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The structure of adult ADHD

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Abstract

Although DSM-5 stipulates that symptoms of attention-deficit hyperactivity disorder (ADHD) are the same for adults as children, clinical observations suggest that adults have more diverse deficits than children in higher-level executive functioning and emotional control. Previous psychometric analyses to evaluate these observations have been limited in ways addressed in the current study, which analyzes the structure of an expanded set of adult ADHD symptoms in three pooled US samples: a national household sample, a sample of health plan members, and a sample of adults referred for evaluation at an adult ADHD clinic. Exploratory factor analysis found four factors representing executive dysfunction/inattention (including, but not limited to, all the DSM-5 inattentive symptoms, with non-DSM symptoms having factor loadings comparable to those of DSM symptoms), hyperactivity, impulsivity, and emotional dyscontrol. Empirically-derived multivariate symptom profiles were broadly consistent with the DSM-5 inattentive-only, hyperactive/impulsive-only, and combined presentations, but with inattention including executive dysfunction/inattention and hyperactivity-only limited to hyperactivity without high symptoms of impulsivity. These results show that executive dysfunction is as central as DSM-5 symptoms to adult ADHD, while emotional dyscontrol is more distinct but nonetheless part of the combined presentation of adult ADHD.

KEYWORDS

adults, ADHD, attention-deficit hyperactivity disorder, epidemiology

1 | INTRODUCTION

Adult attention-deficit hyperactivity disorder (ADHD) is a commonly-occurring childhood-onset disorder that often persists into adulthood (Kessler et al., 2006). Although the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) requires fewer symptoms among adults than children (American Psychiatric Association, 2013), the symptoms are stipulated to be the same for adults as children despite the fact that clinical observations suggest that the frank hyperactivity of childhood ADHD manifests more as a sense of internal restlessness among adults (Adler & Cohen, 2004) and that adults have a more diverse set of deficits than children in higher-level executive functioning and emotional control (Barkley, Murphy, & Fischer, 2008; Faraone, Biederman, & Spencer, 2010; Surman et al., 2011; Ward, Wender, & Reimherr, 1993).

A number of researchers have attempted to confirm these clinical observations by developing expanded assessments that include deficits in executive functioning and in emotional control along with the DSM symptoms of inattention deficit (AD) and hyperactivity/impulsivity deficit (HD) and carrying out exploratory factor analyses of this expanded symptom set among patients with ADHD and controls (Amador-Campos, Gomez-Benito, & Ramos-Quiroga, 2014; Christiansen et al., 2011; Conners, Erhardt, & Sparrow, 1999; Kessler et al., 2010; Marchant, Reimherr, Robison, Robison, & Wender, 2013; Marchant, Reimherr, Wender, & Gift, 2015). These studies have found a 2-factor structure in studies of the clinician-administered Wender–Reimherr Adult Attention Deficit Disorder Scale (WRAADDS) (Marchant et al., 2013) and the self-report version of that scale (Marchant et al., 2015) compared to 3-factor (Kessler et al., 2010), 4-factor (Amador-Campos et al., 2014; Conners et al., 1999), or 6-factor (Christiansen et al., 2011) solutions in studies using other instruments.

In evaluating these discrepant results, it is important to note that published WRAADDS factor analyses were carried out on seven rationally-constructed subscales rather than on the more than 60 underlying symptoms assessed in the WRAADDS. The 2-factor solutions showed the inattention and disorganization subscales loading on the

first factor, three emotion subscales (temper, affective liability, emotional over-reactivity) loading on the second factor, and the remaining subscales of hyperactivity/restless and impulsivity loading on both factors. However, the items in the overall scale were combined into these seven presumed underlying subscales based on theory rather than on empirical considerations. To our knowledge, no empirical data have ever been reported confirming the empirical validity of these seven subscales. Critically, the resulting 7 × 7 correlation matrix among the rational WRAADDS subscales contains only 21 correlations (i.e. 7 × 6/2 = 21), making it impossible to identify a factor model with more than two correlated factors, as a 3-factor model would contain 21 factor loadings (seven for each of three factors) and three correlations among factors, which would exceed the number of degrees of freedom in the correlation matrix. As a consequence, the "finding" of a 2-factor structure in the WRAADDS exploratory factor analyses is actually a construction rather than a finding.

This problem could have been avoided by carrying out the WRAADDS factor analyses on the symptom-level data rather than introducing the intermediate step of creating rationally-constructed subscales, but this was not done in the WRAADDS studies because the samples on which the factor analyses were based were thought to be too small to allow symptom-level factor analyses to be carried out. For example, the paper reporting the factor structure of the self-report version of the WRAADDS was based on a mere 120 community controls and 122 patients with adult ADHD (Marchant et al., 2015). But were these samples too small? Guidelines on the required sample size for exploratory factor analysis have been inconsistent (Comrey & Lee, 1992; Gorsuch, 1983; Kline, 1994), but recent simulations show that the sample size required to recover a stable factor structure is a joint function of number of factors, number of items per factor (with the required sample size stabilizing after 6–10 items per factor), and strength of factor loadings (MacCallum, Widaman, Zhang, & Hong, 1999; Mundfrom, Shaw, & Ke, 2005). In addition, sample size requirements are higher when the symptoms are dichotomies, as they typically are in factor analyses of psychiatric symptoms, and when symptom prevalence is variable (Pearson & Mundfrom, 2010). Based on these results, a scale like the WRAADDS, where the number of items per hypothesized factor is 8–9, and there might be as many as seven factors, the minimum required sample size for good recovery of the population factor structure would be 1,600–2,000. For a 4-factor solution of the sort hypothesized to exist by many experts in ADHD (i.e. inattention/executive dysfunction, hyperactivity, impulsivity, emotional dyscontrol), a stable factor structure based on scales with between nine (the number of DSM-5 symptoms of inattention and the number for hyperactivity/impulsivity) and 12 items, the minimum required sample size would be 320–500 respondents (Pearson & Mundfrom, 2010). Even the smallest of these required sample sizes is several times larger than the sample size used in the factor analysis of the self-report version of the WRAADDS. However, the sample size used in an earlier factor analysis of the clinician-administered version of the WRAADDS that combined data across three clinical trial samples (with a combined sample of 717) would have been large enough to evaluate a 4-factor model, although not a 7-factor model (Marchant et al., 2015).

Other published factor analyses of expanded adult ADHD symptom sets were based on symptom-level analyses. Our own previous work, based on a pooled analysis of 345 respondents in a national household sample and a health plan sample, found a 3-factor structure among symptoms in an expanded symptom assessment that included all 18 DSM symptoms of AD and HD in addition to 14 additional symptom questions designed to assess executive dysfunction and emotional dyscontrol (Kessler et al., 2010). The three factors in that analysis included an inattentive/executive dysfunction factor, a hyperactivity factor, and an impulsivity factor, with the emotional dyscontrol items loading on the impulsivity factor. Other exploratory factor analyses evaluated the structure of the Conners' Adult ADHD Rating Scale (CAARS; Amador-Campos et al., 2014; Christiansen et al., 2011; Conners et al., 1999). The original CAARS factor analysis (Conners et al., 1999) and a confirmatory factor analysis replication (Amador-Campos et al., 2014) found a 4-factor solution, with three of the factors the same as the inattentive/executive dysfunction, hyperactivity, and impulsivity factors in our earlier study, and the fourth factor representing problems with self-concept. However, another CAARS replication study in Germany found a 6-factor solution after excluding CAARS items with high cross-loadings or low loadings on any factor (Christiansen et al., 2011). That analysis found a separate emotional dyscontrol factor in addition to inattentive/executive dysfunction, hyperactivity, and impulsivity factors as well as two other factors appearing to represent dimensions not strongly related to adult ADHD.

The fact that an inattention/executive dysfunction factor was found consistently in all the symptom-level factor analyses of expanded ADHD symptoms is consistent with the thinking of clinical experts that adults have a more diverse set of deficits than children in higher-level executive functioning. However, these studies were inconsistent in finding evidence that childhood hyperactivity or impulsivity broaden in adulthood to include difficulties in emotional control. Our failure to find evidence of such an emotional dyscontrol factor in our earlier study might have been due to our exclusive reliance on community samples, whereas the failure to find such evidence in the CAARS studies other than the German replication might have been due to conceptual confounding with self-concept problems that was removed in the German study by deleting items with cross-loadings.

Even if a distinct emotional dyscontrol factor can be found in future symptom-level factor analyses of the WRAADDS, CAARS, or other expanded assessments of adult ADHD, though, this might not mean that emotional dyscontrol is a feature of adult ADHD any more than the CAARS factor analyses demonstrated that problems with self-concept are a feature of adult ADHD. An alternative possibility is that such factors emerge simply because the researchers who developed the expanded adult ADHD symptom scales included symptoms of these dimensions in their scales even though the dimensions underlying these symptoms are not specific to adult ADHD. A confirmation that emotional dyscontrol is a feature of adult ADHD would require a further person-level analysis that might involve a factor analysis carried out separately among cases (e.g. patients diagnosed with adult ADHD) and controls (e.g. a community sample), with factor structure-scores compared across the two samples to demonstrate similar structure and higher emotional dyscontrol among cases than controls. An alternative person-level analysis would be a person-level cluster analysis or latent class analysis of previously-derived factor scores to document the existence of one or more distinct adult ADHD presentations

involving emotional dyscontrol. The latter approach would be the more attractive one due to the fact that the DSM system specifies that patients with ADHD can be divided into those with presentations characterized by either AD-only, HD-only, and combined AD and HD. A number of analyses of adult ADHD treatment response (e.g. Unal, Kenar, Herken, & Kiroglu, 2015) and consequences (e.g. Yoon, Jain, & Shapiro, 2013) are based on this 3-part subtyping scheme. If emotional dyscontrol is an adult variant of the hyperactivity and/or impulsivity of childhood ADHD, we would expect that a person-level analysis would find evidence of one or more presentations featuring elevated emotional dyscontrol. We are aware of no previous study that investigated this possibility.

The current report describes the results of an analysis designed to address the earlier methodological limitations of previous research by carrying out a symptom-level exploratory factor analysis of the same expanded symptom assessment as in our earlier study (Kessler et al., 2010), but in an expanded sample that adds a subsample of adults referred for evaluation at an adult ADHD clinic, followed by a cluster analysis of factor scores that distinguishes respondents who meet full DSM-5 criteria for adult ADHD from other respondents. As in our earlier analysis, the symptoms evaluated include both the 18 DSM symptoms of ADHD and 14 additional symptoms indicative of executive dysfunction and emotional dyscontrol. We chose to add a referred sample to the community samples in our earlier study in order to increase statistical power in the upper end of the symptom distribution.

2 | METHODS

2.1 | Samples

2.1.1 | NYU Langone sample

The patient sample was a mix of patients seeking treatment at the adult ADHD program of the New York University (NYU) Langone Medical Center (Kessler, Berglund, et al., 2004b; NYU School of Medicine, 2015) and a convenience sample recruited through print, radio, and referral from health care professionals to receive a free evaluation for adult ADHD through that program. Blinded semi-structured diagnostic interviews described later were administered face-to-face to these patients and controls as part of their intake evaluation. No incentive for participation was provided to patients and only the free evaluation to controls. Study purposes and procedures were described to patients and controls and signed informed consent obtained before administering interviews. These recruitment and consent procedures were approved and a HIPAA (Health Insurance Portability and Accountability Act) waiver granted for de-identified data analysis by the Institutional Review Board of NYU Langone School of Medicine. These interviews were not weighted. We focused on the 191 individuals classified by the diagnostic interview as having at least one DSM-5 (American Psychiatric Association, 2013) Criterion A1 (AD) or A2 (HD) symptom of adult ADHD in the six months before interview.

2.1.2 | NCS-R

The national general population sample was based on the subsample of respondents in the National Comorbidity Survey Replication (NCS-R) (Kessler & Merikangas, 2004) who were used to validate the ADHD Self-report Scale (ASRS) screening scale for adult ADHD (Kessler, Ames, et al., 2004a). The NCS-R was a face-to-face national US household survey (Kessler, Ames, et al., 2004a). The validation sample assessed NCS-R respondents ages 18–40 meeting criteria for childhood ADHD who reported adult symptoms. This sample was administered the same blinded semi-structured diagnostic interview as in the NYU Langone sample telephonically. Interviews were tape recorded for quality control review. Respondents received a $25 incentive. Study purposes and procedures were described to patients and verbal informed consent obtained before administering and tape recording interviews. These recruitment, consent, and data collection procedures were approved by the Human Subjects committees of the University of Michigan and Harvard Medical School. The completed interviews were weighted to adjust for over-sampling of screened positives. Study design is described elsewhere (Kessler et al., 2005). We focused on the 108 respondents classified by the diagnostic interview as having at least one DSM-5 Criterion A1 or A2 symptom of adult ADHD in the six months before interview.

2.1.3 | Health plan

The health plan sample was of participants in a telephone survey of subscribers to a large managed health care plan (Brod, Johnston, Able, & Swindle, 2006) that included the ASRS screening scale for adult ADHD (Kessler, Ames, et al., 2004a). A subsample of these respondents over-sampling screened positives was re-interviewed six months later and a third-stage sample over-sampling stably screened positives was then telephonically administered the same blinded semi-structured diagnostic interview as in the NCS-R using recruitment, consent, and quality assurance procedures identical to those in the NCS-R (i.e. verbal informed consent over the telephone, a $25 incentive, tape recording of interviews with respondent consent for quality control review). These procedures were approved and a HIPAA waiver granted by the Institutional Review Board of NYU Langone School of Medicine. The completed interviews were weighted to adjust for over-sampling of screened positives. Study design is described elsewhere (Kessler et al., 2007). We focused on the 161 respondents classified by the diagnostic interview as having at least one DSM-5 Criterion A1 or A2 symptom of adult ADHD in the six months before interview.

The study was performed according to the Declaration of Helsinki.

2.2 | The clinical reappraisal interview

Adult ADHD was assessed in these samples with version 1.2 of the Adult Clinician ADHD Diagnostic Scale (ACDS; Adler & Cohen, 2004; Adler, Shaw, Kovacs, & Alperin, 2015), a semi-structured research diagnostic interview used in a number of prior clinical studies of adult ADHD (Spencer et al., 1995; Spencer et al., 1998; Spencer et al., 2001). The interview began with a retrospective assessment of all symptoms of childhood ADHD and then assessed an expanded set of recent (past six months) symptoms including all nine DSM-5 Criterion A1 (AD) symptoms, all nine Criterion A2 (HD) symptoms, and 14 non-DSM symptoms believed relevant to adult ADHD based on clinical experience and the research literature, including deficits in higher-

level executive function and emotional control. Many of these additional items are similar to symptoms proposed in the Utah Criteria for adult ADHD (Wender, 1998).

The ACDS uses childhood and adult specific prompts to ensure adequate exploration of the severity and breadth of DSM ADHD symptoms and additional symptoms of executive dysfunction and emotional dyscontrol. The items related to executive function and emotional dyscontrol are distinct from the DSM symptoms of inattention and hyperactivity/impulsivity. Selected examples of executive function symptoms include: wasting or mismanaging time, trouble planning ahead or planning for upcoming events, having a hard time keeping track of several things at once and unable to complete tasks in the allotted time – needs extra time to finish satisfactorily. Selected examples of emotional dyscontrol symptoms include: mood changes frequently, feels easily hassled or feels frequently overwhelmed and difficulty expressing anger appropriately at others – does not stand up for self. These non-DSM symptoms were established and validated by similar mechanisms as the basic ACDS v1.2 by investigators at Massachusetts General Hospital and NYU School of Medicine.

DSM-5/ACDS diagnoses of adult ADHD require respondents to have 6–9 childhood and 5–9 current adult DSM-5 Criterion A1 or A2 symptoms (DSM-5 Criterion A), at least one Criterion A symptom prior to age 12 (Criterion B), some ADHD-related impairment in at least two domains of functioning in the past six months (Criterion C), and clinically significant ADHD-related impairment in at least one domain of functioning over the same time period (Criterion D). Criterion E (that the symptoms do not occur exclusively during the course of a pervasive developmental disorder or psychotic disorder and are not better accounted for by another mental disorder) was not operationalized and ADHD not otherwise specified was not diagnosed. None of the 14 non-DSM symptom items was used in making diagnoses. The DSM-5 requirement of impairment before age 12 was not operationalized. Adult ADHD cases were further divided into AD-only (inattention symptoms), HD-only (hyperactive/impulsive symptoms), and combined (i.e. AD and HD). The AD-only and HD-only cases were further divided into restrictive (0–2 Criterion A symptoms of the other type) and non-restrictive (3+ Criterion A symptoms of the other type).

The ACDS interviews were administered in the NYU Langone sample by two clinical psychology trainees (a PhD candidate with an MA and an MA candidate with a BA) trained by one of the investigators (LA). Quarterly calibration meetings were used to review rating guidelines and prevent drift. A random 20% of NCS-R and health plan interviews were reviewed by a supervising psychiatrist and agreement was over 95% in each of these samples. Validity of the NYU Langone interviews was established by regular direct observation of interviews. The ACDS was administered in the NCS-R by four experienced PhD-level clinical interviewers who received 40 hours of training from two board certified psychiatrists specializing in adult ADHD research (LA, TS). Each interviewer had to complete five practice interviews with symptom ratings matching those of the trainers prior to beginning interviews. ACDS interviews in the managed care sample were administered by six PhD-level clinical psychologists or MA-level social workers experienced in administering the ACDS in clinical studies and trained by one of the investigators (TS). Weekly calibration meetings and reviews of tapes were used in both studies to prevent drift.

2.3 | Analysis methods

Analysis of de-identified data was approved by the Institutional Review Board of NYU Langone School of Medicine. Participants provided written informed consent. A tetrachoric correlation matrix was estimated for the 32 ACDS symptoms within each sample and pooled across samples. Exploratory factor analysis was used to analyze these data within and across samples. Our main focus is on pooled analysis that combines data across all the samples due to the fact that simulations described in the introduction show that the numbers of respondents in the individual samples are too small to recover a stable factor structure involving the anticipated number of factors with their anticipated number of items per factor (Pearson & Mundfrom, 2010). In carrying out that analysis, the parallel analysis simulation method (Preacher, Zhang, Kim, & Mels, 2013) was used to determine the number of factors. Oblique (promax) rotation was used to improve factor interpretation.

Regression-based factor scores were generated retaining the correlations among factors. K-means cluster analysis of standardized (to a mean of 0 and variance of 1) factor scores was used to estimate empirical symptom profiles. The optimal number of clusters was defined as the number that maximized explained variance in factor scores without producing small splinter clusters. Clusters were interpreted by inspecting mean factor scores and distributions of DSM-5/ACDS adult ADHD presentations classified according to DSM-5 criteria. K-means cluster analysis was used rather than latent class analysis based on evidence that cluster analysis produces clusters with lower within-cluster variation and higher between-cluster variation than latent class analysis (Eshghi, Haughton, Legrand, Skaletsky, & Woolford, 2011). These desirable features are due to cluster analysis being designed to minimize distance between cluster centroids and observed cases within clusters (Chaturvedi, Green, & Caroll, 2001), whereas latent class analysis requires that the variables used to define the clusters are uncorrelated within clusters (Goodman, Hagenaars, & McCutcheon, 2002).

3 | RESULTS

3.1 | Socio-demographic characteristics of the samples

The NYU Langone patient sample was the youngest (66.5% of respondents ages 18–30) followed by the NCS-R (46.6% ages 18–30) and health plan (26.6% ages 18–30) samples (Table 1). The NCS-R sample was a subset of respondents from a national household sample ages 18–44. The health plan sample was a more limited sample of the general population (i.e. of people with health insurance) without age restriction. The ratio of respondents in the age range 18–30 versus 31–40 (54.8%) in the health plan sample was similar to the NCS-R (46.6%), but the proportion was much higher in the NYU sample (66.5%), suggesting that younger adults were more likely than older adults to self-select into the NYU Langone sample.

The NCS-R and health plan samples also had higher proportions of women (57.8–61.0%) than the NYU Langone sample (50.3%), suggesting either that men or people with symptom profiles more

TABLE 1 Socio-demographic characteristics of the three samples (n = 460)

	NCS-R		Health plan		NYU Langone		Total				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	X^2	Df	p Value
Age											
18–30	46.6	(15.1)	26.7	(7.5)	66.5	(3.4)	47.9	(4.9)	0.2[a]	1	0.673
31–40	53.4	(15.1)	22.0	(7.2)	20.9	(2.9)	28.9	(4.9)	–	–	–
41–50	0.0	–	25.8	(6.8)	8.9	(2.1)	12.7	(2.7)	–	–	–
51+	0.0	–	25.6	(9.1)	3.7	(1.4)	10.5	(3.7)	32.*[b]	3	<.0001
Gender											
Male	42.2	(14.3)	39.0	(8.3)	49.7	(3.6)	44.2	(4.8)	–	–	–
Female	57.8	(14.3)	61.0	(8.3)	50.3	(3.6)	55.8	(4.8)	0.8[c]	2	0.664
Race/ethnicity											
Non-Hispanic Black	14.0	(8.8)	4.7	(3.4)	9.4	(2.1)	8.8	(2.5)	–	–	–
Non-Hispanic White	66.1	(14.3)	83.8	(6.2)	62.8	(3.5)	71.0	(4.4)	–	–	–
Hispanic	4.2	(1.8)	8.3	(5.1)	12.6	(2.4)	9.1	(2.2)	–	–	–
Other	15.7	(13.3)	3.2	(2.1)	15.2	(2.6)	11.1	(3.5)	7.6[d]	6	0.268
(n)	(108)		(161)		(191)		(460)				

*Indicates significant at the alpha = 0.05 level.

[a]Test of significance of differences in age distributions across NCS-R and Health plan surveys, for age groups 18–30 and 31–40.

[b]Test of significance of differences in age distributions across all surveys.

[c]Test of significance of differences in gender distributions across all surveys.

[d]Test of significance of differences in race/ethnicity distributions across all surveys.

characteristic of men were more likely than others with adult ADHD to self-select into the NYU Langone sample. The health plan sample had a much higher proportion of non-Hispanic Whites (83.8%) than either the NCS-R (66.1%) or the NYU Langone (62.8%) samples, presumably reflecting the higher rate of health insurance coverage among non-Hispanic Whites than racial-ethnic minorities (Artiga, 2013).

3.2 | Distribution of DSM-5/ACDS adult ADHD presentations

DSM-5/ACDS adult ADHD prevalence was considerably lower in the NCS-R (23.3%) and health plan (39.7%) samples than the NYU Langone sample (94.2%) (Table 2). Roughly half (47.6%) of the NCS-R cases had the HD-only presentation, with the others divided roughly equally between AD-only (23.2% of cases) and combined (29.2%) presentations. The majority of health plan cases, in comparison, had the AD-only presentation (51.1%), followed by HD-only (32.7%) and combined (16.4%) presentations. The majority of the NYU Langone cases, in comparison, had the combined presentation (63.4%), with almost all the remaining cases having the AD-only presentation (35.0%).

3.3 | Exploratory factor analysis

Exploratory factor analysis in the pooled sample found one very large unrotated first principal factor (eigenvalue = 15.3) for which 29 of the 32 ACDS items had factor loadings above 0.40. Almost all these

TABLE 2 Distribution of DSM-5/ACDS adult ADHD presentations across samples (n = 460)

	NCS-R		Health plan		NYU Langone		Total			
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	X^2_2	p Value
Inattentive										
Restrictive	2.0	(1.2)	8.0	(4.8)	17.3	(2.7)	10.4	(2.2)	8.4*	0.015
Non-restrictive	3.4	(1.6)	12.3	(7.9)	15.7	(2.6)	11.6	(3.1)	3.0	0.219
Total	5.4	(2.2)	20.3	(8.5)	33.0	(3.4)	22.1	(3.7)	10.9*	0.004
Hyperactive/impulsive										
Restrictive	2.4	(1.5)	7.7	(5.0)	1.0	(0.7)	3.7	(1.9)	7.1*	0.028
Non-restrictive	8.7	(7.4)	5.3	(4.3)	0.5	(0.5)	4.1	(2.3)	3.1	0.215
Total	11.1	(7.6)	13.0	(6.4)	1.5	(0.9)	7.8	(2.9)	4.6*	0.010
Combined										
Total	6.8	(2.7)	6.5	(3.5)	59.7	(3.6)	28.7	(3.3)	101.7*	<.0001
Total										
Any adult ADHD	23.3	(9.3)	39.7	(9.1)	94.2	(1.7)	58.5	(5.3)	56.4*	<.0001
Non-cases	76.7	(9.3)	60.3	(9.1)	5.8	(1.7)	41.5	(5.3)	56.4*	<.0001
(n)	(108)		(161)		(191)		(460)			

*Indicates significant at the alpha = 0.05 level.

loadings were higher than those on the second unrotated principal factor. These results suggest that all ACDS items are part of a single universe of content representing adult ADHD (Table 3). Importantly in this regard, the non-DSM-5 symptoms had loadings comparable to the DSM-5 symptoms (range 0.32–0.84 versus 0.30–0.86; interquartile range 0.74–0.82 versus 0.56–0.82). The single DSM-5 symptom with a loading lower than 0.40 ("talks excessively") was one of three DSM-5 symptoms with lower loadings on the first (0.30) than second (0.54) un-rotated principal factor, the others being "fidgeting" (0.41, 0.44) and "difficulty remaining seated" (0.50, 0.54). The two non-DSM-5 items with loadings less than 0.40 on the first unrotated factor ("difficulty expressing anger", "sensitive to criticism") both had higher loadings on the first (0.33–0.38) than second (−0.03-0.14) factor.

The existence of one dominant unrotated principal factor does not mean that the factor structure among items is unidimensional. In fact, simulation based on the parallel analysis method found four reliable factors in the pooled correlation matrix. Promax rotation showed that Factor 1 (20 items with loadings above 0.40) included all nine DSM-5 AD symptoms (with standardized regression coefficients in the range 0.47–0.97) and 11 of the 14 ACDS symptoms not in DSM-5, including

TABLE 3 Unrotated loadings on first principal factor and standardized partial regression coefficients of the 32 Adult ADHD Clinical Diagnostic Scale (ACDS) items from a 4-factor exploratory factor analysis with promax rotation 1 in the pooled sample (n = 460)[a]

		Standardized partial regression coefficients			
	Unrotated loadings first principal factor	Executive dysfunction/ inattention	Hyperactive	Impulsive	Emotional dyscontrol
I. DSM-5 Criterion A symptoms of inattention deficit (AD)					
Makes careless mistakes	.80	**.82**	−.08	.07	.06
Difficulty sustaining attention	.84	**.75**	.25	−.12	.01
Does not listen	.77	**.47**	.39	.10	.01
Difficulty follow instructions	.85	**.72**	.29	−.09	.02
Difficulty organizing tasks	.83	**.97**	−.06	−.07	−.08
Dislikes tasks requiring attention	.86	**.90**	.12	−.07	−.11
Loses things	.64	**.58**	.00	.00	.16
Easily distracted	.82	**.75**	.25	−.04	−.10
Forgetful in daily activities	.77	**.68**	.17	−.01	.01
II. DSM-5 Criterion A symptoms of hyperactivity/impulsivity deficit (HD)					
Fidgets	.41	−.07	**.73**	.03	−.04
Difficulty remaining seated	.50	−.11	**.84**	.08	.00
Restless	.66	.09	**.74**	.11	.05
Difficulty playing quietly	.56	−.01	**.78**	−.07	.18
Driven by motor	.58	.09	**.63**	.26	−.14
Talks excessively	.30	−.18	.08	**.86**	−.07
Blurts out answers	.57	.16	−.04	**.80**	.01
Difficulty waiting turn	.47	.03	.15	**.62**	.03
Interrupts or intrudes	.62	.14	.12	**.68**	.08
III. Symptoms not in DSM-5					
Wastes or mismanages time	.80	**.78**	−.07	.15	.01
Trouble planning ahead	.80	**.91**	−.07	.00	−.08
Lacks self-discipline	.82	**.80**	−.11	.21	.02
Difficulty prioritizing work	.85	**.88**	−.04	.05	−.01
Trouble keeping track of multiple things	.78	**.83**	−.16	.01	.18
Easily bored	.74	**.40**	**.56**	−.03	−.02
Others keep life order	.59	**.49**	.19	−.10	.09
Cannot work unless deadline	.84	**.96**	−.01	−.03	−.14
Cannot complete tasks in time	.84	**.93**	−.09	−.03	.05
Remembers details, not main idea	.75	**.55**	.11	.15	.13
Frequent mood changes	.46	.01	−.02	.21	**.76**
Easily overwhelmed	.67	**.51**	−.08	.10	.39
Difficulty expressing anger	.33	.04	.13	−.32	**.81**
Sensitive to criticism	.38	−.04	−.03	.15	**.77**

[a]Analysis was based on a matrix of tetrachoric correlations among dichotomized symptom classifications. Correlations among factors in the promax solution were Factors 1–2 0.49, Factors 1–3 0.40, Factors 1–4 0.37, Factors 2–3 0.36, Factors 2–4 0.22, and Factors 3–4 0.30. Factor loadings (unrotated first principal factor) and standardized partial regression coefficients (promax-rotated 4-factor solution) greater than 0.40 are bolded. Eigenvalues for the first four unrotated factors were 15.3, 2.7, 2.0, and 1.5.

all the ACDS symptoms of difficulties with planning and organization (0.49–0.96) and two ("easily bored" [with prompting for resulting emotionality]; "easily overwhelmed") indicating mood lability (0.40–0.51). The two mood lability symptoms, but none of the planning-organization symptoms, had meaningful loadings on other factors, leading us to interpret Factor 1 as executive dysfunction/inattention. The nine DSM-5 HD symptoms all had loadings greater than 0.40 on either Factor 2 (hyperactivity; five items; 0.63–0.84) or Factor 3 (impulsivity; four symptoms; 0.62–0.86). Only one other symptom loaded on Factor 2: the non-DSM-5 symptom "being easily bored", with a higher loading on Factor 2 (0.56) than Factor 1 (0.40). No symptoms other than those of the DSM-5 impulsivity symptoms had loadings as high as 0.40 on Factor 3. The three symptoms with loadings of 0.40 or higher on Factor 4 (0.76–0.81), finally, were all symptoms of emotional dyscontrol: "frequent mood changes", "difficulty expressing anger", and "sensitivity to criticism". Correlations among factors were all positive and in the range between 0.22 (Factors 2 and 4) and 0.49 (Factors 1 and 2).

3.4 | Cluster analysis

Respondents were assigned standardized factor-weighted scores on each of the four factors. K-means cluster analysis was used to examine the multivariate associations among these four factor scores. A 6-cluster solution was optimal in increasing explained variance in factor scores without producing small splinter clusters, with R^2 values in the range 0.55–0.80 across factors and each cluster containing between 12.5% and 28.4% of respondents (Table 4). Three of the clusters featured respondents who were high on only one factor: executive dysfunction/inattention (C1; 12.4% of respondents), hyperactivity (C2; 15.9%), or emotional dyscontrol (C3; 28.5%), while the other three clusters included respondents either high on all factors (C4; 17.6%), on all but emotional dyscontrol (C5; 12.6%), or high on no factor (C6; 13.0%). The most prevalent cluster was C3 (high only on emotional dyscontrol).

Cross-classification of cluster membership with DSM-5/ACDS diagnoses showed that virtually all respondents in three of the clusters (C1, high only on executive dysfunction/inattention; C4 and C5, high either on all factors or on all but emotional dyscontrol) met DSM-5 criteria for adult ADHD and that 40.6–51.9% of those in two other clusters (C2, high only on hyperactivity; C6, high on none) did so. The remaining cluster (C3, high only on emotional dyscontrol), while having the highest prevalence in the sample, had by far the lowest proportion of cluster members with DSM-5 adult ADHD (0.5%). Cluster C1 cases (high only on executive dysfunction/inattention) were made up exclusively of DSM-5 AD-only cases. Cluster C4 (high on all factors) and C5 (high on all other than emotional dyscontrol) cases, in comparison, almost entirely had the combined presentation. Somewhat more than half the respondents in two clusters C2 and C6 also met diagnostic criteria.

The 51.0% of respondents in C2 (high only on hyperactivity) who met diagnostic criteria consisted mostly of AD-only cases, with smaller numbers of HD-only cases, and very few cases with the combined presentation (0.7%). The 60.6% of respondents meeting diagnostic criteria in C6 (low on all factors), in comparison, were primarily non-restrictive AD-only (24.4%) or non-restrictive HD-only (27.8%), with far fewer restrictive (0.0% AD-only; 2.2% HD-only) or combined (6.1%) cases. It is important to note in this regard that the characterization of C6 as not being high on any dimension is a comparative statement, as 60.6% of C6 respondents met DSM-5 criteria. More detailed analysis showed, though, that most of these cases had the bare minimum of the five AD or HD symptoms required to meet diagnostic criteria.

3.5 | Comparison of cluster-based profiles across samples

Cross-classification of DSM-5/ACDS diagnostic presentations with clusters documented substantial differences across the three component samples (Table 5). The most striking difference, and the only one that was statistically significant, was that the majority of NYU Langone cases had a DSM-5 combined presentation (63.3%), while that presentation was considerably less common in the NCS-R (29.0%; $t = 2.9$, $p = 0.002$) and health plan (16.3%; $t = 4.8$, $p < 0.001$) samples. The vast majority of combined presentation cases in all samples were either in C4 (high on all factors) or C5 (high on all but emotional dyscontrol). Nearly all (95.4%) of the remaining NYU Langone cases had the DSM-5 AD-only profile. The proportion of AD-only cases did not differ significantly across samples ($t = 0.1–1.7$, $p = 0.10–0.88$). Cluster C1 (high only on executive dysfunction/inattention) was the most common cluster among DSM-5 AD-only cases in all three samples (43.0–60.3%).

The DSM-5 HD-only profile was the most common one in the NCS-R (47.7%). A somewhat lower proportion of cases had the HD-only profile in the health plan sample (32.6%) while this profile was very rare in the NYU Langone sample (1.7%), suggesting a help-seeking bias. Yet none of the higher proportions in the two general population samples was statistically different from the extremely low proportions in the NYU Langone patient sample (NCS-R: $t = 1.5–1.7$, $p = 0.08–0.14$; health plan: $t = 1.2–1.5$, $p = 0.13–0.23$) due to the comparative rarity of the HD-only profile. Cluster C6 (high on none of the factors) was by far the most common cluster among HD-only cases in the NCS-R (82.0%). In the health plan sample, in comparison, C2 (high only on hyperactivity, 54.3%) was the most common symptom profile among HD-only cases followed by C6 (34.3%). The DSM-5 AD-only profile was the most common one in the health plan sample (51.1%), with insignificantly lower proportions of cases having this profile in the NCS-R (23.3%) and NYU Langone (35.2%) samples ($t = 0.3–1.7$; $p = 0.09–0.79$). Cluster C1 (high only on executive dysfunction/inattention) was the most common cluster among AD-only cases in all three samples (43.0–66.3%).

4 | DISCUSSION

Our factor analysis showed clearly that adult ADHD is characterized by a broader set of symptoms than in DSM-5. This conclusion is based on the observations that all but a handful of non-DSM-5 symptoms had factor loadings of 0.40 or higher on the first unrotated principal factor, that these loadings were similar to those of DSM-5 symptoms, and that these loadings were consistently much higher on the first than second unrotated principal factor. We are aware of no previous factor analysis of expanded adult ADHD symptoms that made these comparisons. These results suggest that symptoms of executive dysfunction

TABLE 4 Mean factor scores and DSM-5/ACDS adult ADHD presentations prevalence within clusters

	High on only one factor						Others					
	C1. Executive dysfunction/inattention		C2. Hyperactive		C3. Emotional dyscontrol		C4. High on all		C5. High on all but emotional dyscontrol		C6. High on none	
	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)
I. Mean standardized factor scores												
Executive dysfunction/inattention (ExD)	42	(.06)	−.18	(.09)	−.10	(.07)	.82	(.07)	.47	(.09)	−1.45	(.03)
Hyperactive	−.74	(.07)	.93	(.05)	−.69	(.05)	.83	(.08)	.73	(.08)	−1.02	(.06)
Impulsive	−.67	(.08)	−.53	(.06)	−.50	(.06)	.99	(.07)	.99	(.06)	−.78	(.08)
Emotional dyscontrol	−.82	(.06)	−.10	(.09)	.94	(.04)	1.04	(.06)	−.81	(.06)	−.89	(.05)
II. DSM-5/ACDS adult ADHD presentation prevalence (i.e. row percentages)												
AD-only												
Restrictive	51.8	(9.4)	24.8	(8.1)	0.0	—	0.0	—	0.0	—	0.0	—
Non-restrictive	44.2	(9.4)	9.8	(3.8)	0.0	—	4.0	(2.1)	5.2	(2.9)	24.4	(18.0)
HD-only												
Restrictive	0.0	—	14.7	(10.1)	0.1	(0.1)	0.4	(0.2)	7.8	(3.7)	2.2	(1.8)
Non-restrictive	0.0	—	1.1	(1.1)	0.4	(0.4)	0.8	(0.4)	0.4	(0.3)	27.8	(16.4)
Combined	2.0	(1.8)	0.7	(0.4)	0.0	—	94.8	(2.2)	86.6	(4.6)	6.1	(3.7)
Any DSM-5/ACDS ADHD	98.0	(1.8)	51.0	(11.3)	0.5	(0.4)	100.0	—	100.0	—	60.6	(20.3)
III. DSM-5/ACDS adult ADHD cluster prevalence (i.e. column percentages)												
AD-only												
Restrictive	62.2	(10.0)	37.8	(10.0)	0.0	—	0.0	—	0.0	—	0.0	—
Non-restrictive	47.5	(13.7)	13.4	(5.5)	0.0	—	6.0	(3.5)	5.6	(3.4)	27.4	(17.8)
HD-only												
Restrictive	0.0	—	63.1	(20.3)	0.8	(0.8)	2.0	(1.4)	26.5	(16.3)	7.6	(6.6)
Non-restrictive	0.0	—	4.2	(4.7)	2.5	(2.8)	3.4	(2.5)	1.3	(1.1)	88.6	(8.0)
Combined	0.9	(0.8)	0.4	(0.2)	0.0	—	58.1	(4.5)	37.9	(4.4)	2.8	(1.7)
Any DSM-5/ACDS ADHD	20.9	(3.7)	13.9	(3.6)	0.2	(0.2)	30.0	(3.7)	21.4	(2.9)	13.5	(5.5)
(*n*)	(57)		(73)		(131)		(81)		(58)		(60)	

TABLE 5 The distribution of DSM-5/ACDS adult ADHD in the general population, among health plan subscribers, and among help-seekers

	NCS-R		Health plan		NYU Langone		Total	
	%	(SE)	%	(SE)	%	(SE)	%	(SE)
AD-only restrictive								
C1. High only on executive Dysfunction/inattention	4.8	(4.0)	11.9	(9.6)	11.7	(2.4)	11.1	(2.8)
C2. High only on hyperactivity	3.7	(2.7)	8.2	(7.4)	6.7	(1.9)	6.7	(2.2)
Total	8.5	(5.1)	20.1	(11.7)	18.3	(2.9)	17.8	(3.4)
AD-only non-restrictive								
C1. High only on executive Dysfunction/inattention	7.9	(4.3)	10.1	(8.9)	9.4	(2.2)	9.4	(2.6)
C2. High only on hyperactive	2.8	(2.0)	—[a]	—[a]	3.3	(1.3)	2.7	(0.9)
C4. High on all	—[a]	—[a]	—[a]	—[a]	1.7	(1.0)	1.2	(0.6)
C5. High on all but emotional dyscontrol	—[a]	—[a]	—[a]	—[a]	1.7	(1.0)	1.1	(0.6)
C6. High on none	4.0	(3.5)	19.8	(16.7)	—[a]	—[a]	5.4	(2.6)
Total	14.8	(6.8)	31.0	(16.7)	16.7	(2.8)	19.9	(4.8)
HD-only restrictive								
C2. High only on hyperactive	—[a]	—[a]	16.5	(11.9)	—[a]	—[a]	4.0	(3.0)
C4. High on all	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
C5. High on all but emotional dyscontrol	3.8	(3.9)	2.4	(2.3)	1.1	(0.8)	1.7	(0.8)
C6. High on none	5.2	(4.1)	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Total	10.3	(6.1)	19.4	(12.1)	1.1	(0.8)	6.3	(3.1)
HD-only non-restrictive								
C2. High only on hyperactive	—[a]	—[a]	1.2	(1.3)	—[a]	—[a]	—[a]	—[a]
C3. High only on emotional dyscontrol	1.9	(1.9)	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
C4. High on all	1.4	(1.0)	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
C6. High on none	33.9	(22.0)	11.2	(10.5)	—[a]	—[a]	6.2	(3.9)
Total	37.4	(21.0)	13.2	(10.5)	0.6	(0.6)	7.0	(3.8)
Combined type								
C1. High only on executive dysfunction/inattention	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
C2. High only on hyperactive	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
C4. High on all	12.0	(5.6)	13.3	(8.8)	36.1	(3.6)	28.5	(3.7)
C5. High on all but emotional dyscontrol	14.0	(7.2)	2.1	(1.1)	25.0	(3.2)	18.5	(2.7)
C6. High on none	2.2	(2.3)	—[a]	—[a]	1.7	(1.0)	1.4	(0.7)
Total	29.0*	(11.3)	16.3*	(9.1)	63.3	(3.6)	49.0	(4.8)
(*n*)[b]	(61)		(92)		(180)		(333)	

*Significantly different from the proportion in the NYU Langone sample at the 0.05-level.

[a]Means < 1.0% of sample, not reported.

[b]The numbers of respondents with ADHD in the NCS-R and health plan samples are considerably more than the numbers expected by multiplying the prevalence estimates in Table 2 by the total sample sizes, as respondents who screened positive for ADHD in the first phases of those samples were over-sampled in the second-stage (NCS-R) and second/third-stage (health plan) samples considered here. Weights were introduced to correct for this over-sampling in calculating the prevalence estimates in Table 2.

and emotional dyscontrol should be considered in future revisions of the DSM.

Our simulation showed that four correlated sub-factors underlie the strong first principal factor among adult ADHD symptoms. Although these four factors have an intuitive interpretation, they are inconsistent with all but one previous factor analysis of expanded ADHD symptoms. As noted in the introduction, the finding of a 2-factor structure in studies of the WRAADDS (Marchant et al., 2013; Marchant et al., 2015) should not be considered in this comparison, as this was a methodological artifact. That is, it was impossible to find more than two factors in those studies because only seven underlying subscales were used as the basis of the factor analyses. However, our own prior analysis of the NCS-R and health plan samples found only three of these four factors: inattention/executive dysfunction, hyperactivity, and impulsivity. The emotional dyscontrol factor emerged only when we added the NYU Langone patient sample to the analysis. A somewhat different 4-factor solution than ours was found in the original exploratory factor analysis of the CAARS (Conners et al., 1999) as well as in a subsequently confirmatory factor analysis of that solution in a Spanish sample (Amador-Campos et al., 2014). However, a German replication of the CAARS factor analysis found evidence for an emotional dyscontrol factor along with inattention/executive dysfunction, hyperactivity, and impulsivity factors after excluding CAARS items with strong cross-loadings and weak loadings on all factors (Christiansen et al., 2011).

We are not aware of any previous investigation of multivariate adult ADHD symptom profiles comparable to our cluster analysis. We found evidence for the traditional distinctions among AD-only (C1), HD-only (C2), and combined (C4–C6) presentations, but the

HD-only presentation was specific to hyperactivity rather than also including high impulsivity. No impulsivity-only presentation emerged in the analysis. Instead, high impulsivity was found only in the combined presentations. The three combined presentations differed in that one (C4) was characterized by high scores on all four factors, another (C5) by high scores on all factors other than emotional dyscontrol (C5), and the last (C6) by below-average scores on all factors.

It is noteworthy that the 20.9% of respondents meeting DSM-5/ACDS criteria for adult ADHD who had an AD-only symptom profile is not dramatically higher than the 13.9% of DSM-5/ACDS cases who had an HD-only profile. This finding is inconsistent with the widely-accepted view that the AD-only presentation is much more common than the HD-only presentation in adult ADHD. An important reason for this discrepancy can be seen in Table 2, where we showed that the DSM-5 AD-only presentation was as common as the HD-only presentation in the community samples (i.e. the NCS-R and health plan samples), but much less common than the AD-only presentation in the treatment sample (i.e. the NYU Langone sample), suggesting that there is a treatment selection bias in favor of AD-only cases. This observation is worthy of future examination of the prevalence of narrowly-defined HD-only in unrestricted population samples of adults. Narrowly-defined HD-only has low prevalence among youth, but it might be that the results of our cluster analysis are due to a much higher proportion of these youth retaining their symptoms in adulthood than youth with an AD-only profile. If so, this would be a new and potentially important finding.

Virtually all respondents with the AD-only presentation and with the combined presentations featuring high factor scores met DSM-5/ACDS criteria for adult ADHD. This suggests that high inattention/executive dysfunction and high impulsivity (which, as noted earlier, occurred only in the combined presentations) are specific to adult ADHD. In comparison, only about half the respondents with the HD-only presentation met DSM-5/ACDS criteria for adult ADHD, suggesting that high HD is less specific to adult ADHD. And virtually none of the respondents in the emotional dyscontrol-only cluster met DSM-5/ACDS criteria for adult ADHD, suggesting that high emotional dyscontrol in the absence of high AD and high HD is strongly suggestive of the absence of adult ADHD.

It is instructive to compare C3 (high only on emotional dyscontrol) and C6 (below average on all factors) in this regard, as both clusters have very similar scores on all factors other than emotional dyscontrol. Cluster C3 would be considered the more severe of the two clusters in that it featured high emotional dyscontrol while C6 did not. Yet only 0.5% of respondents in C3 met DSM-5/ACDS criteria for adult ADHD compared to 60.6% in C6. It is unclear what to make of this result. Other research suggests that emotional dyscontrol is common in adult ADHD (Surman et al., 2013; Vidal et al., 2014), shows familial association with ADHD (Surman et al., 2013), and predicts the longitudinal course of ADHD (Biederman et al., 2012). But our finding that uniquely elevated emotional dyscontrol is indicative of an absence of adult ADHD suggests that emotional dyscontrol is more a comorbidity than a central feature of adult ADHD. However, an important caution here is that emotional dyscontrol was operationalized more narrowly in the ACDS than in those other studies, with the ACDS including only one indicator of affective lability ("frequent mood changes") and three indicators of emotional over-reactivity ("easily overwhelmed", "sensitive to criticism", "difficulty expressing anger"). It would consequently be valuable to replicate our cluster analysis in independent samples that had more exhaustive evaluations of emotional dyscontrol.

In interpreting the associations of cluster profiles with the DSM-5 specification of presentations it is important to recognize that our cluster analysis was based on standardized factor scores in which standardization was normed to the distribution of symptoms among people with adult ADHD symptoms. This means that our characterization of symptoms as high versus low was not based on DSM-5 thresholds but rather on the distributions in the sample. In addition, we gave equal weight to the symptoms in each of the four observed factors. The DSM-5 distinctions, in comparison, reflect threshold decisions using reduced sets of symptoms in which symptoms of hyperactivity and impulsivity are down-weighted (in the sense that they are combined into one dimension rather than two) relative to symptoms of inattentiveness. It is unclear whether the cluster-based profiling approach would have any advantages over the DSM-5 approach in predicting differential treatment response or in improving understanding of the underlying pathophysiology of adult ADHD, but this question could be the subject of future study, possibly in the context of more elaborate and objective characterizations of executive dysfunction (Barkley, 2012; Brown, Reichel, & Quinlan, 2009; Dehili, Prevatt, & Coffman, 2013) and emotional dyscontrol (Surman et al., 2013; Surman et al., 2015; Vidal et al., 2014).

Although our analysis had a number of strengths, including a large sample size, diverse sample composition, and assessments based on semi-structured clinical interviews rather than self-report scales, the data we worked with also had three important limitations. First, as noted earlier, the ACDS assessment of emotional dyscontrol was less differentiated than the assessments in other recent studies. It would be valuable to determine the sensitivity of our results to an expanded assessment of emotional dyscontrol. Second, our assessment did not include any of the performance-based measures of neurocognitive functioning used in a number of other recent studies of adult ADHD (e.g. Dehili et al., 2013; Micoulaud-Franchi et al., 2016; Surman et al., 2015). It is important to note in this regard that the concept of "executive dysfunction" is heterogeneous and that different behavioral and neurocognitive measures are often only weakly correlated with each other (Biederman et al., 2008). Third, we did not assess comorbid disorders in a uniform fashion across samples, making it impossible to carry out an investigation of the extent to which the factors and clusters documented here are specific to adult ADHD.

Within the context of these limitations, we found that virtually all of the expanded symptoms had factor loadings on the first unrotated principal factor of adult ADHD symptoms comparable to those of DSM-5 symptoms. This finding supports the importance of executive dysfunction and emotional dyscontrol in many patients with adult ADHD, suggesting that clinicians should consider including these additional symptoms in their evaluations of patients for adult ADHD as they might provide targets for treatment with medication or cognitive behavior therapy. We also found four meaningful factors among these symptoms. One of these factors shows that DSM-5 AD symptoms are part of a larger executive dysfunction/inattention factor, while others show that hyperactivity and impulsivity can be distinguished in adult ADHD and that emotional dyscontrol is a distinct component of adult

ADHD. Finally, we found that empirically derived symptom profiles based on cluster analysis are broadly consistent with the DSM-5 distinctions among AD-only, HD-only, and combined presentation, but that a considerably higher proportion of cases are characterized in this empirically-derived scheme as having the combined presentation than in the DSM-5 scheme. Although the data we presented shed no light on the extent to which this cluster-based scheme would have any advantages over the rationally-derived DSM-5 scheme in improving our understanding of adult ADHD, this is a question that could be investigated in future studies using external validators such as impairment and family history.

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DECLARATION OF INTEREST STATEMENT

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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