The latent structure of attention deficit/hyperactivity disorder in an adult sample

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ABSTRACT

The vast majority of studies that have examined the latent structure of attention deficit/hyperactivity disorder (ADHD) in children and adolescents have concluded that ADHD has a dimensional latent structure. In other words, ADHD symptomatology exists along a continuum and there is no natural boundary or qualitative distinction (i.e., taxon) separating youth with ADHD from those with subclinical inattention or hyperactivity/impulsivity problems. Although adult ADHD appears to be less prevalent than ADHD in youth (which could suggest a more severe adult ADHD taxon), researchers have yet to examine the latent structure of ADHD in adults. The present study used a sample ($N = 600$) of adults who completed a self-report measure of ADHD symptoms. The taxometric analyses revealed a dimensional latent structure for inattention, hyperactivity/impulsivity, and ADHD. These findings are consistent with previous taxometric studies that examined ADHD in children and adolescents, and with contemporary polygenic and multifactorial models of ADHD.

Attention deficit/hyperactivity disorder (ADHD) is one of the most prevalent psychiatric conditions, affecting roughly 8% of children and adolescents (CDC, 2005) and 4.4% of adults (Kessler et al., 2006) in the United States. Despite considerable advances in the diagnosis, treatment, and etiology of ADHD, a number of unresolved issues remain, including questions about (a) whether ADHD is the consequence of a single core deficit (e.g., Barkley, 1997) or whether multiple pathways can lead to ADHD (e.g., Sonuga-Barke, 2002), (b) how to understand the high comorbidity between ADHD and other externalizing disorders (e.g., Waschbusch, 2002), and (c) when symptoms of inattention and hyperactivity/impulsivity are sufficiently severe to warrant treatment and medication.

A clear understanding of the latent structure of ADHD can help inform many of these unresolved issues. In other words, knowing whether ADHD is a categorically distinct condition or "taxon" that is either present or absent (like Type 1 diabetes) or whether it is dimensional and exists on a continuum (like Type 2 diabetes), can inform questions of assessment, etiology, diagnosis, and treatment. In recent years a growing research literature has examined the latent structure of ADHD using a variety of statistical methods, including latent class analysis and Meehl's taxometric procedures (Waller and Meehl, 1998). Most (but not all) of these studies have yielded dimensional results. The findings from both Hudziak et al.'s (1998) and Neuman et al.'s (1999) latent class analyses of parent reports of adolescent symptoms suggested that these ADHD

symptoms were continuously distributed and not taxonic. Similarly, using factor mixture modeling (which combines latent class analysis with factor analysis) to analyze parent reports of child ADHD symptoms in a national registry sample of male twins, Lubke et al. (2009) concluded that ADHD symptoms are dimensional and that children with ADHD are at the far end of this continuum. In contrast, Todd et al. (2001) latent class analysis of data from adolescent female twins yielded findings that could be interpreted as supporting a taxonic latent structure.

Three studies have used Meehl's taxometric procedures to examine the latent structure of ADHD. Unlike latent class analysis, Meehl's taxometric procedures were specifically designed to test whether a construct has a taxonic or dimensional latent structure. Haslam et al. (2006) applied taxometric procedures to parent report data from two epidemiological samples. One sample consisted of children between the ages of 6 and 12, and the other was an adolescent sample (13–17). Their analyses yielded dimensional findings in both samples. Using parent and teacher reports as well as measures of cognitive ability, Frazier et al. (2007) examined the latent structure of each set of symptoms associated with ADHD (e.g., academic underachievement, sustained attention), as well as a combination of ADHD symptoms across these domains. Like Haslam et al., Frazier et al. found consistent evidence that both ADHD and its components had a dimensional latent structure. Most recently, Marcus and Barry (2011) used taxometric procedures to examine data from the NICHD Study of Early Child Care and Youth Development that were collected when the children were in third grade. This data set included parent reports, standardized tests of

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achievement, and laboratory measures. These taxometric analyses yielded dimensional results for inattention, hyperactivity/impulsivity, and ADHD as a whole.

All of these ADHD studies that have yielded dimensional findings have used child or adolescent samples and the primary indicators in most of these studies have been parent reports of child symptoms. Given that ADHD is classified as a disorder "usually first diagnosed in infancy, childhood, or adolescence" (DSM-IV-TR; American Psychological Association, 2000), the focus on child and adolescent samples is appropriate. However, considering that the prevalence rate for adult ADHD is roughly half that for children and adolescents, it is conceivable that child and adolescent samples include individuals who do not belong in a putative ADHD taxon, but who have transient symptoms of inattention or hyperactivity/impulsivity, which might create the illusion of continuity across the ADHD spectrum. Perhaps a taxometric study of ADHD using an adult sample might reveal an ADHD taxon that was obscured in these child and adolescent samples. On the other hand, a replication of these dimensional results in an adult sample would strengthen the conclusion that ADHD and its various components are dimensional across the lifespan. Furthermore, whereas these other studies relied primarily on parent reports and not self-reports, a taxometric analysis of self-reported adult ADHD symptoms would test whether these dimensional findings are robust across multiple assessment methods.

1. Materials and methods

1.1. Participants

1.1.1. Subjects

Six-hundred physically healthy subjects participated in this study. All subjects were systematically evaluated in regard to psychopathology as part of a larger program designed to study correlates of impulsive aggressive, and other personality-related, behaviors in human subjects. Subjects were recruited from clinical settings and through newspaper advertisements seeking out individuals who: a) reported psychosocial difficulty related to one or more Axis I and Axis II conditions (Axis I/II subjects: $n = 432$) or, b) had little evidence of psychopathology (Healthy Control subjects: $n = 168$). All subjects gave informed consent and signed the informed consent document approved by our Committee for the Protection of Human Subjects (IRB).

Of the subject group, 322 (53.7%) were male (mean ± sd for age = 35.3 ± 9.6 years; range: 18–65 years) and 278 (46.3%) were female (mean ± sd for age = 34.2 ± 10.0 years; range: 18–58 years). Three-hundred-thirty-five (55.8%) were Caucasian, 202 (33.7%) were African-American; the remaining 63 (10.5%) were self-identified as neither Caucasian nor African-American. Most subjects (60.3%) came from the upper middle two Hollingshead Socio-Economic Classes [I = 67 (11.2%); II = 243 (40.5%); III = 119 (19.8%); IV = 88 (14.7%); V = 83 (13.8%)].

1.1.2. Diagnostic assessment

Axis I and Axis II Personality Disorder diagnoses were made according to DSM-IV criteria (American Psychiatric Association, 1994). The diagnosis of Intermittent Explosive Disorder was made by Research Criteria as previously described (Coccaro, 2011). Diagnoses were made using information from: (a) the Structured Clinical Interview for DSM Diagnoses (SCID-I; First et al., 1997) for Axis I disorders and the Structured Interview for the Diagnosis of DSM Personality Disorder (SIDP-IV; Pfohl et al., 1997) for Axis II disorders; (b) clinical interview by a research psychiatrist; and, (c) review of all other available clinical data. Final diagnoses were assigned by team best-estimate consensus procedures (Leckman et al., 1982; Klein

et al., 1994) involving research psychiatrists and clinical psychologists as previously described (Coccaro et al., 2010). This methodology has previously been shown to enhance the accuracy of diagnosis over direct interview alone (Kosten and Rounsaville, 1992).

1.1.3. Diagnoses

Four-hundred-thirty-two subjects met DSM-IV criteria for an Axis I and/or II Disorder. Among this group, current Axis I disorders were as follows: Any Depressive Mood Disorder ($n = 71$); Any Anxiety Disorder ($n = 100$); Intermittent Explosive Disorder ($n = 207$); Other Impulse Control Disorder ($n = 11$); Substance Dependence Disorder ($n = 13$); Eating Disorder ($n = 18$); Somatoform Disorder ($n = 7$); Adjustment Disorder ($n = 7$); lifetime Axis I disorders were as follows: Any Depressive Mood Disorder ($n = 222$); Any Anxiety Disorder ($n = 142$); Intermittent Explosive Disorder ($n = 273$); Other Impulse Control Disorder ($n = 30$); Substance Dependence Disorder ($n = 153$); Eating Disorder ($n = 36$); Somatoform Disorder ($n = 7$); Adjustment Disorder ($n = 23$). Among the 363 subjects with an Axis II disorder 243 (67%) met DSM-IV criteria for a specific personality disorder as follows: a) Cluster A ($n = 58$): Paranoid ($n = 53$), Schizoid ($n = 5$), Schizotypal ($n = 1$); b) Cluster B ($n = 170$), Borderline ($n = 105$), Antisocial ($n = 68$); Narcissistic ($n = 66$); Histrionic ($n = 14$); c) Cluster C ($n = 108$): Obsessive-Compulsive ($n = 65$); Avoidant ($n = 46$); Dependent ($n = 5$). The remaining 120 (33%) of PD subjects were diagnosed as Personality Disorder-Not Otherwise Specified (PD-NOS). These subjects met DSM-IV General Diagnostic Criteria for Personality Disorder, had pathological personality traits from a variety of personality disorder categories and had clear evidence of impaired psychosocial functioning [Mean (±sd) Global Assessment of Function score = 60.6 ± 7.4]. By definition, healthy controls had no current or life history of any Axis I or II disorder.

1.2. Measure

The Self-Report Wender–Reimherr Adult Attention Deficit Disorder Scale (SR-WRAADDS; Reimherr et al., 2007) includes 18 items that correspond to the nine DSM-IV-TR inattention symptoms and the nine DSM-IV-TR hyperactivity/impulsivity symptoms. Responses are provided using a 4-point Likert-type scale ranging from 0 (never or rarely) to 3 (very often). The inattention scale was internally consistent ($\alpha = .88$) in the current sample, as was the hyperactivity/impulsivity scale ($\alpha = .86$), and the total ADHD score ($\alpha = .92$).

1.3. Taxometric data analysis

Three nonredundant taxometric procedures were used to analyze the current data: mean above minus mean below a cut (MAMBAC; Meehl and Yonce, 1994), maximum eigenvalue (MAX-EIG; Waller and Meehl, 1998), and latent mode (L-Mode; Waller and Meehl, 1998). The MAMBAC procedure requires two variables for analysis: an input and output indicator. The input indicator data are sorted along the x-axis and a series of cuts are made along this axis (50 in the current study). At each cut, the plotted y-value is the difference between the mean of the output values above the cut and the mean of those below the cut. If a taxon is present, the graph will have an inverse U-shape, with the highest point representing the taxon base rate. In contrast, when a dimensional construct is analyzed the graph is prototypically U-shaped. When there are more than two indicator variables, one variable may be used as the output indicator and the remaining variables summed to create the input variable. The procedure is then repeated with each variable serving as the output indicator. Because each indicator was a single item from the SR-WRAADDS, this summing method was used in the present study (Walters and Ruscio, 2009).