



# A CHC Theoretical Approach to Examining Cognitive and Academic Deficits Among Students with ADHD Using a Three-Battery Configuration

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## Introduction

- In the United States, it is estimated that over six percent of students are diagnosed with Attention-Deficit Hyperactivity Disorder (ADHD) with a global prevalence rate of five percent. Students with ADHD often exhibit symptoms of various neuropsychological, behavioral, cognitive, academic, and social interaction problems, which are usually first identified by a parent or teacher and referred to a school psychologist for further review (Barkley & Murphy, 2005; DuPaul, & Stoner, 2014; Nijmeijer et al., 2008). Common co-occurring disorders reported among students diagnosed with ADHD include “learning disorders, oppositional defiant disorder, conduct disorder, depressive disorder, and anxiety disorder” which often impact academic functioning, behavioral, and social interactions (Muskin, 2014; Sattler, 2008). Due to the challenge of distinguishing normal behaviors and developmental delays of students from clinically significant impairment, a psychoeducational evaluation is frequently initiated to establish whether the behaviors constitute deficits that significantly limit daily life activities and academic achievement.
- The current study expands on the current knowledge of research into the assessment of cognitive and academic deficits of students diagnosed with ADHD (Pinto, Rijdsdijk, Ronald, Asherson, & Kuntsi, 2016; Sorge, Toplak, & Bialystok, 2016; Tamm et al., 2016). Current research into ADHD and CHC factor scores have been examined (Rowland, 2013; Sjöwall, Roth, Lindqvist, & Thorell, 2013), but few studies have evaluated the discrepancies in CHC factor scores of students diagnosed with ADHD in comparison to healthy controls using the updated WJ-IV three battery configuration. With little research on the WJ-IV three battery configuration, this study expands on the limited research into the discrepancies among students with ADHD in comparison to healthy controls using CHC factor scores.

CHC Factor	ADHD		Control		p
	Mean	SD	Mean	SD	
Gc-Comprehension-Knowledge	87.06	9.08	89.59	13.43	.389
Gf-Fluid Reasoning	81.74	12.60	81.29	13.14	.891
Gwm-Short-Term Working Memory	90.26	12.37	87.35	11.05	.334
Gs-Cognitive Processing Speed	81.65	13.80	85.68	9.88	.190
Ga-Auditory Processing	78.39	10.84	87.46	14.26	.007
Glr-Long-term Retrieval	79.77	11.40	91.80	14.53	.001
Gv-Visual Processing	91.19	9.28	91.69	14.41	.871

Broad Cluster	ADHD		Control		p
	Mean	SD	Mean	SD	
Broad Reading	77.97	16.61	84.64	15.18	.104
Broad Mathematics	77.10	18.10	82.52	11.99	.168
Broad Written Language	80.45	18.31	83.92	16.87	.441

CHC Factor	F	p	Structure Coefficient	Discriminant Function
Gc-Comprehension-Knowledge	.752	.389	.146	-.036
Gf-Fluid Reasoning	.019	.891	-.023	.052
Gwm-Short-Term Working Memory	.950	.334	-.164	-.567
Gs-Cognitive Processing Speed	1.76	.190	.224	.001
Ga-Auditory Processing	7.95	.007	.476	.803
Glr-Long-term Retrieval	13.16	.001	.612	.890
Gv-Visual Processing	0.026	.871	.027	-.464

## Method

### Subjects

- Data for this study was obtained from 12 schools in a large urban district in the northwestern corner of Arizona that had students with an ADHD diagnosis and standardization data from the WJ-IV. The district has twelve school sites with a total of 7,223 students. Class sizes average 22 students with 380 certified teachers, 4 full time school psychologists, and 2 full time school psychology interns. The ADHD group data came from students referred for a re-evaluation with an educational eligibility of Other Health Impairment and a diagnosis of ADHD to determine re-eligibility of special education services as required by IDEA. The control data came from the Woodcock-Johnson® IV standardized data. Subjects for the ADHD group included 31 students diagnosed with ADHD. Healthy control subjects included 31 students with no clinical diagnosis derived from the standardization data from the Woodcock-Johnson® IV (WJ IV®). Copyright © 2014 by Riverside Assessments LLC. All right reserved. Used by permission of the publisher.

### Measure

- Diagnostic interview. Licensed school psychologists collected diagnostic data during initial intake interviews. Requested information included age, grade, sex, ethnicity, family history, developmental and medical history of complaints, developmental milestones, and symptomology associated with the student's referral
- Woodcock-Johnson® IV Tests of Cognitive, Academic, and Oral Abilities (WJ IV COG, WJ IV ACH, WJ IV OL). The WJ IV COG is an assessment used to measure the broad and narrow cognitive abilities of individuals from 2 to 90 years.
- The WJ IV ACH is an assessment used to measure academic abilities of individuals from early childhood to adulthood.
- The WJ IV OL is an assessment used to measure oral language, listening comprehension, oral expression, and auditory and memory span of individuals between early childhood and adulthood.

## Results

- A (MANOVA) was conducted to determine whether CHC factor scores could distinguish differences in cognitive performance among the ADHD and control group. There was a statistically significant difference between the ADHD and control group on the combined dependent variables. However, when the results for the dependent variables were considered separately, the only differences to reach statistical significance were Auditory Processing, and Long-term retrieval. A review of the mean scores determined that subjects in the control group had higher scores on Auditory Processing and Long-term Retrieval compared to subjects in the ADHD group as seen in Table 4.
- A second (MANOVA) was conducted to determine if CHC factor scores could distinguish differences in academic performance among the ADHD and control group. There were no statistically significant differences between subjects in the ADHD and control group on the combined dependent variables, as seen in Table 5. Based on the results of the MANOVA's, significant differences was reported among the two groups in cognition only. Specifically long-term retrieval and auditory processing.
- In order to establish group membership a discriminant function analysis (DFA) was conducted to determine if student performance properly aligned into the ADHD group or the control group in the areas of cognitive performance. The results of the discriminant function indicated significant differences between the two groups. Based on the discriminant loadings of the factors, long-term retrieval and auditory processing displayed the strongest ability in discriminating between the two groups. The mean discriminative scores indicate that the ADHD students display overall lower scores on the seven factors in relationship to the control group. Subjects in the control group recalled more prior learned information and were able to process auditory information with greater ability than the ADHD group. Performance in long-term retrieval indicated higher capability in identifying group membership than auditory processing as seen in Table 6.

## Conclusion

- The current study found that differences between students with ADHD compared to healthy controls may depend largely on the ADHD subtypes. Students with ADHD-Inattentive tend to display deficits in executive functioning and have higher incidences of learning disabilities. However, students with ADHD-Hyperactive and Combined Presentation display deficits in social and emotional behavior. Based on the findings of the current study, it could be assumed that many of the ADHD subjects within the study presented with Hyperactive and Combined Presentations of the disorder. These findings are useful when implementing interventions to support individual cognitive and academic success.
- Secondly, the study found that differences between the ADHD and control group in auditory processing and long-term retrieval could expand the utilization of the CHC model when assessing students with ADHD for a comorbid diagnosis of auditory processing disorder. The three-battery configuration explored cognitive, academic, and oral skills among students which can be interpreted using the CHC model to define deficits specific to individual student needs. As found within the current study, the CHC model identified deficits among students with ADHD and alluded to potential uses of specific CHC factors to assist in identifying auditory processing concerns that may warrant further investigation.

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