The Use of WJ Arabic Tests to Investigate the Cognitive Profiles of Gifted Students

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Abstract

The Cattell-Horn-Carroll (CHC) factors of the Woodcock-Johnson Arabic Tests of Cognitive and Achievement Abilities were studied with a group of gifted students (*n*60) and average studen

ts (*n*60) between second and fifth grades. The major purpose of this study was to identify the cognitive and achievement variables that underlie performance differences between gifted students and average students. Specifically, this study was conducted using the CHC factors which identified by the WJ Arabic Tests. The two groups were matched on grade, gender, age, and father's level of education. The findings indicated that there were statistically significant differences between gifted students and average students in all study variables, and these differences were in favor of gifted students. In addition, the hierarchical multiple regression analyses in this study revealed that the best model of predicting students' GPA consisted of the WJ Arabic Achievement Tests with a higher contribution from Calculation Test. Implications of the findings were also discussed.

Keywords: Gifted Students, Woodcock-Johnson Arabic Tests, Cattell-Horn-Carroll Theory.

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استخدام اختبارات الوودكوك جونسون العربية للبحث في الملامح المعرفية للطلبة الموهوبين

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ملخص

هدفت هذه الدراسة للبحث في عوامل الذكاء في نظرية كاتل–هورن–كارول للذكاء (CHC)، والتي استندت عليها اختبارات الوودكوك–جونسون العربية للقدرات المعرفية والتحصيلية. تم تطبيق هذه الدراسة على مجموعة من الطلبة الموهوبين والطلبة العاديين (متوسطي الذكاء)، حيث تكونت العينة من 60 طالب موهوب، و60 طالب متوسط الذكاء، والذين تتراوح صفوفهم بين الثاني والخامس الأساسي. الهدف الرئيس من هذه الدراسة هو التعرف المتغيرات المعرفية والتحصيلية التي تكمن وراء اختلاف الأداء بين الطلبة الموهوبين ومتوسطي الذكاء. تم مطابقة المجموعتين بناء على مستوى الصف، والجنس، والعمر، والمستوى التعليمي للأب، وأظهرت النتائج وجود فروق ذات دلالة إحصائية بين الطلبة الموهوبين والطلبة متوسطي الذكاء في جميع متغيرات الدراسة، وهذه الفروق لصالح الطلبة الموهوبين. بالإضافة إلى ذلك، كشفت التحليلات الانحدارية المتعددة الهرمية في هذه الدراسة أن أفضل نموذج للتنبؤ بالمعدل التحصيلي التراكمي للطلبة يتألف من اختبارات الوودكوك جونسون العربية التحصيلية مع المساهمة الكبرى لاختبار الحساب. التطبيقات العملية لنتائج الدراسة تم مناقشتها أيضًا في الختام.

الكلمات الدالة: الطلبة الموهوبون، اختبارات الوودكوك جونسون العربية، نظرية كاتل هورن–كارول.

Researchers (Borland, 2009; Marland Report, 1972) estimate that approximately 3% to 5% of the school-age population were gifted students. Comparable prevalence was suggested in Jordan and Arab world as well (Abu-Hamour & Al-Hmouz, 2014). In view of this fact, it is of critical importance to conduct accurate assessment to investigate the cognitive profiles of Jordanian gifted students then use the results in Arabic educational system. Assessment is a systematic process of collecting data that can be used to make decisions about students (Reynolds, Livingston, & Willson, 2006; Salvia & Ysseldyke, 2009). We assess students to learn what we need to do to serve their needs. We also assess students to determine if what we are doing is effective. Today, more than ever, student diversity typifies the general education classroom (Tomlinson, 2004). In most classrooms, the range of cognitive abilities is vast. Inclusion and legislative mandates challenge general educators to design and implement teaching and behavior management strategies that will ensure success for all student groups—including the gifted and highly able. Research indicates, however, that a majority of psychologists and teachers have little specific knowledge (e.g., the cognitive abilities) about this group of children (Archambault, 1993; Westberg & Daoust, 2003; Whitton, 1997). Practitioners should also be knowledgeable about the needs of gifted students and seek out appropriate training.

Jolly (2005) provided the 2004 federal definition of gifted as: "The term 'gifted and talented students' means children and youth who give evidence of high performance capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by the school in order to fully develop such capabilities (p. 38)". Fortunately, the evolution and refinement of theory- and research-based tests measuring multiple abilities have also given professionals the opportunity to gain a better understanding of an individual’s unique characteristics, and specifically gifted students. For example, to link the theory with the practice, there has been considerable research linking academic achievements to specific psychological processes, or “cognitive abilities.” Much of the current literature has focused on the broad and narrow cognitive abilities as identified by the Cattell–Horn–Carroll (CHC) theory of cognitive abilities (Flanagan & Harrison, 2005).

The Cattell, Horn, and Carroll (CHC) Theory

Recent advances in current theory and research on the structure of human cognitive abilities have resulted in a new empirically derived model commonly referred to as the *Cattell-Horn-Carroll Theory* (CHC theory) (McGrew, Laforte, & Schrank, 2014). The CHC theory of cognitive abilities is identified by researchers as one of the most validated models of cognitive abilities (Flanagan, Ortiz, &Alfonso, 2013; McGrew, 2005). CHC theory is grounded in a body of historical analytic research, as well as developmental studies of cognitive abilities, neurocognitive analyses, and research on genetic heredity research to substantiate its validity (Horn & Noll, 1997). Currently, most well-known intelligence tests (e.g., Woodcock-Johnson Cognitive and Achievement Tests—4th edition; Wechsler Intelligence Scale for Children—5th edition; Stanford-Binet Intelligence Scale—5th edition) work to be aligned with a stratified model of intellectual abilities defined and refined by Cattell, Horn, and Carroll. For example, the fundamental criteria for developing cognitive abilities in the Woodcock-Johnson Cognitive and Achievement Tests (WJ IV) were derived from the CHC theory of cognitive abilities as described in the WJ IV examiner's manual (Mather & Wendling, 2014). CHC Theory is a three-level model of human cognitive abilities that includes general intelligence (*g*), nine broad cognitive abilities, and more than 100 narrow cognitive abilities (McGrew, 2005). The broad CHC abilities measured by the WJ IV are: Long-Term Retrieval (*Glr*), Auditory Processing (*Ga*), Fluid Reasoning (*Gf*), Processing Speed (*Gs*), Short-Term Working Memory (*Gwm*), Visual-Spatial Thinking (*Gv*), Comprehension-Knowledge (*Gc*), Reading-Writing (*Grw*), and Quantitative Knowledge (*Gq*) (see Table 1 for definitions).

Previous Studies

In terms of previous studies, Matthews (2004) stated that intellectual ability has been the hallmark of any definition of gifted since its early origins. Terman, who is considered the father of gifted education, defined gifted as performance in the top two percent on a standardized test of intelligence (Heward & Orlansky, 1992; Jolly, 2005). In 1958, Witty described gifted as having performance that is remarkable in any area

(Heward & Orlansky, 1992), while others define giftedness as the top five percent of the population (Coleman, 2004; Cramond, 2004; Jolly, 2005).

Table (1) Broad CHC Cognitive Factor Definitions

Factor	Symbol	Definition
Fluid Reasoning	*Gf*	Ability to reason, form concepts, and problem solve, using novel information and/or procedures
Comprehension-Knowledge)	*Gc*	Measures an individual's breadth and depth of general knowledge of a culture, including verbal communication and reasoning with previously learned procedures
Visual Processing	*Gv*	Ability to analyze and synthesize visual information
Auditory Processing	*Ga*	Ability to analyze and synthesize auditory information
Processing Speed	*Gs*	Ability to quickly perform automatic cognitive tasks, particularly when under pressure to maintain focused concentration
Short-Term Working Memory	*Gwm*	Ability to temporarily hold information in immediate awareness and then use it within a few seconds
Long-Term Retrieval	*Glr*	Ability to store information and retrieve it later through association
Quantitative Knowledge	*Gq*	Ability to comprehend quantitative concepts and relationships and to manipulate numerical symbols
Reading-Writing	*Grw*	A common factor underlying both reading and writing, including basic reading and writing skills and the skills required for comprehension and expression.

Source: (Mather & Wendling, 2014).

In practice, schools have traditionally defined giftedness in terms of intellectual ability. This has been the consensus approach since Terman's initial study of giftedness in the 1920s (Winner, 2000) and, consequently, IQ tests have been the most widely used tool for its assessment (Callahan, 2000). However, most of the literature on the identification of gifted and talented students has suggested the use of multiple criteria including scores on standardized measures of cognitive ability, academic achievement, classroom performance, teacher reports, and parent nomination (Davis & Rimm, 1994; Renzulli & Reis, 1997). Similarly, Kaufman and Harrison (1986) support the use of multiple criteria for assessing gifted and talented but they strongly encourage the use of intelligence tests. Indeed, it is common practice for gifted education programs to weight standardized test scores (e.g., intelligence and achievement tests) heavily in identification decisions of gifted students (Callahan, 2005).

Regarding the predictive validity of intelligence tests in predicting gifted students, Newton, McIntosh, Dixon, Williams, and Youman (2008) investigated the accuracy of three shortened measures of intelligence for predicting giftedness as assessed by the Stanford–Binet Intelligence Scale, Fifth Edition-Full Scale IQ score (SB5 FSIQ): the Woodcock– Johnson Tests of Cognitive Ability, Third Edition Brief Intellectual Ability (WJ III COG BIA) score; the Stanford–Binet Intelligence Scale, Fifth Edition Abbreviated IQ (SB5 ABIQ); and the Kaufman Brief Intelligence Test IQ Composite (K-BIT). The results revealed that overall, the WJ III score was the most accurate and the K-BIT score was the least accurate in identifying giftedness using the SB5 Full Scale. Other studies highlight the cognitive differences between gifted students and their average counterparts. For example, Rizza, McIntosh, and McCunn (2001) investigated the WJ III CHC factors among a group of gifted individuals and typical individuals. The researchers found that gifted students performed significantly higher across the CHC factor clusters compared to the typical group. Thus, these results were very promising for researchers to use intelligence tests to investigate the cognitive profiles of gifted students for the purpose of early identification that lead to appropriate intervention as well. For example, the most frequently noted cognitive characteristics of gifted students were early language development and reading (Hodge & Kemp, 2000; Jackson, 2003; Sankar-De-Leeuw, 2004), however other common patterns also exist.

Among these were strong verbal and visual memory (Harrison, 2004; Sankar-DeLeeuw, 2004); intense curiosity and sustained attention spans (Hodge & Kemp, 2000; Rotigel, 2003); development of advanced mathematical reasoning (Gavin, Casa, Adelson, Carroll, & Sheffield, 2009; Harrison, 2004; Sankar-DeLeeuw, 2004); and the capacity for abstract thinking (Walker, Hafenstein, & Crow-Enslow, 1999). To the best of the researcher knowledge, previous work was not conducted to explore the cognitive profiles of gifted students and among Arabic speaking students using Woodcock-Johnson Arabic Tests. Using standardized assessments to investigate the cognitive profiles of Jordanian gifted students is a necessity in Jordan as well as other Arab countries to provide better understanding for the needs of these students as early as possible. Fortunately, an Arabic version of Woodcock-Johnson Cognitive and Achievement Tests (WJ IV COG and ACH) have been standardized recently and can be used to identify the cognitive profiles of gifted students in Jordan (WJ IV; Abu-Hamour, Mattar, & Al-Hmouz, 2016; Schrank, McGrew & Mather, 2014) (see Method section for more details).

Significance of the Study

Given the high prevalence of giftedness in the general school population, a good strategy to understand gifted students and to investigate the underlying cognitive factors that influence their performance is needed. Cognitive assessment is not only relevant, but it is essential for the accurate identification of gifted students. As research continues to increase our knowledge of the relationships among cognitive abilities and achievement, more and more educators are taking advantage of that knowledge and applying it to their teaching and evaluation practices. Recurring themes and findings from the literature provide a strong rationale for an increased focus on the needs of young children who show signs of potential. Numerous researchers underscore the importance of early educational intervention for gifted children, arguing that gifted education should follow the lead of special education in recognizing individualized needs as early as possible in order to provide responsive instructional environments to allow for potential to be actualized (Brighton, Moon, Jarvis, & Hockett, 2007; Porter, 2005).

Furthermore, it is important for educators as well to promote the early and accurate identification of gifted students who are at-risk of academic failure (Abu-Hamour, Urso, & Mather, 2012). Because variation exists within and among gifted students, it is perfectly normal to have significant strengths and weaknesses within the same student; a child who struggles with reading may have spectacular gifts in math (Abu-Hamour et.al., 2012; Gilger & Hynd, 2008). Thus, evaluators need to pay attention to individual differences and create appropriate instructional goals for students who are identified as being advanced or gifted in one academic domain, but not in another. Understanding the cognitive profile of gifted students is an essential first step for developing appropriate identification tools and intervention methods to improve their abilities. It is a myth that gifted students will make it without positive and supportive interventions from school and family.

Problem and Context of the Study

May be the biggest issue currently in the Jordanian national educational system that identifying gifted students and providing them with appropriate programs are not integrated under the provision of inclusion to provide fair opportunities for all gifted students across the country. Unfortunately, most of the gifted students in Jordan do not receive the appropriate or necessary assessment and intervention services needed to maximize their developmental trajectories. In addition, gifted programs and assessment services are rarely offered in preschool and early primary elementary grades for a variety of reasons including limited public school funding and the belief by some that young gifted and potentially gifted students do not require services. Therefore, what services that are available for these youngsters are typically provided through one of two avenues: acceleration such as in early entrance to first grade, grade skipping, or subject-specific content-focused acceleration; and enrichment programs such as moving to another teacher for math only but staying with same-age peers for all other school-day activities. In Jordan, there are specialized schools and centers for distinguished students that takes care of their creative abilities. As many as 1045 students in grades 7 to 12 are served in three established schools for gifted students. Pioneer centers programs for gifted students were established as well. There are 18 pioneer centers distributed throughout Jordan serving about 1700 students in the seventh grade and above. In addition, resource room programs are provided for gifted students from grades 3 to 10. There are 24 resource rooms that serve 505 gifted students across Jordan (Abu-Hamour & Al Hmouz, 2014).

Considering the lack of information about the cognitive profiles of Jordanian gifted students using CHC theory, this study examines this field of research. Thus, the final aim of this study is to make recommendations to enhance the quality of the gifted research and practice in Jordanian education system. The study problem is represented by the following questions:

Study Question 1: How will gifted students perform on the WJ Arabic Tests?

Study Question 2: What are the differences between gifted students and average students on WJ Arabic Tests that measure CHC factors?

Study Question 3: What is the best model among the WJ Arabic Tests for predicting students' achievement (gifted students and average students) that represented by their Grade Point Average (GPA)?

Study Delimitations and Limitations

- Participants were from Jordan and the generalizability of findings to other Arab countries, geographic areas, and students should be investigated further.
- The results of this study may not be generalized to other grades not targeted in this study.

Method

Participants

The sample included 60 gifted students and 60 average students between second and fifth grades. Participants were recruited from two private schools in the central region of Jordan. Two coordinated teachers worked closely with the researcher to choose the samples. In the Jordanian educational system, students are ordered and assigned a numerical rank compared with their peers, starting with 100 for the student with the highest GPA and 0 for the student with the lowest GPA. Students in the average group were required to have a GPA of 67 and above. In addition, these students must have intelligence within the average range, native speakers of Arabic, no noted emotional or behavioral disorders, no noted attention disorders and no sensory impairments.

Gifted students were primarily identified by classroom teachers who used a custom-made survey that addressed the major characteristics of gifted students, and other inclusion criteria for the study (e.g., native speakers of Arabic, no noted emotional or behavioral disorder, no noted attention disorders, and no sensory impairments, and no learning disabilities) to make eligibility decisions. In addition, each student was placed in gifted and talented education program (Applied Cognitive Science to Enhance Learning) in his/her school. Finally, for the purpose of this study, only top 5% of the class in their general achievement were included in the study as gifted students.

All participants were chosen purposefully to match the study groups and consent forms were sent to parents seeking their permission for participation. Parents who agreed to let their children participate in the study were requested to complete a short questionnaire that addressed the inclusion criteria of this study. The participants were selected from a larger set of students (416) who were assessed to meet the requirements for inclusion in the study. The two groups of this study were matched on grade, gender, age, and father’s level of education. Each group consisted of 30 females and 30 males. The mean age in months for the gifted group was 100.68 (*SD* = 13.98) and the mean age in months for the average group was 101.67 (*SD* = 14.96). The mean for the two groups is not exactly the same due to how the groups were matched. However, there was no difference in mean age in months between the two groups, t (118) = -.372, p = .711. Socio-economic status was based upon the father’s highest level of education. For each group, 21 had 1–3 years of college, and 39 had a Bachelor degree or higher.

Instrumentation

The Arabic version of Woodcock-Johnson Cognitive and Achievement Tests (WJ IV COG and ACH) were used to assess the cognitive and achievement skills of the participants (WJ IV; Abu-Hamour et al., 2016; Schrank et al., 2014). The WJ Arabic Tests are based on the Jordanian local norms that have been established in Jordan for individuals ranging in age from 4 years to 22 years. The WJ Arabic Tests are a comprehensive, norm-referenced, individually administered assessment of cognitive abilities and achievement. In general, the internal consistency reliability estimates for all WJ Arabic measures are uniformly high, most often with magnitudes in the .80s and .90s for individual tests, and in the .90s for clusters; and scientific indicators of content, construct, and discriminant validities are provided in the Test's Manual (Abu-Hamour et al., 2016). The WJ Arabic battery is a perfect tool to identify gifted students since it relies on assessing multiple criteria of Cognitive and Achievement abilities by using Cattell-Horn-Carroll theory of cognitive abilities (CHC theory). To conduct this study, the following WJ Arabic Tests were selected:

Test 1: Verbal Comprehension. Verbal Comprehension includes three subtests: 1A) Picture Vocabulary, 1B) Synonyms, and 1C) Antonyms. Picture Vocabulary measures aspects of lexical knowledge. The task requires the person to identify pictures of familiar and unfamiliar objects. The items become increasingly difficult as the selected pictures appear less frequently in the environment or represent less familiar concepts. Synonyms measure an aspect of vocabulary knowledge. The task requires hearing a word and then providing a synonym. Antonyms measure a counterpart aspect of vocabulary knowledge. The task requires hearing a word and then providing an antonym. Verbal Comprehension is a measure of Comprehension-Knowledge (*Gc*).

Test 2: Reasoning. 2A) Number Series is a test of Fluid Reasoning (*Gf*). In this test the subject is presented a series of numbers with one missing that could be found according to mathematical logic. 2B) Concept Formation is a test of Fluid Reasoning (*Gf*). This controlled-learning task involves categorical reasoning based on principles of inductive logic. This test also measures aspect of executive processing-flexibility in thinking when required to shift one's mental set frequently. The subject is presented with a complete stimulus set from which to derive the rule for each item. With the exception of the last items, the subject is given immediate feedback regarding the correctness of each response before a new item is presented.

Test 3: Orthographic Matching. Orthographic Matching is a test of processing speed (*Gs*). More specifically, it is a measure of perceptual speed. This task measures an aspect of cognitive efficiency-the speed at which an individual can make visual symbol discriminations. The subject is asked to locate and circle the two identical letters or syllables in a row of six letters or syllables. This task proceeds in difficulty from single letters to four-letter syllable and has a 3-minute time limit.

Test 4: Verbal Attention. Verbal Attention is a test of Short-Term Working Memory (*Gwm*). Although this test primarily measures short-term working memory span, it can also be classified as a measure of working memory or attentional capacity. The test requires the individual to hold a span of numbers and animals in immediate awareness (memory) while performing a mental operation on it.

Test 5: Visualization. 5A) Spatial Relations is a test of Visual-Spatial Thinking (*Gv*). This visualization-of-spatial-relationships task requires the subject to identify the two or three pieces that form a complete target shape. The difficulty increase as the drawings of the pieces are flipped, rotated, and become more similar in appearance. 5B) Block Rotation is a test of Visual-Spatial Thinking (*Gv*). This visual task requires the subject to identify the two similar drawings to the target one that was drawn inside a box. The difficulty increase as the drawings of the pieces are flipped, rotated, and become more similar in appearance.

Test 6 Phonological Processing. 6A) Sounds Substitution is a one measure of the phonological awareness. Because of the nature of items, the audio recording must be used when the test is administered. The test primarily measures Auditory Processing (*Ga*). 6B) Lexical Access is a one measure of the phonological awareness. The test primarily measures Auditory Processing (*Ga*). In this test the subject is asked to recall meaningful words when certain sounds (in the beginning, middle, or the end of the word) are provided. Because of the nature of items, the audio recording must be used when the test is administered.

Test 7: Long-Term Retrieval. 7A) Memory for Names measures the ability to learn associations between unfamiliar auditory and visual stimuli (an auditory-visual association task). At each step in the test, the subject is shown a picture of a space creature and told the creature's name. The subject is then shown a page of nine space creatures and is asked to point to the creatures just introduced and to other previously introduce space creatures as named by the examiner. The subject's errors are corrected in this controlled-learning task. The level of difficulty increases as more "creature-name" associations are introduced. This test primarily measures Long-Term Retrieval *(Glr)*. 7B) Sounds Fluency Recall is a one measure of the phonological awareness. The test primarily measures Auditory Processing (*Ga*). In this test the subject is asked to recall as many meaningful words as he/she can recall in a one minute. These words should start with certain sound to be counted.

Test 8: Letter-Word Identification. Letter-Word Identification measures the subject's word identification skills. The initial items require the individual to identify letters that appears in large type on the subject's side of the Test Book and the remaining items require the person to pronounce words correctly. The individual is not required to know the meaning of any word. The items become increasingly difficult as the selected words appear less and less frequently in written English. The test primarily measures reading ability (*Grw*).

Test 9: Spelling. Spelling measures the ability to write orally presented words correctly. The initial items measure prewriting skills such as drawing lines and tracing letters. The next set of items requires the person to produce uppercase and lowercase letters. The remaining items measures the person's ability to spell words correctly. The items become increasingly difficult as the words become more difficult. The test primarily measures spelling ability (*Grw*).

Test 10: Calculation. Calculation is a test of math achievement measuring the ability to perform mathematical computations (*Gq*). The initial items in Calculation require the individual to write single numbers. The remaining items require the person to perform addition, subtraction, multiplication, division, and combination of these basic operations, as well as some geometric, trigonometric, logarithmic, and calculus operations. The calculations involve negative numbers, percents, decimals, fractions, and whole numbers. Because the calculations are presented in a traditional problem format in the Subject Response Booklet, the person is not required to make any decisions about what operations to use or what data to include.

Procedures

Selected schools were approached by the researcher to coordinate the study work with the principals and teachers. The participants were assessed in the first semester of the 2015 academic year. The data was collected by the researcher and other two certified WJ Arabic Tests examiners. These examiners have a degree in school psychology or educational psychology. During the data collection, the researcher had daily updates and discussions among the examiners team to address the crucial points in the tests' administration and provide feedback. The actual administration time of the WJ Arabic Tests was around two hours and half per student in two to three sessions. Fidelity of administration and interrater reliability of scoring fidelity ranged from 99 to 100%. The Statistical Package for the Social Sciences (SPSS), version 17.0, was used to analyze the data. Descriptive statistics (e.g., means, standard deviations), *t-tests* for independent samples, and Hierarchical multiple regression were used to investigate the study questions.

Results

The following sections present the results for each question explored in this study.

Study Question 1: *How will gifted students perform on the WJ Arabic Tests?*

Means and standard deviations for student's GPA, the WJ achievement tests, and CHC cognitive factors can be found in Table 2. In general, the lowest performance of gifted students included Long-Term Retrieval, Visual-Spatial Thinking, Short-Term Working Memory, and Auditory Processing; while the highest performance areas were observed in Quantitative Knowledge and Reading-Writing (as represented by the WJ Achievement Tests), Comprehension-Knowledge, Processing Speed, and Fluid Reasoning. These results were confirmed by the visual presentation of the mean performance of WJ Achievement Tests and CHC Factors for the Gifted and Average Groups (See Figure 1).

Study Question 2: *What are the differences between gifted students and average students on WJ Arabic Tests that measure CHC factors?*

Table 2 presents *t*-test results for gifted and average groups. Results indicated that there were statistically significant differences, at the .05 level of significance, between gifted students and average students in all study variables, and these differences were in favor of gifted students.

Study Question 3: *What is the best model among the WJ Arabic Tests for predicting students' achievement (gifted students and average students) that represented by their Grade Point Average (GPA)?*

To predict the relative contributions of WJ Achievement Tests and CHC cognitive factors to students' scholastic achievement as measured by students' GPA, both groups (gifted and average) were integrated and hierarchical multiple regression was conducted. This action was taken to produce stronger statistical power, meet the assumptions for performing the regression.

Assumptions were tested by examining normal probability plots of residuals and a scatter diagram of residual versus predicted residual. No violations of normality, linearity, or homoscedasticity of residuals were detected. In addition, box plots revealed no evidence of outliers. Test 10: Calculation, Test 8: Letter-Word Identification, and Test 9: Spelling were entered in the first block because all them were achievement tests. The CHC Cognitive factors were entered in the second block. Regression analyses revealed that the best model of predicting student's GPA consisted of all WJ Achievement Tests (specifically Test 10: Calculation) $F(3, 116) = 65.92$, $p < .001$. R^2 for the model = .43, and adjusted R^2 = .42. Table 3 presents the hierarchical regression predicting students' GPA by the study variables.

Table (1) GPA/WJ Achievement Tests/CHC Factors Means, Standard Deviations, and Results of t-tests for Gifted and Average Groups

	Gifted (n=60)		Average (n=60)		Total (n=120)		95% CI for Mean Difference	
Factor/Test	Mean	SD	Mean	SD	Mean	SD		*t*
GPA	93.62	2.81	79.95	5.95	86.78	8.28	11.98, 15.35	16.07*
LWI	118.20	7.71	100.35	8.38	109.28	12.03	14.93, 20.76	12.13*
Spelling	117.22	10.21	99.50	9.74	108.36	13.33	14.10, 21.32	9.72*
Calculation	120.43	7.70	101.62	8.72	111.03	12.50	15.84, 21.79	12.52*
G*c*	118.97	7.55	100.82	11.23	109.89	13.18	14.68, 21.61	10.38*
G*lr*	110.23	7.66	99.65	13.59	104.94	12.20	6.59, 14.57	5.25*
G*v*	112.77	10.62	99.25	10.92	106.01	12.69	9.62, 17.41	6.87*
G*a*	113.93	8.28	99.92	11.45	106.93	12.18	10.40, 17.62	7.68*
G*f*	116.12	10.87	100.48	10.13	108.30	13.08	11.83, 19.43	8.14*
G*s*	116.30	8.62	100.23	13.83	108.27	14.03	10.89, 20.23	7.63*
G*wm*	112.28	8.22	100.20	14.52	106.24	13.22	7.81, 16.35	5.60*

Note. GPA = Grade Point Average, LWI = Letter-Word Identification Test, G*c* = Comprehension-Knowledge, G*lr* = Long-Term Retrieval, G*v* = Visual-Spatial Thinking, G*a* = Auditory Processing, G*f* = Fluid Reasoning, G*s* = Processing Speed, G*wm* = Short-Term Working Memory. * $p < .05$. CI = Confidence Interval. df = 118.

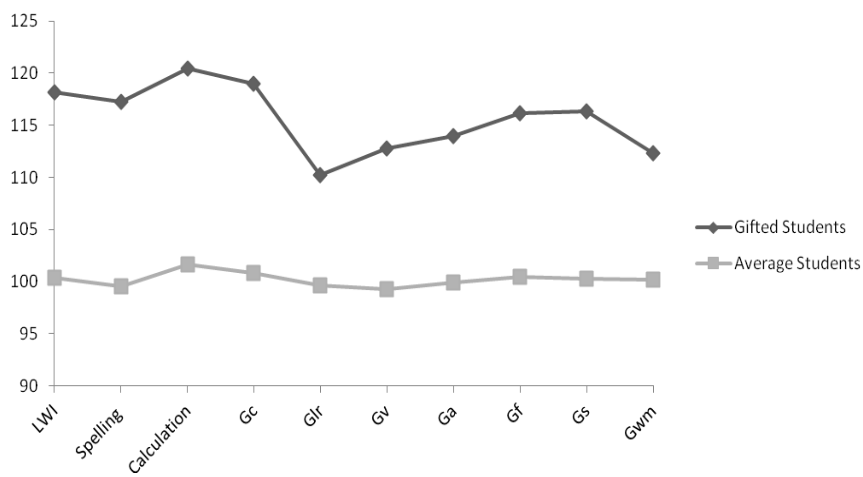

Figure 1. *Mean Scores for WJ Achievement Tests and CHC Factors for the Gifted and Average Groups. Note*. LWI = Letter-Word Identification Test, G*c* = Comprehension-Knowledge, G*lr* = Long-Term Retrieval, G*v* = Visual-Spatial Thinking, G*a* = Auditory Processing, G*f* = Fluid Reasoning, G*s* = Processing Speed, G*wm* = Short-Term Working Memory.

Table (3) ***Hierarchical Regression Predicting Students' GPA by WJ Achievement Tests and CHC Cognitive Factors***

Predictor Variables	**Zero-order r**	**B**	**SEB**	**β**
Step 1 Constant		70.50	1.09	
Calculation	.66	.396	.047	.786
Letter-Word Identification	.51	-.007	.021	-.031
Spelling	.49	-.037	.026	-.126
Step 2		80.16	3.44	

Predictor Variables	**Zero-order r**	**B**	**SEB**	**β**
Constant				
Comprehension-Knowledge	.48	.044	.122	.040
Fluid Reasoning	.34	-.180	.092	-.176
Processing Speed	.38	-.138	.073	-.175
Short-Term Working Memory	.39	.055	.068	.075
Visual-Spatial Thinking	.29	-.218	.090	-.159
Auditory Processing	.35	-.290	.086	-.280
Long-Term Retrieval	.28	-.034	.050	-.042

Note. n = 120. Zero-order r = The ordinary correlations coefficient, B = The un-standardized regression coefficients, SEB = The standard error of B, β = The standardized regression coefficients, $R^{2\,=}$ .43 for Step 1, R square change ($\Delta R^{2)}$ = .096 for Step 2.

Discussion

Research has shown that the CHC broad and narrow cognitive abilities differentially predict performance on academic tasks (Floyed, Evans, & McGrew, 2003) and may be used to investigate the cognitive profiles of gifted students (Rizza et al., 2001). The purpose of this study was to identify the cognitive and achievement variables that underlie performance differences between gifted students and average students. Specifically, this study was conducted using the CHC factors which identified by the WJ Arabic Tests. The WJ Arabic Tests was developed from a blueprint of CHC theory and provides scores for distinct cognitive abilities and areas of academic achievement. The most important results of this study were discussed in the following sections.

Results indicated that there were statistically significant differences between gifted students and average students in all study variables, and these differences were in favor of gifted students. This result is in agreement with previous research (e.g., Gavin et al., 2009; Harrison, 2004; Rizza et al., 2001; Rotigel, 2003; Sankar-De-Leeuw, 2004) which suggested that gifted students performed significantly higher across the CHC factor clusters compared to the average students. As indicated previously, the characteristics of gifted students (e.g., early language development and reading, strong verbal and visual memory, intense curiosity and sustained attention spans, development of advanced mathematical reasoning, and the high capacity for abstract thinking) facilitate their superior performances on cognitive and achievement tests such as WJ Arabic Tests.

However, it is worth documenting that *gifted students display different patterns of performance across the CHC factor clusters.* Specifically, the lowest performance of gifted students included Long-Term Retrieval, Visual-Spatial Thinking, Short-Term Working Memory, and Auditory Processing; while the highest performance areas were observed in Quantitative Knowledge and Reading-Writing (as represented by the WJ Achievement Tests), Comprehension-Knowledge, Processing Speed, and Fluid Reasoning. This observation was consistent with a similar finding by Margulies and Floyd (2009), but in contrast to prior research by Rizza and her colleagues (2001) who found a group of gifted students displayed similar patterns of performance across the CHC factor clusters. The differing results found between the Rizza et al., and the present study were most likely due to sampling differences and criteria used to identify the gifted students. For example, the major inclusion criteria for this study that students were from the top 5% of achievers, identified by classroom teacher as gifted, and placed in gifted program, while the Rizza et al., used the WJ III COG General Intellectual Ability Extended (GIAE) score of 125 or higher as the primary criteria for giftedness. Another explanation for this finding (displaying intra-cognitive discrepancies) that may be gifted students in Jordan are identified and trained mostly on achievement skills and Comprehension-Knowledge, and less attention is given to other cognitive abilities such as Visual-Spatial Thinking or Auditory Processing. The important consideration of this finding, however, is that the WJ Arabic Tests appears to be a good measure when assessing abilities of gifted students.

Finally, besides providing a comprehensive view of the cognitive abilities, one major function of the WJ Tests is to provide statements regarding a person's predicted performance in academic achievement. *The* *hierarchical multiple regression analyses in this study revealed that the best model of predicting students' GPA consisted of the WJ Arabic Achievement Tests with a higher contribution from Test 10: Calculation.* This finding is not surprising since both student's GPA and WJ Arabic Tests of Achievement measure similar two broad factors of CHC theory. These factors were Reading-Writing and Quantitative Knowledge. The direct implication of this finding was that WJ achievement Tests may be used as a screening measure to identify cognitively gifted children.

Recommendations, Future Research, and Implications

As is the case with any research study, the conclusions drawn must be viewed within the context of the study’s limitations. Foremost of the limitations was external validity. Participants were from Jordan and the generalizability of findings to other Arab countries, geographic areas, grades, and students should be investigated further. Future studies using larger representative samples of participants from diverse geographic areas and other Arab countries are recommended. In addition, this study did not explore the differences at the individual test level. Future research may wish to investigate if differences are found at that level which may provide further understanding of the cognitive abilities of gifted students.

Additionally, it is worth documenting that this study did not include gifted students who have other special needs. Other advantages of standardized cognitive and achievement tests, such as WJ Arabic Tests, are their abilities to identify exceptionally gifted individuals with special educational needs (e.g., children identified as gifted and with learning disabilities). Identification of students with both talents and disabilities is problematic and challenges educators (Olenchak & Reis, 2002). The identification of these students is complicated because their gifted abilities often mask their disabilities, or, conversely, their disabilities may disguise their giftedness. These problems may exclude students from inclusion in either programs for gifted individuals or programs for those with learning disabilities. Thus, future research in this line is recommended.

Finally, gifted students in this study were presenting better performances in CHC Achievement abilities than their performances in CHC Cognitive abilities. The results of this study may be used as a first step for building comprehensive gifted educational programs for Arabic speaking students. These programs should be countered-balanced to promote all CHC abilities and follow up the progress of gifted students. In addition, these programs should be integrated in the Jordanian national educational system under the provision of inclusion to provide fair opportunities for all gifted students across the country.

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