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Use of the *Woodcock-Johnson III NU Tests of Cognitive Abilities and Tests of Achievement* with Canadian Populations

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The use of U.S.-normed tests with Canadian populations is common practice. Few individual batteries of cognitive and achievement abilities have reported independent validation with Canadian populations. In a random sample of 310 school-age Canadian students, the use of the Woodcock-Johnson III Normative Update *(WJ III NU)* Tests of Cognitive Abilities *and* Tests of Achievement *with a Canadian sample is examined. Results were compared with a matched sample of U.S. subjects selected from the WJ III NU standardization sample using WJ III NU norms. While some minor score differences are reported across the two samples, the study findings generally support the use of the U.S.-based WJ III NU norms with Canadian school-age populations.*

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Use of the *Woodcock-Johnson III NU Tests of Cognitive Abilities* and *Tests of Achievement* with Canadian Populations

Introduction

In the past decade several widely used comprehensive batteries of cognitive and achievement abilities have undergone significant revision. These revisions include the *Differential Ability Scales–Second Edition* (DAS-II) (Elliott, 2007), *Kaufman Assessment Battery for Children–Second Edition* (KABC-II) (Kaufman & Kaufman, 2004a), *Kaufman Tests of Educational Achievement–Second Edition* (KTEA™-II) (Kaufman & Kaufman 2004b), *Stanford-Binet Intelligence Scales, Fifth Edition* (SB5) (Roid, 2003), *Wechsler Individual Achievement Test–Third Edition* (WIAT-III) (Wechsler, 2009), *Wechsler Intelligence Scale for Children–Fourth Edition* (WISC-IV) (Wechsler, 2003), *Wechsler Adult Intelligence Scale–Fourth Edition* (WAIS-IV) (Wechsler, 2008a), *Wechsler Preschool and Primary Scale of Intelligence–Third Edition* (WPPSI-III) (Wechsler, 2002), *Woodcock-Johnson III* (WJ III) (Woodcock, McGrew, & Mather, 2001a), and the subsequent *WJ III Normative Update* (WJ III NU) (Woodcock, McGrew, Schrank, & Mather, 2001, 2007). All these test batteries have been well standardized in the United States and meet or exceed most standards articulated in the *Standards for Educational and Psychological Testing* (AERA/APA/NCME, 1999) and the International Test Commission (ITC, 2000). While a number of special purpose or special population studies are reported on some batteries of cognitive and achievement abilities with Canadian samples (Beal, Dumont, Branche, & Cruse, 1996; Beal, Dumont, Cruse, & Branche, 1996; Iverson, Lange, & Viljoen, 2006; Mark, Beal, & Dumont, 1998; Reddon, Whippler, & Reddon, 2007; Saklofske, Tulsky, Wilkins, & Weiss, 2003; Saklofske, Hildebrand, Reynolds, & Wilson, 1998; Weiss, Saklofski, Prifitera, Chen, & Hildebrand, 1999), surprisingly only three of the major cognitive measures, the WAIS-IV, WISC-IV, and WPPSI-III, have completed norming studies with a Canadian population—the *Wechsler Adult Intelligence Scale–Fourth Edition, Canadian* (WAIS-IV^{CND}) (Wechsler, 2008b); the *Wechsler Intelligence Scale for Children–Fourth Edition, Canadian* (WISC-IV^{CND}) (Wechsler, 2004); and the *Wechsler Preschool and Primary Scale of Intelligence–Third Edition* (WPPSI-III^{CND}) (Wechsler, 2003).[1] In the case of individually administered measures of academic achievement, the *KeyMath3™ Diagnostic Assessment* (KeyMath3) (Connolly, 2007) and the *Wechsler Individual Achievement Test–Second Edition* (WIAT-II) (Wechsler, 2001) are the only widely used U.S. achievement tests to have undergone standardization with a Canadian sample—the *KeyMath3 Canadian Edition* (KeyMath3^{CND}) (Connolly, 2008) and the *Wechsler Individual Achievement Test–Second Edition, Canadian* (WIAT-II^{CND}) (Wechsler, 2003) respectively.[2]

[1] Standardization studies conducted with the WISC-III and WAIS-III found significant differences in the performance of Canadian and U.S. populations, and separate norms were published. With the subsequent revisions of the Wechsler scales—WPPSI-III, WISC-IV, and WAIS-IV—separate standardizations and norms have been published with Canadian samples.

[2] A standardization of the WIAT-III is currently underway with publication anticipated in late 2010.

The *Standards on Educational and Psychological Testing* (AERA/APA/NCME, 1999) Standards 7.1 to 7.12 address issues of fairness in testing and test use. Standard 7.1 states:

> When credible research reports that test scores differ in meaning across examinee subgroups for the type of test in question, then to the extent feasible, the same forms of validity evidence collected for the examinee population as a whole should also be collected for each relevant subgroup. (p. 80).

Further, in the *Guidelines for Educational and Psychological Testing*, the Canadian Psychological Association (CPA, 1996) indicates that the user of a test developed for something other than local only use must understand the applicability of the test to different groups. Norms and summary information about group differences is important, and test users should be aware of situations when the norms are less appropriate for one group than another. When a test user has reason to question the use of the norms for a specific population, it is the user's responsibility to further examine their appropriateness (Joint Advisory Commission, 1993).

The question of whether U.S. norms are appropriate for use with Canadian populations is not new. While a number of U.S.-normed batteries of cognitive and achievement abilities are used extensively throughout Canada, surprisingly few comprehensive validation and/or standardization studies are reported in the literature. Of the limited number of published studies on the use of U.S. cognitive and achievement test norms used in Canada, the majority published to date have examined differences in the various versions and editions of the Wechsler scales standardized in the United States and administered to Canadian populations. All have pointed to significant score differences across the Canadian and U.S. populations with Canadian samples scoring, on average, 2 to 5 standard score points higher than the U.S. sample, depending on the factor or subtest (Hildebrand & Saklofske, 1996; Wechsler, 1996; 2001b; 2003; 2004; 2008b). These findings have suggested the need for Canadian standardization of the Wechsler scales.

Given the widespread use of many cognitive and achievement batteries normed in the United States with Canadian populations for diagnosis, treatment, and program planning, more research is needed. There is a need to determine if the U.S. norms are "transportable" and applicable to Canadian populations and, if not, whether additional norming with a Canadian sample is needed, and/or if special adjustments are necessary to the norms for tests standardized in the United States to make them more applicable for Canadian populations.

The primary purpose of the present study was to examine the comparability of WJ III NU (Woodcock, McGrew, Schrank, & Mather, 2001, 2007) cognitive and achievement scores in matched school-age Canadian/U.S. samples. The following research questions guided the investigation: a) Are there significant differences on the *WJ III NU Tests of Cognitive Abilities* test and cluster scores between matched Canadian and U.S. samples?, b) Are there significant distribution differences on the *WJ III NU Tests of Cognitive Abilities* test and cluster scores between matched Canadian and U.S. samples?, c) Are there significant mean differences on the *WJ III NU Tests of Achievement* test and cluster scores between matched Canadian and U.S. samples?, d) Are there significant distribution differences on the *WJ III NU Tests of Achievement* test and cluster scores between matched Canadian and U.S. samples?

Overview of the *WJ III NU*

The WJ III (Woodcock, McGrew, & Mather, 2001) is the most recent edition of the *Woodcock-Johnson Psycho-Educational Battery* (WJ) originally published in 1977 (Woodcock & Johnson, 1977). The WJ III is based on the Cattell-Horn-Carroll (CHC) theory of cognitive abilities (Schrank, Flanagan, Woodcock, & Mascola, 2002). The WJ III was published in 2001 and the norms were "freshened" in the WJ III NU in 2007. Briefly, the original 2001 WJ III norms were based on year 2000 U.S. Census *projections* available at the time the standardization of the WJ III commenced (1996). Census projections are estimates of the population for future dates and are subsequently replaced by census *statistics*. The 2000 census final statistics produced a somewhat different description of the U.S. population than was available from the last projections issued in 1996. The WJ III NU updated the WJ III norms to reflect the final U.S. 2000 census statistics. In addition, innovative bootstrap resampling methods were used in the development of the WJ III NU norms—methods not fully developed at the time of the 2001 publication of the WJ III (see McGrew, Dailey, & Schrank, 2007 for details).

McGrew (1997) was the first to synthesize Cattell-Horn's *Gf-Gc* and Carroll's Three-Stratum models in an attempt to provide a comprehensive integrative framework for interpreting human cognitive abilities. The result is the CHC (Cattell-Horn-Carroll) theory, which serves as the theoretical blueprint for the WJ III (McGrew & Woodcock, 2001a). The latest updates of contemporary CHC theory can be found in McGrew (2005) and McGrew (2009). The theoretical underpinnings of the WJ III are different from many other measures of cognitive ability and achievement (e.g., WISC-IV, WAIT-III, DAS-II). In order to appropriately interpret the WJ III, an understanding of the CHC model is needed.

The CHC model applies Carroll's (1993) Tri-Stratum theory of intelligence, organizing cognitive abilities and Cattell-Horn's *Gf-Gc* theory into an integrated three-level hierarchy. Carroll (1993) identified over 69 specific, or narrow cognitive abilities, at Stratum I. The narrow abilities are subsumed under the broad (Stratum II) cognitive ability domains of Fluid Intelligence or Reasoning (*Gf*), Crystallized Intelligence or Comprehension-Knowledge (*Gc*), Broad Visual-Spatial Processing (*Gv*), Broad Auditory Processing (*Gu*), and Processing Speed (*Gs*). At the apex of his model (Stratum III), Carroll identified a higher-order factor above the broad factors, which he interpreted as General Intelligence, or *g*. (For a more extensive discussion of the CHC model and Carroll's Tri-Stratum theory, see Carroll [1993] and McGrew [2005, 2009].) In the WJ III COG, clusters represent the broad abilities (e.g., *Gf*, *Gc*, *Gv*) and the individual tests (e.g., Verbal Comprehension, Retrieval Fluency) are intended to represent the narrow abilities.

The WJ III NU (Woodcock, McGrew, Schrank, & Mather, 2001, 2007) is a comprehensive measure of cognitive abilities and achievement organized into three distinct, co-normed test batteries: The *Woodcock-Johnson III NU Tests of Cognitive Abilities* (WJ III NU COG); the *Woodcock-Johnson III Diagnostic Supplement to the Tests of Cognitive Abilities* (WJ III DS) and the *Woodcock-Johnson III NU Tests of Achievement* (WJ III NU ACH). The WJ III is designed to measure a wide array of cognitive, oral language, and academic achievement abilities for individuals from preschool (2 years) through the geriatric (90+ years) age levels.

Each battery is organized into a Standard and Extended battery that can be used independently, together, or in conjunction with other tests (including tests from the WJ

III DS). In addition to the CHC clusters, the complete set of 31 WJ III NU cognitive tests (20 in the original WJ III cognitive battery plus 11 in the WJ III DS) are also organized by three broader categories related to cognitive performance (Cognitive Performance Model [CPM] Clusters): Verbal Ability, Thinking Ability, and Cognitive Efficiency and five clinical clusters: Broad Attention, Executive Functioning, Working Memory, Cognitive Efficiency, and Phonemic Awareness. The 22 achievement tests are organized by curricular area (reading, mathematics, written language, and academic knowledge) and oral language and by clusters within these areas (e.g., Basic Reading Skills, Math Reasoning), with additional groupings for special purpose clusters (e.g., Academic Skills, Phoneme/Grapheme Knowledge). These batteries have particular diagnostic utility because they encourage examiners to be selective in their testing and select different evaluation tools based on specific referrals.

Like the earlier versions of the WJ, the WJ III has been viewed as state of the art in the individual measurement of cognitive abilities and achievement (Cizek, 2003; Cummings, 1995; Hicks & Bolan, 1996; Lee & Stefany, 1995; Standoval, 2003). The WJ has long been one of the most widely used individually administered academic achievement batteries. Furthermore, the WJ III COG is being taught as a primary measure of intelligence in over one third of all school psychology training programs across the United States and Canada (Braden & Alfonzo, 2003; Ford, Percy, & Negreiros, 2010). Its strong psychometric properties, the co-normed tests of cognitive abilities and achievement, its utility for use with individuals throughout the lifespan, and features that assist in understanding unique processing strengths and weakness contribute to its frequent use in Canada. The widespread use of the WJ III NU in the absence of norm transportability research heightens the importance of the current investigation.

Method

Participants

The study is comprised of two matched samples, one strategically sampled from Canada and a matched sample of WJ III NU standardization subjects obtained from the United States. This section describes the sample selection and comparison procedures.

Canadian Sample

The Canadian sample consisted of 341 English-speaking school-aged children from three geographical areas (Western Canada, Central Canada, and Atlantic Canada). The sampling procedures mirrored those used in the standardization of the WJ III (McGrew & Woodcock, 2001a). A three-stage procedure of sampling communities, then schools, and finally subjects was used to identify and select a sample that would be broadly representative of the English-speaking Canadian school-age population. Communities were sampled by census region and type of community as defined by Statistics Canada (1996). Participants were obtained from six Provinces (British Columbia, Saskatchewan, Manitoba, Ontario, Prince Edward Island, and Newfoundland). Communities were targeted for selection within each of the three geographical areas based on geographic distribution, size of community, and socioeconomic status (SES) characteristics (high, average, and low SES communities). School board participation was then solicited from the targeted communities. When school board participation was not obtained for a targeted community, a similarly matched community from the same geographic area

was identified and school board participation was subsequently sought. In summary, final inclusion of a community in the sample reflects: a) a targeted community based on geographical area, community size, and community SES and b) school board agreement to participate in the study.

In small communities, testing was conducted in all schools. In larger communities, testing was conducted in a subset of schools. The general guideline for selecting the subset of schools was to obtain an equal distribution of schools in high versus low SES areas. This guideline was specified to avoid any potential selection bias. To best represent a cross-section of students in the community, Catholic schools were included in communities where these schools were available and agreement to participate was obtained. Thirty-four Catholic schools were included in the study.

Sampling of participants was based on a quota-by-grade level criterion. The solicitation of subjects was entirely random. The permission forms included subject identifying information (e.g., date of birth, grade, sex, and ethnic origin), mother's and father's education level, and mother's and father's current occupation. Any subject who had less than 1 year of experience in an English-only classroom was excluded from the sample.

From among the returned permission forms, subjects were selected based on the identified subject-level variables needed to fill the sampling plan (male versus female, highest grade completed by parents, ethnic origin) and were subsequently tested at school. Although the total sample was 341 in grades kindergarten through 12, only 310 students in grades 1 through 12 were included in the present study due to missing data from some tests or clusters. The 310 Canadian children ranged in age from 6 years, 8 months to 19 years, 5 months (M = 149.41 months, SD = 40.37) and were closely distributed by sex (148 males and 162 females).

U.S. Matched Sample

The 310 Canadian subjects served as the foundation for the U.S. matched sample that was selected from the 8,782 participants in the WJ III standardization sample. A U.S. subject that best matched each Canadian subject was selected from the complete WJ III standardization sample.

Subject matching was based on a hierarchical sequence of matching variables—age (in months), parent education (highest level of either mother's or father's education), race/ethnicity (white or nonwhite), and sex. If more than one U.S. subject met the match criteria, a U.S. subject was randomly selected from the available pool. Although a concerted effort was made to collect common demographic indicators across the two samples, an exact match was not possible, given differences in the way census information and demographic variables are defined in Canada and in the United States. For example, Statistics Canada defines ethnic groups according to ancestry (e.g., British, French or European, Multiple Origins, or Other); the U.S. Census categorizes individuals according to race (e.g., White, Black/African-American, American Indian, Asian/Pacific Islander) and Hispanic origin (Hispanic or non-Hispanic). The 310 U.S. subjects selected ranged in age from 6 years, 8 months to 19 years, 5 months (M = 149.74 months, SD = 40.11) and were closely distributed by sex (150 males and 160 females).

A comparison of the two samples on the matching and other variables revealed a high degree of comparability. Chi-square analyses revealed no significant differences in frequencies of subjects in the Canadian and U.S. samples as a function of parent

education level (chi-square = 4.56; *df* = 4.0, *p* = 0.34), race (chi-square = 0.37; *df* = 1.0, *p* = 0.54), or gender (chi-square = 0.03; *df* = 1.00, *p* = 0.87). Comparison of the ages (in months) of the Canadian and U.S. samples (*t* test) revealed no significant difference (*M* difference = 0.40, *t* (618) = 0.12, *p* = 0.90). A similar *t*-test comparison of grade placement in tenth of years (*M* difference = 0.29, *t* (618) = 1.09, *p* = 0.27) also was not significant. Comparisons of the distributional characteristics of the two samples also suggested strong comparability of the two samples. Summary statistics for the matching variables are presented in Table 1.

Table 1.
Sample Characteristics (N = 310)

	***N* Canadian**	**Percentage**	***N* U.S.**	**Percentage**
Sex				
Male	148	47.7	150	48.4
Female	162	52.3	160	51.6
Grade				
1–4	91	29.4	99	31.9
5–8	105	33.8	112	36.2
9–12	114	36.8	99	31.9
Father's Education Level				
< High School Diploma	76	24.5	5	1.6
High School Diploma	62	20.0	50	16.1
Post Secondary/Diploma	75	24.2	80	25.8
University Degree	80	25.8	90	29.1
Not Reported	17	5.5	85	27.4
Mother's Education Level				
< High School Diploma	65	21.0	47	15.2
High School Diploma	61	19.7	84	27.1
Post Secondary/Diploma	105	33.8	107	34.5
University Degree	75	24.2	72	23.2
Not Reported	4	1.3	0	0
Ethnic Origin				
White/Anglo/European	247	79.7	252	81.3
Asian-Pacific Islander	46	14.8	13	4.2
First Nations/Aboriginal/Native American	10	3.2	7	2.3
Black/African/African American	7	2.3	38	12.2
Hispanic[a]	4	1.3	33	10.6
Community Size				
Central Place	89	28.7	81	26.1
Urban Fringe	76	24.5	75	24.2
10,000 to 50,000	38	12.3	73	23.6
<10,000	107	34.5	81	26.1

[a]Calculated independently of the other ethnic categories. Does not figure in total percentage.

Instrumentation

Canadian participants in this study were administered selected tests from the standardization edition of the *Woodcock-Johnson III Tests of Cognitive Abilities* (WJ III COG) (Woodcock, McGrew, & Mather, 2001c) and the *Woodcock-Johnson III Tests of Achievement* (WJ III ACH) (Woodcock, McGrew, & Mather, 2001b) and the complete *Wechsler Intelligence Scale for Children–Third Edition* (WISC-III) (Wechsler, 1991). Only the WJ III COG tests that comprise the Broad CHC Ability clusters and the WJ III ACH tests that comprise the primary academic clusters and two oral language tests were included in the present study. Tables 2 and 3 describe the tests, clusters, and abilities measured by the WJ III. Students were administered U.S. standardization versions of the WJ III tests, and scores were calculated with the WJ III NU norms. WJ III NU ACH Form B is the Canadian version of the WJ III NU ACH and was used in the present study. In the WJ III NU ACH Form B Canadian, the majority of the test is exactly the same as the WJ III NU ACH Form B, however, a number of items were changed to more appropriately reflect Canadian content (e.g., coins, measurement, spelling).

Table 2.

Descriptions of WJ III NU COG Clusters and Tests Used in the Study

Cluster	Test Descriptions
Intellectual Ability Clusters	
General Intellectual Ability–Standard (GIA-Std) *Tests 1–7*	Global score considered to be the best single-score predictor of a performance, *on average*, across a wide variety of academic and cognitive outcomes; the single best (psychometric) measure of *g*. Includes one measure of each CHC ability.
General Intellectual Ability–Extended (GIA-Ext) *Tests 1–7 and 11–17*	A broader global score considered to be the single best (psychometric) measure of theoretical *g*. Includes two measures of each CHC ability.
Brief Intellectual Ability (BIA) *Tests 1, 5, & 6*	A brief measure of intelligence. Useful in screening.
Cognitive Performance Clusters	
Verbal Ability–Standard *Test 1* Verbal Ability–Extended *Tests 1 & 11*	A measure of language-based acquired knowledge development that includes the comprehension of individual words and the comprehension of relationships among words and the ability to communicate that knowledge.
Thinking Ability–Standard *Tests 2, 3, 4, & 5* Thinking Ability–Extended *Tests 2, 3, 4, 5, 12, 13, 14, & 15*	Represents different thinking processes invoked when information in short-term memory cannot be processed automatically.
Cognitive Efficiency–Standard *Tests 6 & 7* Cognitive Efficiency–Extended *Tests 6, 7, 16, & 17*	Represents the capacity of the cognitive system to process information automatically.
Broad Cognitive CHC Ability Clusters	
Comprehension Knowledge (*Gc*) *Tests 1 & 11*	Test 1: Verbal Comprehension: Identifying Objects: Knowledge of synonyms and antonyms; completing verbal analogies. Test 11: General Information: Identifying where objects are found and what people typically do with an object.
Long-Term Retrieval (*Glr*) *Tests 2 & 12*	Test 2: Visual Auditory Learning: Learning and recalling pictographic representations of words. Test 12: Retrieval Fluency: Naming as many examples as possible from a given category.
Visual-Spatial Thinking (*Gv*) *Tests 3 & 13*	Test 3: Spatial Relations: Identifying the subset of pieces needed to form a complete shape. Test 13: Picture Recognition: Identifying a subset of previously presented pictures within a field of distracting pictures.
Auditory Processing (*Ga*) *Tests 4 & 14*	Test 4: Sound Blending: Synthesizing phonemes. Test 14: Auditory Attention: Identifying orally presented words amid increasingly intense background noise.
Fluid Reasoning (*Gf*) *Tests 5 & 15*	Test 5: Concept Formation: Identifying, categorizing, and determining rules. Test 15: Analysis-Synthesis: Analyzing puzzles (using symbolic formulations) to determine missing components.
Processing Speed (*Gs*) *Tests 6 & 16*	Test 6: Visual Matching: Rapidly locating and circling identical numbers from a defined set of numbers. Test 16: Decision Speed: Locating and circling two pictures most similar conceptually in a row.
Short-Term Memory (*Gsm*) *Tests 7 & 17*	Test 7: Numbers Reversed: Holding a span of numbers in immediate awareness while reversing the sequence. Test 17: Memory for Words: Repeating a list of unrelated words in correct sequence.

Table 3.

Descriptions of WJ III NU ACH Clusters and Tests Used in the Study

	Test Requirement
Total Achievement *Tests 1, 2, 5, 6, 7, 8, 9, 10, & 11*	Provides an overall score of achievement.
Curricular Area	
Reading (*Grw*)	
Broad Reading *Tests 1, 2, & 9*	Test 2: Reading Fluency: Reading printed statements rapidly and responding true or false.
Basic Reading Skills *Tests 1 & 13*	Test 1: Letter-Word Identification: Identifying and pronouncing printed letters and words; sight word recognition. Test 13: Word Attack: Pronouncing nonwords that conform to English spelling rules.
Reading Comprehension *Tests 9 & 17*	Test 9: Passage Comprehension: Identifying a missing key word that makes sense in the context of a written passage. Test 17: Reading Vocabulary: Reading words and providing synonyms, and antonyms; completing analogies.
Math (*Gq*)	
Broad Math *Tests 5, 6, & 10*	
Math Calculation Skills *Tests 5 & 6*	Test 5: Calculation: Performing various mathematical calculations. Test 6: Math Fluency: Adding, subtracting, and multiplying rapidly.
Math Reasoning *Tests 10 & 18*	Test 10: Applied Problems: Analyzing and solving orally presented, practical mathematical problems. Test 18: Quantitative Concepts: Identifying math terms and formulae; identifying number patterns.
Written Language (*Grw*) Broad Written Language *Tests 7, 8, & 11*	
Basic Writing Skills *Tests 7 & 16*	Test 7: Spelling: Spelling letter combinations that are regular patterns in written English. Test 16: Editing: Identifying and correcting errors in written passages.
Written Expression *Tests 8 & 11*	Test 8: Writing Fluency: Formulating and writing simple sentences rapidly. Test 11: Writing Samples: Writing meaningful sentences for a given purpose.
Special Purpose Clusters Academic Skills *Tests 1, 5, & 7*	Overall measure of basic achievement skills.
Academic Fluency *Tests 2, 6, & 8*	Overall measure of academic fluency.
Academic Applications *Tests 9, 10, & 11*	Overall measure of application of academic knowledge.
Academic Knowledge *Test 19*	A measure of information in curricular areas of science, social studies, and humanities.

Statistical Analyses

Two sets of analyses were completed to determine if the WJ III NU scores from the Canadian sample were similar to the scores for the U.S. sample. The first analysis evaluated the comparability of the U.S. and Canadian samples based on the similarity of each sample's distribution (variance) of general intelligence and overall achievement. The second analysis evaluated mean score differences for the WJ III NU cognitive and achievement clusters and individual tests.

Results

Canadian/U.S. Sample Comparability

A two-sample test for the equality of variance for the WJ III NU General Intellectual Ability Index–Extended (GIA-Ext) score was nonsignificant ($F[309] = 1.14$, $p = .26$), indicating that the distribution of general intelligence in the U.S. (*W*-score variance = 195.46) and Canadian (*W*-score variance = 172.00) samples was not significantly different. The two-sample test for the equality of variance for the WJ III NU Total Achievement cluster score was also nonsignificant ($F[309] = 0.99$, $p = .93$), indicating that the distribution of overall achievement (reading, math, and written language combined) in the U.S. (*W*-score variance = 486.81) and Canadian (*W*-score variance = 492.01) samples was also similar. These findings indicate that the sample matching process was successful in producing two samples that were similar in their distribution of general intelligence and overall academic achievement abilities.

Canadian and U.S. WJ III NU Score Comparisons

To better understand the performance of the Canadian sample compared to the U.S. standardization sample, means and standard deviations of the tests and clusters for both the Canadian and U.S. sample were calculated. Paired sample *t* tests (see Table 4) were calculated to evaluate differences between the results of the Canadian and U.S. samples. Due to the large number of *t* tests conducted, which can produce significant findings based on chance alone, each set of *t*-test comparisons was evaluated against familywise bonferroni corrected *p* values. The results indicate that while the U.S. sample typically scored slightly higher than the Canadian sample on the WJ III NU COG clusters, the differences were *not* statistically significant with one exception—the Long-Term Retrieval cluster. The mean difference of the General Intellectual Ability–Extended (GIA-Ext) score for the U.S. sample ($M = 100.74$, $SD = 15.77$) was not significant compared to the mean difference for the Canadian sample ($M = 98.88$, $SD = 13.73$). Specific CHC cluster scores for the Canadian sample ranged from 95.05 on the Long-Term Retrieval cluster to 100.78 on the Short-Term Memory cluster, while the range for the U.S. sample was from 100.09 on the Fluid Reasoning Cluster to 102.05 on the Short-Term Memory cluster. While the overall standard deviation is somewhat smaller for the Canadian sample, indicating a slightly more restricted range than the range of scores for the U.S. sample, the previously discussed tests of the equality of variances for general intelligence and total achievement indicates that, overall, these differences are not significant.

Table 4.

Means and Standard Deviations of the WJ III NU Clusters for the Canadian (CND) and U.S. Samples (N = 310)

	CND *M*	CND *SD*	U.S. *M*	U.S. *SD*	Diff.	*t*	*p*[a]
Intellectual Ability							
General Intellectual Ability–Standard (GIA-Std)	98.57	13.52	100.52	15.72	1.95	1.84	.066
General Intellectual Ability–Extended (GIA-Ext)	98.88	13.73	100.74	15.77	1.86	1.78	.075
Brief Intellectual Ability (BIA)	100.62	13.06	100.78	15.48	.16	.15	.882
CPM Clusters							
Verbal Ability–Standard	101.25	14.37	100.08	15.91	-1.17	1.10	.276
Verbal Ability–Extended	99.98	14.45	100.42	16.39	.44	.41	.685
Thinking Ability–Standard	98.05	13.52	101.01	15.66	2.96*	2.75	.006
Thinking Ability–Extended	98.79	13.36	101.35	14.88	2.56*	2.52	.012
Cognitive Efficiency–Standard	99.79	16.12	101.65	15.26	1.86	1.47	.143
Cognitive Efficiency–Extended	101.11	15.69	102.55	15.42	1.44	1.22	.225
CHC Clusters							
Comprehension-Knowledge	99.98	14.45	100.42	16.39	.44	.41	.685
Long-Term Retrieval	95.05	15.59	100.52	15.09	5.47*	4.84	.000
Visual-Spatial Thinking	97.90	15.02	100.23	14.06	2.33*	2.08	.038
Auditory Processing	100.18	14.62	101.07	16.21	.89	.77	.441
Fluid Reasoning	98.92	13.08	100.09	15.51	1.17	1.07	.284
Processing Speed	100.07	15.92	101.39	14.45	1.32	1.16	.248
Short-Term Memory	100.78	16.00	102.05	15.62	1.27	1.04	.299

[a]The 16 cognitive cluster comparisons were evaluated at the $p = .003$ ($p = .05/16 = .003$) level of significance to reflect an overall familywise error rate per the Bonferroni adjustment. $N = 310$ for all clusters for both samples. All t tests had $df = 309$.

*Designates significant differences. Significant at the .05 level. All t tests had $df = 309$.

A review of the CPM clusters (see Table 4) again indicates that the U.S. sample scores were slightly higher. However, no significant differences were reported between the two samples on any of the CPM clusters. Given that the Thinking Abilities cluster is comprised of tests from the Fluid Reasoning, Long-Term Retrieval, Auditory Processing, and Visual-Spatial Thinking clusters, this difference is not surprising. An examination of the tests that impact the Long-Term Retrieval cluster revealed that the Visual-Auditory Learning test was the primary reason for the significant difference. A summary of the standard scores and differences across the WJ III NU COG tests for the Canadian and U.S. samples are highlighted in Table 5. A review of the mean score test comparisons (Table 5) indicated that on the 14 primary cognitive tests, the samples only differed significantly on the Visual-Auditory Learning test, with the Canadian subjects (M = 94.09, SD = 16.78) scoring approximately 6 standard score points lower than the U.S. subjects (M = 100.28, SD = 15.40), $t(309) = 5.27$, $p = .000$.

Table 5.

Means and Standard Deviations of the WJ III NU COG Tests for the Canadian (CND) and U.S. Samples (N = 310)

	CND *M*	CND *SD*	U.S. *M*	U.S. *SD*	Diff.	*t*	*p*[a]
Verbal Comprehension	101.25	14.37	100.08	15.91	-1.17	-1.09	.277
General Information	99.16	14.11	101.15	16.18	1.99	1.86	.063
Visual-Auditory Learning	94.09	16.78	100.28	15.40	6.19*	5.27	.000
Retrieval Fluency	98.24	14.37	99.86	15.11	1.62	1.38	.168
Spatial Relations	99.05	16.29	100.59	15.53	1.54	1.21	.228
Picture Recognition	97.71	15.03	99.75	13.78	2.04	1.79	.074
Sound Blending	98.41	14.05	99.83	16.41	1.42	1.27	.207
Auditory Attention	101.97	14.49	101.04	12.80	-.93	-.86	.391
Concept Formation	98.78	12.26	99.99	16.02	1.21	1.11	.268
Analysis-Synthesis	99.86	14.52	100.64	14.52	.78	.70	.484
Visual Matching	100.65	15.12	100.81	13.98	.16	.14	.887
Decision Speed	98.95	15.94	101.26	14.98	2.31	1.96	.051
Numbers Reversed	99.11	16.65	101.44	15.61	2.33	1.78	.076
Memory for Words	101.81	15.84	101.47	15.34	-.34	-.29	.774

[a]The 14 cognitive test comparisons were evaluated at the $p = .004$ ($p = .05/14 = .004$) level of significance to reflect an overall familywise error rate per the Bonferroni adjustment. $N = 310$ for all tests for both samples. All t tests had $df = 309$.

*Designates significant differences. Significant at the .05 level. All t tests had $df = 309$.

The means and standard deviations, as well as the mean score comparisons, for the *WJ NU III Tests of Achievement* clusters and tests for both samples are summarized in Tables 6 and 7, respectively. While the Canadian sample scored slightly higher ($M = 101.30$, $SD = 14.16$) than the U.S. sample ($M = 100.90$, $SD = 15.37$) on the Total Achievement cluster, the difference was not statistically significant ($t[309] = -.37$, $p = .715$). While the Canadian sample scored higher than the U.S. sample (although not statistically significant) on 7 of the 14 WJ III NU ACH clusters, the achievement cluster scores are more variable, with the Canadian sample tending to score higher on some clusters (e.g., Broad Reading, Broad Written Language, Math Reasoning, Academic Fluency). However, it is important to note that the Canadian and U.S. samples displayed no statistically significant achievement cluster differences.

At the test level (Table 7), five statistically significant differences are noted (Reading Fluency, Reading Vocabulary, Quantitative Concepts, Editing, and Oral Comprehension). The Canadian sample scored significantly higher on the Reading Fluency, Quantitative Concepts, and Oral Comprehension tests, while the U.S. sample scored statistically higher on the Reading Vocabulary and Editing tests.

Table 6.

*Means and Standard Deviations of the WJ III NU ACH Clusters for the Canadian (CND) and U.S. Samples (*N *= 310)*

	CND *M*	CND *SD*	U.S. *M*	U.S. *SD*	Diff.	*t*	*p*[a]
Total Achievement	101.30	14.16	100.90	15.37	-.40	-.37	.715
Broad Reading	102.07	15.21	101.44	15.69	-.63	-.56	.573
Basic Reading Skills	100.52	15.21	101.45	15.55	.93	.81	.416
Reading Comprehension	93.59	14.58	96.29	15.73	2.70*	2.63	.009
Broad Math	99.38	15.65	100.97	15.95	1.59	1.27	.204
Math Calculation Skills	98.33	15.64	100.63	15.67	2.30	1.91	.058
Math Reasoning	101.49	14.26	100.22	15.90	-1.27	-1.09	.278
Broad Written Language	101.48	14.67	99.54	14.41	-1.94	-1.81	.070
Basic Writing Skills	100.09	14.84	101.96	15.88	1.87	1.87	.123
Written Expression	100.32	12.05	99.77	13.48	-.55	-.574	.566
Academic Skills	101.83	14.82	101.41	16.31	-.42	-.35	.726
Academic Fluency	99.89	14.12	98.73	14.50	-1.16	-1.06	.289
Academic Applications	100.53	13.90	100.55	15.13	.02	.019	.984
Academic Knowledge	98.51	12.74	100.44	15.69	1.93	1.87	.062

[a]The 14 achievement cluster comparisons were evaluated at the $p = .004$ ($p = .05/14 = .004$) level of significance to reflect an overall familywise error rate per the Bonferroni adjustment. $N = 310$ for all clusters for both samples. All t tests had $df = 309$. No significant differences were noted.

Table 7.

*Means and Standard Deviations of the WJ III NU ACH Tests for the Canadian (CND) and U.S. Samples (*N *= 310)*

	CND *M*	CND *SD*	U.S. *M*	U.S. *SD*	Diff.	*t*	*p*[a]
Letter-Word Identification	101.97	15.19	102.34	16.42	.37	.31	.753
Word Attack	99.07	12.59	100.37	13.74	1.30	1.19	.233
Reading Fluency	102.31	14.33	99.09	14.04	-3.22*	-3.02	.003
Passage Comprehension	100.04	15.30	100.68	15.15	.64	.58	.559
Reading Vocabulary	90.29	11.93	94.00	14.02	3.71*	4.33	.000
Calculation	98.25	15.84	100.56	16.29	2.31	1.84	.067
Math Fluency	99.40	14.78	100.80	13.98	1.40	1.25	.124
Applied Problems	100.24	14.74	100.78	14.37	.54	.46	.644
Quantitative Concepts	102.41	13.82	98.83	16.57	-3.58*	-3.07	.002
Spelling	102.87	15.46	99.81	15.17	-3.06*	-2.47	.014
Editing	97.02	15.01	101.43	18.99	4.41*	2.95	.003
Writing Fluency	97.92	12.59	98.25	13.94	.33	.33	.74
Writing Samples	102.18	11.34	100.85	12.50	-1.33	-1.51	.132
Picture Vocabulary	102.26	14.82	99.94	15.43	-2.32*	-2.18	.03
Oral Comprehension	107.03	11.72	100.73	14.40	-6.30*	-6.24	.000

[a]The 15 cognitive test comparisons were evaluated at the $p = .003$ ($p = .05/15 = .003$) level of significance to reflect an overall familywise error rate per the Bonferroni adjustment. $N = 310$ for all clusters for both samples. All t tests had $df = 309$.

*Designates significant differences. Significant at the .05 level. All t tests had $df = 309$.

Discussion

While a handful of statistically significant mean score difference comparisons were reported between matched U.S. and Canadian school-age subjects across certain WJ III NU COG and ACH tests and clusters, the majority of the analyses reveal no systematic WJ III mean score differences. These findings support, with some caution, the use or transportability of the WJ III NU U.S.-based norms with Canadian populations. While these findings are somewhat different than previous Canadian/U.S. comparison studies with the Wechsler scales (e.g., Wechsler, 1996; 2001b; 2003; 2004; 2008b), the present study employed somewhat different procedures for comparing the two samples and used a test with several different types of measures of cognitive abilities grounded in a different theoretical framework (i.e., CHC theory). Instead of administering the two tests to both a Canadian and a U.S. sample, scoring the Canadian sample using U.S. norms and comparing the Canadian sample results with the entire U.S. standardization sample, or conducting a Canadian standardization with the full test, the present study used a matched sample where the Canadian sample was compared to a demographically matched U.S. sample drawn from the WJ III NU standardization sample. This may account for the differences in the findings of the present study from previous research with the Wechsler scales. While the differences in the Canadian and U.S. samples are widely reported in the Canadian testing literature, these differences are based largely on studies with the Wechsler scales. Few others have studied and published differences across U.S. and Canadian samples on individually administered tests of cognitive abilities. A review of the only non-Wechsler tests comparison of U.S. and Canadian samples on the *KeyMath Second Edition and KeyMath3* revealed results similar to the WJ III NU ACH results reported in the present study, with similar overall scores and the Canadian sample scoring slightly lower on several subtests (e.g., Applications and Operations).

The issues related to the transportability of the norms for measures of cognitive abilities and achievement standardized in the United States is complex. There are no simple answers. Consumers and users of tests must recognize that what may be gained from the Canadian norms may result in a potential loss in other areas (e.g., reliability and/or breadth of constructs measured or needed to answer referral questions). The decision is not black and white. Examiners must use the test in a responsible manner and understand both the strengths and limitations of using a given test with any population.

Additional research is needed to better understand the need for Canadian norms on all widely used measures of cognitive ability and achievement. The present study is the first to explore the use of the WJ III NU and its U.S.-based norms in Canada. Further, it is one of the few studies to explore these issues with a test other than the Wechsler scales. One should not automatically assume that separate Canadian norms are needed for tests that are well standardized with U.S. populations and are used in Canada. And one should not assume that any single study should result in an immediate call for separate Canadian norms or special adjustments to scores and interpretations of scores. Simple explanations of complex measurement issues do not provide the answer. Even the CPA guidelines (1996) point to the complexity and cost of the proper construction of norms for all published tests by reminding consumers that norms are both difficult and costly to construct properly and may not be required for all tests standardized in the United States and used with Canadian populations.

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