun, 2011). Anxiety and depression are common in young individuals with ASD (Bitsika & Sharpley, 2014; MacNeil, Lopes, & Minnes, 2009; White, Oswald, Ollendick, & Scahill, 2009). Higher levels of anxiety are seen in individuals with more severe ASD symptoms and are interrelated with SF (Liss, Mailloux, & Erchull, 2008). The direction of the relationship between depression and ASD subtypes or severity is less clear, although depression is more prevalent in ASD samples than in their non-ASD peers (Bitsika & Sharpley, 2015). One study reported a greater incidence of depression in individuals with Autistic Disorder than those with PDD-NOS (Pearson et al., 2006) and another reported a positive

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